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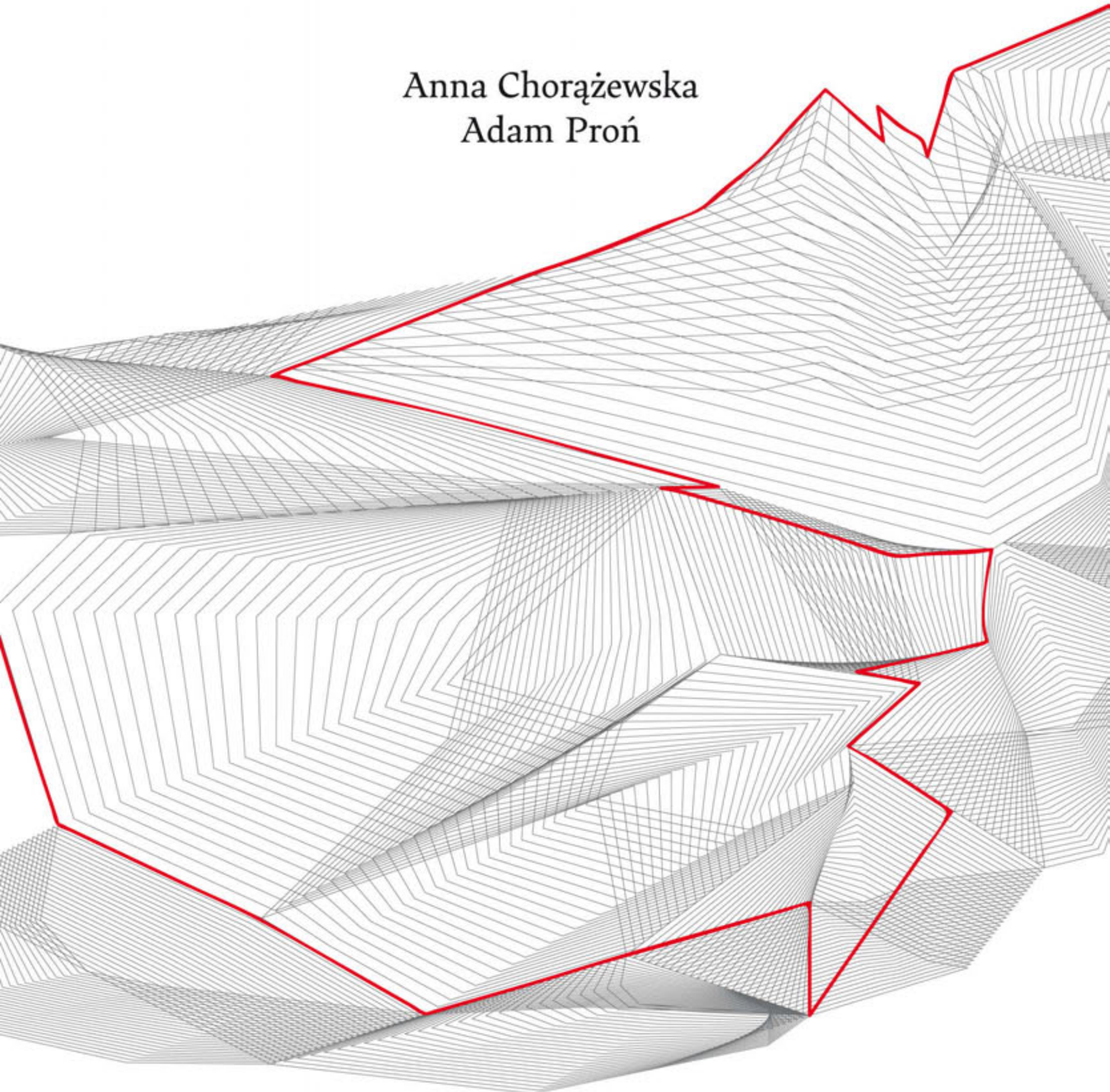

Intellectual Property Rights and Scientific Authorship: Legal and Ethical Considerations

Case Study in Hard Sciences and Natural Sciences

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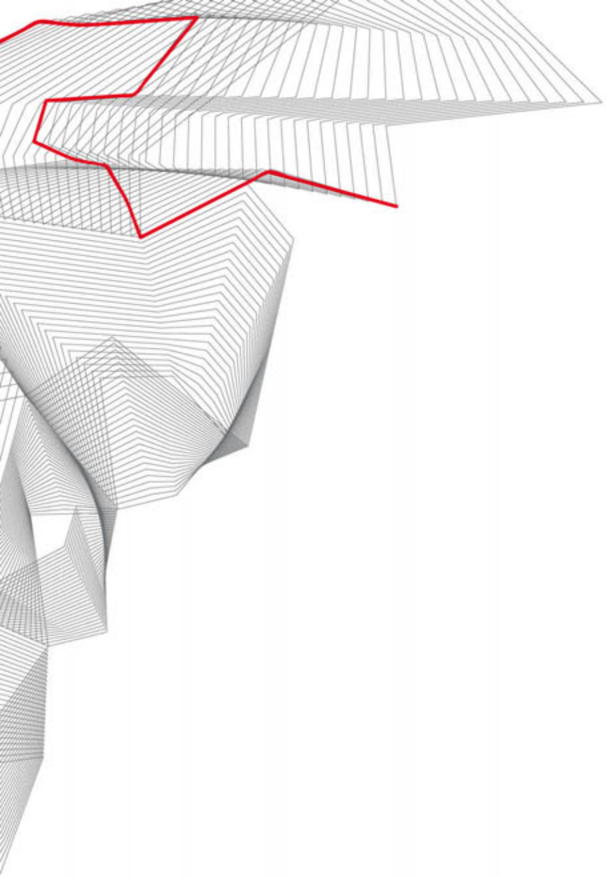

The Science

Quotations from Richard P. Feynman
(Nobel Prize in Physics, 1965):

There is the value of the worldview created by science. There is the beauty and the wonder of the world that is discovered through the results of these new experiences.

What is science? The word is usually used to mean one of three things, or a mixture of them. [...] Science means, sometimes, a special method of finding things out. Sometimes it means the body of knowledge arising from the things found out. It may also mean the new things you can do when you have found something out, or the actual doing of new things.

A quotation from Percy W. Bridgman
(Nobel Prize in Physics, 1946):

A formulation of the purpose of scientific activity which appeals to me as rather exhaustive is the understanding, prediction and control of events.

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Intellectual Property Rights and Scientific Authorship:

Legal and Ethical Considerations Case Study in Hard Sciences and Natural Sciences

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Katowice 2024

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(*Anna Chorążewska, Adam Proń*)

Introductory Remarks

The link between human rights, intellectual property rights and the safeguarding of personal and property rights of scientific creators has garnered increasing attention in recent times. While the 1997 Constitution of the Republic of Poland, along with the constitutions of other countries, guarantees researchers the freedom to engage in scientific inquiry and disseminate their findings, they often fall short in adequately addressing the protection of these rights. Furthermore, in the 20th century, as scientific and technological advancements surged, research inquiries and methodologies grew increasingly intricate. In the 21st century, the challenges confronting the scientific community have become even more intricate. Additionally, the advent of data-driven science, financial considerations, national science policies and the pressure exerted by rapidly developing China have substantially shaped the trajectory of research, particularly within the domains of the hard sciences, life sciences and medicine. These developments have given rise to a growing demand for multidisciplinary research projects led by teams of scientists and technical support personnel. The outcomes of such research endeavours are often announced as multi-author scientific articles or invention projects. The researcher's involvement in such projects can assume various forms. It may encompass the inception of a research concept or hypothesis, the attainment of a scientific breakthrough (discovery) or the establishment of scientific truths. It can also encompass more technical roles, such as experiment design or data acquisition during measurement processes, followed by comprehensive analysis and interpretation of experimental data. Thus, the results of research activities do not, in all cases, demonstrate the ability to be expressed in a form appropriate to the categories of intangible goods defined in the intellectual property law system. In such cases, researchers do not obtain legal protection for the fruits of their labour either from copyright or invention law.

Consequently, the evolving landscape of scientific research, characterized by multidisciplinary and international collaboration, presents challenges in protecting scientific authorship. It should be explained that having its source in the Berne Convention for the Protection of Literary and Artistic Works, the copyright law of many countries protects only the author of the work, which means that only the method of expression is subject to copyright protection. For example, the Polish legislator explored in Article 1(1) that a "work" constituting the subject matter of copyright is every manifestation of creative activity of individual nature, fixed in any form, regardless of value, purpose and manner of expression. Furthermore, as far as negative definition is concerned, the legislator explains what form a "work" cannot take, that is, what it is not. Article 1(2)1 sentence 2 excludes copyright protection of: discoveries, ideas, procedures, methods, principles of operation and mathematical concepts. Similarly, the Polish Industrial Property Law Act (Article 28, paragraph 1) provides that inventions are not considered to be, in particular: (1) discoveries, scientific theories and mathematical methods; (2) creations of merely aesthetic nature; (3) schemes, rules and methods for carrying out mental processes, playing games or conducting business; (5) computer programs; (6) representation of information.

It is generally accepted in intellectual property law that a contribution to research can obtain legal protection when it has the capacity to be fixed in the form of an intellectual good as defined in the legal system. In the case of a work subject to copyright protection, the effect of the research activity should be established in any form, even impermanent, yet stable enough to be perceived by persons other than the creator himself. In addition, its nature should be individualised and thus constitute a materialised creative and significant product of the human intellect. In the research process, often essential research contributions, even those that condition the success of the entire project, do not demonstrate this capacity. The problem of the lack of adequate and, at the same time, effective guarantees of legal protection for the fruits of scientific work has already been recognised in the literature. The authors of this book have set themselves the goal of joining the ongoing discussion on this subject. The authors seek to answer the question of who is a creator of science and what constitutes scientific authorship and recognition of individual contributions to the state of knowledge in the contemporary world of collaborative research conducted by very numerous interdisciplinary teams.

The book examines various perspectives on the indicated topic. First, from the point of view of the scientist's right to become a co-author of a single scientific work, established in the form of an article or poster or orally in the form of a conference speech. Second, from the point of view of the criteria used in promotion procedures for the award of scientific degrees for recognising the existence of an individual contribution to the state of knowledge of the applicant. These analyses lead to identifying the prerequisites required to demonstrate the authorship of the scientific achievement identified in the application for the award of a degree. Identifying and delimiting an individual contribution to the state of knowledge today is not an easy task to perform. Conducting scientific research requires drawing on other researchers' scientific achievements and findings. The complexity of research problems means that a researcher rarely works alone or as a member of a small research group. Consequently, in promotion proceedings, scientific achievements are often documented by multi-authored articles and inventions. Determining who should be credited with the authorship of a scientific achievement obtained from collaborative research and based on predecessors' work undoubtedly requires extraordinary clarity of mind, objectivity and expertise in the scientific issues under investigation.

Pursuing answers to these questions compelled the authors to engage in interdisciplinary analyses. It became imperative to scrutinize not only the legal framework governing scientific authorship and the right to be recognized as an author but also the ethical dimensions of the matter. Consequently, this book approaches these issues from the vantage point of legal sciences, encompassing intellectual property law and jurisprudence, as well as the field of the science of studies. Such a precisely defined research problem and the authors' ambitious objectives have also shaped the structure of this book, leading to its division into two parts.

The first part, authored by Anna Chorążewska, delves into examining the freedom of scientific research as a constitutionally protected concept and the problem surrounding the legal foundations for safeguarding the authorship of scientific works under Polish law while considering the legal and comparative background.

The analysis is grounded in the academic thesis positing that an individual who makes an independent, creative (original), and significant contribution to a collaborative research project possesses the right to be acknowledged as a co-author of a scientific work that publishes the outcomes of jointly conducted research. The author's examinations substantiate the validity of this thesis.

The legal basis for protecting the interests of scientists is rooted in national constitutions and international human rights conventions, collectively elevating the subjective rights of creators in the realm of science to the realm of human rights, entitling them to the protection of both personal and material benefits stemming from their scientific endeavours. Simultaneously, the author recognises that existing regulations do not furnish adequate safeguards or ensure the effective realisation of this defined subjective right.

As a result, the book articulates *de lege lata* postulates and *de lege ferenda*. It is duly emphasised that a pressing task for contemporary national legislators is to establish a comprehensive and effective legal framework for protecting authors' personal and property rights in the realm of science. Undoubtedly, it is beyond contention that the exercise of the freedom of scientific research should entail that an originator of an original, significant and individualised contribution to research acquire the right to authorship of a scientific publication or invention to the development of which the results of their creative scientific activity have contributed. A notable exemplar of an appropriate approach to this quandary is the solution embraced within the German higher education and science system, where the German legislator extends the protection of the right to scientific authorship to all participants in the research process, irrespective of whether their research contribution fulfils the criteria for authorship as per intellectual property law. However, such a practice is not widespread. Meanwhile, the extensive inclusion of guarantees for property rights in the constitutions of many countries (e.g., Article 64 of the Constitution of the Republic of Poland) should be construed to encompass not only traditional property rights about tangible things and immovable property but also an intellectual property to all products of the human intellect. Consequently, the identified legal gap within the legal systems of numerous countries necessitates rectification.

The second part of the book, co-authored by Anna Chorążewska and Adam Proń, a legal expert and a representative of the sciences with considerable research and reviewing experience, analyses the legal and ethical conditions for carrying out team-based scientific research in the area of hard sciences and natural sciences from the perspective of reflection inherent in science of studies, taking into account the historical background of the development of the system of science and the assessment of scientists. The foundation for these deliberations, as well as the guiding framework, are rooted in the insights of Professor Józef Pieter (1904—1989), a distinguished Polish psychologist, philosopher and pedagogue who also served as an academic teacher at various Silesian universities. Pieter's exceptional monographs, which explore scientific work as an expression of human creativity, contribute significantly to the exploration of critical issues such as the categorization of scientific work, the scientific methodology, the phenomenon of mentorship in the scientific realm, the subject and essence of research contributions, and the legal and ethical prerequisites for ascribing authorship to scientific works and scientific accomplishments.

The analyses conducted led the authors to two main findings. First, the determination of binding ethical principles for attributing the authorship of scientific works. Considering the legal and ethical context, the authors also answer the question of who is entitled to authorship of scientific work and who should only be mentioned in the Acknowledgments section of the article. Second, within the legal, ethical and factual framework, the principles for effective demonstration of authorship of scientific achievement, that is, authorship of an independent and individualised contribution to the state of knowledge, by applicants for awarding a degree or title in promotion proceedings are set out. It also addresses the issue of proper documentation of authorship of a scientific achievement that has not been published as a single author monograph but as a published series of thematically related multi-author scientific articles.

The authorship of a scientific achievement is analysed through the prism of the requirements for a doctoral dissertation, a habilitation thesis and the scientific achievements of a candidate for the title of professor. It should be noted the doctoral dissertation (thesis) is characterised not only from the perspective of Polish legal and factual conditions but also from a comparative background. In so doing, the authors take into account two aspects. First, the doctoral degree is common in the higher education and science systems of various countries, whereas the postdoctoral (habilitation) degree and the title of professor are rare. The second is that in other countries the professorship is often related to a position of employment in a scientific research unit or university rather than a formally conferred title by the state itself.

Considering that the outlined problem is exceptionally actualised when working in interdisciplinary and often international research groups, considerations of a theoretical nature were supplemented with case studies from the hard sciences and natural sciences. The purpose of this treatment is to decode the content of desirable authorship attribution rules with careful consideration of the role of the research group leader. As a result, the analysis of the established customs and rules of coexistence prevailing in the Polish scientific community is carried out, taking into account the international background. This is because Polish scientists must consider the standards of authorship attribution binding in the international scientific community when working in international research teams or publishing in foreign scientific periodicals.

To achieve this goal, the following formula was applied. The authors have chosen individual research domains in hard sciences and natural sciences to be analysed in the study. Next, in interviews with the subject matter consultants of these domains, the essence of the problems occurring in the attribution of authorship of publications and the documentation of scientific achievements in promotion proceedings was diagnosed. The consultants for this part of the study were scientists of unquestionable scientific status who could be called experts in their discipline of science. These scientists were then asked to explain which types of research processes during the preparation and implementation of a scientific project they qualify as creative and significant to their research and which, in their view, take the form of activities that, although highly specialised and relevant, are non-creative. A case study was developed based on these interviews and the materials provided concerning relevant scientific publications. Then, individual parts of study cases were subjected to the authorisation procedure of each researcher whose research work was analysed. On this basis, the principles of reliable attribution of authorship of scientific works and documentation of scientific achievements in promotion proceedings applicable to selected scientific specialities in the hard sciences and natural sciences were decoded.

The findings reached by the authors of this book allow for the formulation of a thesis. Law and ethics require that "scientific creativity" be covered by appropriate legal protection. On equal terms with other manifestations of human creative activity, it becomes necessary to sanction an effective system of protection of scientific authorship. The adopted solution should cover not only the issue of protection of authorship of a research contribution but also the protection of authorship of a scientific achievement. Consequently, the legal regulations should consider the diversity of the nature and subject of research, the scientific workshop and the nature of academic writing occurring in different areas of knowledge.

Regarding the Polish three-stage scientific promotion system, obtaining full research independence and the possibility of the unfettered exercise of scientific freedom are reached only after receiving the status of titular professor, the lack of protection for scientific authorship seems to be a severe shortcoming of the legal regulations in force in Poland. In their present form, especially in the field of hard sciences and natural sciences, the promoting system may even constitute a factor hampering the development of Polish science. The necessity to demonstrate in the promotion procedure an independent and individualised contribution to the state of knowledge in many cases may preclude the possibility of undertaking exceptionally socially and economically necessary transdisciplinary scientific projects in favour of those that allow the precise determination of the individual contribution of a future postdoctoral (habilitation) candidate or candidate for the title. This may result in Polish scientists being able to contribute effectively to global research trends only after obtaining a professorship. In contrast, researchers from the USA or most Western European countries can do so after receiving a doctoral degree. It, therefore, seems necessary to undertake a broader discussion in Poland on the protection of the right to be an author of a single article and the criteria for scientific authorship in promotion proceedings. In this discussion, attention should be paid to the significant differences in science practice in different areas of knowledge and to the social and economic needs of countries and societies. The nature of research in the humanities is markedly different from that in the hard sciences, natural sciences or medical sciences. States and societies also have different expectations of these sciences. This definite difference seems to be overlooked by the Polish legislator, leaving full freedom to the scientific community to interpret and apply legal norms defining authorship of scientific achievements in individual disciplines and scientific specialisations. However, the directions of interpretation of the application of the law developing in this way are not codified in official collections. Reviewers of promotion proceedings do not have the opportunity to familiarise themselves with the guidelines for assessing scientific merit that are in force in a given scientific discipline. This causes scientific achievements may be evaluated according to different criteria and measures.

Meanwhile, the principles and criteria used in promotion procedures, such as elements of the administrative procedure, should be clear, understandable and effective and they should create a widely regarded system that is transparent, fair and equitable. One of the foundations of such procedures is the assumption that decisions with similar, if not identical, content will be made against an entity whose legal and factual situation is similar. Fulfilment of these requirements should be regarded as a binding standard in every democratic state and society as the implementation of the constitutional principle of a democratic state ruled by law, detailing the rules of protection of citizen's trust in the state and the law created by it, as well as the individual's right to good administration (Article 2 of the Constitution of the Republic of Poland).

Part I

Anna Chorążewska

Creators of Science and Scientific Authorship and the Right to Be the Author of a Scientific Work

Chapter I

The Protection of Scholarly Work

The American Physical Society, concerned about the growing influence of pseudoscientific claims, in a statement of November 1998, by adapting the words of E. O. Wilson from the book *Consilience*, has explained:
What is Science?
Science is the systematic enterprise of gathering knowledge about the universe and organizing and condensing that knowledge into testable laws and theories.
The success and credibility of science are anchored in the willingness of scientists to:
Expose their ideas and results to independent testing and replication by others. This requires the open exchange of data, procedures and materials.
Abandon or modify previously accepted conclusions when confronted with more complete or reliable experimental or observational evidence.
Adherence to these principles provides a mechanism for self-correction that is the foundation of the credibility of science.

https://faculty.washington.edu/bulgac/aps_science.html
https://www.aps.org/policy/statements/99_6.cfm

1.1. Constitutional Freedom of Research

Reflections on the freedom of science[1] should begin with an attempt to define the terms "science" and "scientific research." According to the definition of the Universal Dictionary of the Polish Language, science is "a body of human knowledge arranged in a system of problems, expressed in truth judgements and assumptions," as well as a set of views constituting a systematised whole and forming part of a specific research discipline (science as a theory, doctrine).[2] This is because the aim of science and, accordingly, of research activity is to gain knowledge through understanding of logical relationships and mutual relations between natural and social phenomena, and to establish the theory of cognition.[3] To cite Jacek Sobczak, "in much simplified terms, one could risk a statement that knowledge is a collection of ordered information. The scientist, however, cannot be reduced to the role of a custodian—ordering, cataloguing and dusting off information resources."[4]

As Christian Starck points out, "the very notion of scientific research implies that it is not closed and, thus, eludes simple definitions. Therefore, the nature of scientific research cannot be tied to one specific form or defined formally. The autonomy of scientific research, constitutionally safeguarded by the freedom of science, also does not allow for formal divisions, as well as content or value-related ones."[5] From a methodological point of view, it can be assumed that the term "scientific research" involves a process beginning with the determination of the research

[1] For more, see: A. Biłgorajski, "Część pierwsza: Konstytucyjna wolność badań naukowych" [Part One: Constitutional Freedom of Scientific Research], in A. Chorążewska and A. Biłgorajski, *Konstytucyjna wolność badań naukowych a ochrona pracy naukowej. Studium przypadków z nauk ścisłych eksperymentalnych* [Constitutional Freedom of Scientific Research and Protection of Scientific Work. A Case Study in Experimental Ecience] (Katowice: Wydawnictwo Uniwersytetu Śląskiego, 2018), 17–77.

[2] *Uniwersalny słownik języka polskiego* [Universal Dictionary of the Polish Language], T. 2: k-ó, ed. S. Dubisz (Warszawa: Wydawnictwo Naukowe PWN, 2006), 862.

[3] C. Starck, "Wolność badań naukowych i jej granice" [Freedom of Research and Its Limits], *Przegląd Sejmowy* 3, no. 80 (2007): 46.

[4] J. Sobczak, "Wolność badań naukowych—standardy europejskie i rzeczywistość polska" [Freedom of Scientific Research—European Standards and Polish Reality], *Nauka i Szkolnictwo Wyższe* 2, no. 30 (2007): 61.

[5] Starck, "Wolność badań naukowych," 46.

problem, that is, with the identification of research hypotheses, moving on to the analysis of available literature of the subject (queries), observation of practice, selection of research methods and techniques, and concluding with the research process in the strict sense, conducted through measurements, data collection, data analysis and generalisation. In doing so, the research process follows the paradigms of individual fields and disciplines of science. The indicated activities are aimed at the emergence of scientific findings of various type and importance, including scientific theories.[6] Scientific status can only be attributed to such research that meets the criteria of: generality, originality, objectivity, validity, accuracy, communicability, orderliness and usefulness.[7]

Freedom of science as a subjective right of an individual does not have a long history. It was not guaranteed in first generation constitutions.[8] Most often this freedom was considered a part of the freedom of expression. Freedom of scientific research began to be a stand-alone value only under the constitutions emerging after the First World War. A notable example is Article 117, sentence 1, of the Act of 17 March 1921—Constitution of the Republic of Poland,[9] providing that "scientific research and the publication

[6] M. Królikowski and K. Szczucki, "Komentarz do art. 73 Konstytucji RP" [Commentary on Article 73 of the Constitution of the Republic of Poland], in *Konstytucja RP, T. 1: Komentarz. Art. 1–86*, ed. M. Safjan and L. Bosek (Warszawa: Wydawnictwo C. H. Beck, 2016), 1683, Nb 30. Sobczak, *Wolność badań naukowych*, 62.

[7] B. Klepacki, Wybrane zagadnienia związane z metodologią badań naukowych [Selected Issues in Research Methodology], *Roczniki Nauk Rolniczych* Series G, T. 96, z. 2 (2009), 39. As cited by: M. Królikowski and K. Szczucki, "Komentarz do art. 73 Konstytucji RP" [Commentary on Article 73 of the Constitution of the Republic of Poland], 1683, Nb 30.

[8] An exception in this respect is the Frankfurt Reich Constitution of 1849, which, in § 152, sanctioned the freedom of scientific research. see Starck, "Wolność badań naukowych," 45; cf. L. Garlicki, "Nota 1 do art. 73 Konstytucji RP" [Note 1 to Article 73 of the Constitution of the Republic of Poland], in *Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 roku. Komentarz* [Constitution of the Republic of Poland of 2 April 1997. Commentary], T. 3, Chapter 2, ed. L. Garlicki (Warszawa: Wydawnictwo Sejmowe, 2003), 1.

[9] The March Constitution, on the one hand, in Article 104 guaranteed to everyone—in accordance with the law in force—the freedom of expression of thoughts and beliefs, and, on the other hand, specifying this in the context of science, in Article 117 declared the freedom of scientific research and publication of its results. See M. Jabłoński, "Wolności z art. 73 Konstytucji RP" [Freedoms under Art. 73 of the Constitution of the Republic of Poland], in *Prawa i wolności obywatelskie w Konstytucji RP* [Civil Rights and Freedoms

of its results are free."[10] This regulation of the March Constitution was retained in the next Polish constitution, that is, in Article 81(2) of the Constitutional Act of 23 April 1935.[11] This Act further assumed that "the creativity of the individual is the lever of collective life" (Article 5(1)). It was also the task of the state to provide citizens with, inter alia, "the opportunity to develop their personal values" (Article 5(2)). In turn, the Constitution of the People's Republic of Poland, which was in force in Poland from 1952 to 1989, proclaimed the principle of the state's care for comprehensive development of science, assuming that it was to serve the nation (Article 63), declared care for the creative intelligentsia (Article 64) and, inter alia, freedom of speech (Article 71). Furthermore, Article 65[12] provided that: "The People's Republic of Poland takes special care of the creative intelligentsia—employees of science, education, literature and art, as well as pioneers of technical progress, rationalisers and inventors." The Constitution of the People's Republic of Poland thus imposed an obligation on the state to care for the development of science, however, it did not formulate freedom of scientific research. This approach was symptomatic of socialist constitutionalism.

In such a form the constitutional status of science and scientists remained in force in Poland until 1997. The cited provisions of the Constitution of the People's Republic of Poland were retained under Article 1, item 8 of the Act of 29 December 1989 amending the Constitution of the People's Republic of Poland,[13] with a symbolic change replacing the expression "People's Republic of Poland" with the phrase "Republic of Poland." When the new Constitution of the Republic of Poland of 2 April 1997 came into force,[14] the constitutional status of science changed significantly. This Constitution defined subjective rights corresponding to the creative freedoms to which every person residing in Poland is entitled (Article 73). These include the freedom of art (freedom

in the Constitution of the Republic of Poland], ed. B. Banaszak and A. Preisner (Warszawa: Wydawnictwo C. H. Beck, 2002), 552; L. Garlicki and M. Derlatka, "Komentarz do art. 73" [Commentary on Art. 73], in *Konstytucja Rzeczypospolitej Polskiej. Komentarz* [Constitution of the Republic of Poland. Commentary], ed. L. Garlicki and M. Zubik, 2nd revised and supplemented edition (Warszawa: Wydawnictwo Sejmowe, 2016), 790.

[10] Journal of Laws 1921, no. 44, item 267, as amended.

[11] Journal of Laws 1935, no. 30, item 227, as amended.

[12] After the amendment of 10 February 1976—Article 77.

[13] Journal of Laws 1989, no. 75, item 444, as amended.

[14] Journal of Laws 1997, no. 77, item 483, as amended.

of artistic creation), the freedom of science (freedom of scientific research, freedom to publish its results and to teach) and the freedom to enjoy cultural goods. These freedoms remain inextricably linked (genetically and functionally) to the constitutional freedom of expression (Article 54).

The constitutional regulation adopted in Poland stands out against the background of public international law. International human rights protection systems limit themselves to guaranteeing human beings only the freedom of expression, without sanctioning explicitly the category "freedom of science."[15] Obviously, the definition of freedom of expression encompasses within its scope the typical attributes of freedom of science. Its content is defined as the right to hold an independent opinion and the freedom to express it, as well as the freedom, without interference from public authorities and regardless of state boundaries, to seek, receive and disseminate information, views and ideas by any available means.[16] However, the lack of an explicit mention of the freedom of science results in the preclusion of the educational effect of international documents and, consequently, insufficient protection of this sphere of individual creative activity at the international level. The sanctioning of freedom of expression, although it offers a guarantee for the effective exercise of the freedom of scientific research, does not account for the qualified nature of the freedom of science within its framework. By guaranteeing the individual the freedom to think and analyse the world around and, then, to publicly express the observations made in this process, it does not make clear that the information and analysis obtained and formulated by a person in the process of scientific creativity is more than just a subjective view of its author. The freedom of scientific research is the freedom to undertake and carry out activities with a view to collecting and systematising the results of previously implemented cognitive processes, using only recognised, that is, legitimate research methods, both of a theoretical and empirical nature, and then with a view to publishing the results of man's creative work in specific forms and not as mere statements expressed in the public space. The results of scientific research can be communicated in the following ways:

[15] See Article 19 of the Universal Declaration of Human Rights; Article 19 of the International Covenant on Personal and Political Rights; Article 10 of the European Convention on Human Rights.

[16] Królikowski and Szczucki, "Komentarz do art. 73," 1672–1678; Garlicki and Derlatka, "Komentarz do art. 73," 789–790.

by publishing scientific articles in recognised periodicals,[17] by presenting papers and posters at scientific conferences and congresses, or by applying to the relevant patent offices for the protection of an invention (granting a patent). Consequently, the essence of the analysed creative process boils down to formulating research hypotheses (theses) and then verifying them with the use of research methods and techniques recognised in the scientific community, as well as to logical and substantive justification of the previously formulated theses and attempts to build scientific theories in order to extend the state of scientific knowledge about the phenomenon or object of interest of the researcher or team of researchers. All these findings are intended to define the objective truth (while preserving—with the application of procedures and methods recognised in science—the right to make a false thesis or to justify the thesis erroneously due to human cognitive limits or the still enormous gaps in our knowledge of the surrounding world), and not to create conditions for man to influence the environment by formulating their own subjective (not scientifically verified) judgements about the analysed phenomena or objects.[18]

The failure to distinguish the freedom of scientific research as a qualified form of freedom of expression, as it is based exclusively on objective truth (established in the best faith in accordance with the possibilities and limitations of sanctioned research methods and techniques), has the effect that the legislative act does not give rise to the conclusion that, when receiving and understanding another person's statements, one should distinguish those which are intrinsically subjective from those which are intrinsically objective, as formulated, in the intention of the researcher, on the basis of scientific findings. In contrast, the recipient of an utterance should apply a different level of criticism and implement a different process and method of verification when the communicated position or view constitutes a subjective judgment rather than scientific finding. The Constitution, by naming certain categories of individual freedoms, on the one hand, reflects a socially accepted system of values and beliefs and, on the other hand, formulates a certain programme for the future. In this way, the objectives of the state are defined in reference

[17] P. Sorokowski, E. Kulczycki, A. Sorokowska, and K. Pisanski, "Predatory Journals Recruit Fake Editors," *Nature* 543 (March 22, 2017): 481–483, https://doi.org/10.1038/543481a.

[18] Cf. Sobczak, "Wolność badań naukowych," 62.

to the educational function of the act, that is, determining the desired shape of social reality.[19] The failure to distinguish the freedom of scientific research and publication of its results from the freedom of speech does not educate the recipient of the legislative act that the two categories of speech should be distinguished from one another and assigned a different weight and rationale and method of critical evaluation of their meaning. Nevertheless, despite the lack of formulation of the freedom of science as a separate one, the international legislator qualifies as human right, inter alia, everyone's right to participate in the progress of science and to enjoy the benefits of the application of the achievements of scientific progress,[20] which undoubtedly helps to protect the creative freedom of the individual in this area of creative activity and promotes the authority of scientists and their scientific findings.

Freedom of science, alongside freedom of thought and freedom of expression, has been singled out as an independent norm at the level of EU law in Article 13 of the Charter of Fundamental Rights of the European Union. Under the cited provision, "the arts and scientific research shall be free from restrictions. Academic freedom shall be respected." The normative benchmark for the protection of academic freedom sanctioned in this way is supplemented by recommendations of the European Commission, including, among others, the European Charter for Researchers. The aim of these regulations is to create a European Research Area, unifying the standards of European research policy.[21]

By sanctioning the freedom of science as a separate subjective right of an individual,[22] the Polish legislator has introduced a specific form, from the perspective of a recipient of the researcher's speech, of the more general principle of freedom of speech under

[19] B. Banaszak, *Prawo konstytucyjne* [Constitutional Law] (Warszawa: Wydawnictwo C. H. Beck, 2015), 64.

[20] See Article 27 of the Universal Declaration of Human Rights, Article 15 of the International Covenant on Economic, Social and Cultural Rights, Article 10 of the European Convention on Human Rights.

[21] Królikowski and Szczucki, "Komentarz do art. 73," 1676.

[22] The freedom of arts, sciences and teaching was also sanctioned by the legislatures of other countries after the Second World War, including its adoption: in Article 33(1) of the Italian Constitution of 1947, Article 5(3) of the German Basic Law, Article 16(1) of the Greek Constitution of 1975, Articles 42 and 43 of the Portuguese Constitution of 1976, Article 20 of the Spanish Constitution of 1978, Articles 20 and 21 of the Swiss Constitution. For more on this subject, see: Starck, "Wolność badań naukowych," 45 et seq.

Article 54.[23] The freedom of scientific research is not *ius infinitum*. The freedom in question expresses the right of an individual to take such actions that will not lead to violation of subjective rights of other people, or violation of other interests protected by law. Such a perspective shifts the focus of considerations on the freedom of scientific research to the specification of prerequisites and methods of its limitation.[24] Thus, it is only by delimiting its boundaries that the actual scope of this freedom can be determined.[25]

When defining the boundaries of this freedom, the positive legislator may firstly decide that certain manifestations of human activity will not be regarded as exercise of the freedom of scientific research due to the violation of the principles applicable to the conduct of scientific activity, as specified at various regulatory levels by the scientific community itself in codes of ethics for researchers. These stipulate,[26] among other things, that research must be conducted according to recognised or new, well-founded methods, that the results must be documented, the results achieved must be consistently checked, and strict integrity must be maintained with regard to the contributions of others—both inside and outside the research team. The principles of good scientific practice lay down the criteria for scientific misconduct. These include, but are not limited to: fabrication and falsification of data; selecting results and discarding undesirable results; manipulation in the presentation of results or in the illustration of claims; plagiarism or "idea theft"; misappropriation or unjustified assumption of scientific authorship or co-authorship; falsification of content; unauthorised sharing of information with third parties until a work, achievement, hypothesis or research assumption has been published; sabotage of research activity by damage, manipulation, etc.; deletion of primary data in violation of the recognised principles of the discipline. From the above,

[23] "The freedom to express opinions, to acquire and to disseminate information shall be ensured to everyone."

[24] Ch. Starck, "Konstytucyjne granice wolności nauki na przykładzie zapłodnienia 'in vitro', terapii genetycznej i analizy genomów" [Constitutional Limits of the Freedom of Science, Based on the Example of *in vitro* Fertilisation, Genetic Therapy and Genome Analysis], *Palestra* 11–12 (1989): 172.

[25] W. Lamentowicz, "O wolnościach i ich granicach" [On Freedoms and Their Limits], in *Historia. Idea. Polityka. Księga dedykowana profesorowi Janowi Baszkiewiczowi* [History, Idea, Politics. Book Dedicated to Professor Jan Baszkiewicz], ed. F. Ryszka (Warszawa: Wydawnictwo Naukowe Scholar, 1995), 402.

[26] Starck, "Wolność badań naukowych", 48.

conclusion can be drawn, obvious from the point of view of logic, that the freedom of scientific research somewhat limits itself. Its ethical definition makes in fact a list of conditions whose fulfilment enables research to be subject to legal protection by state institutions. Secondly, the positive legislator may introduce into the legal system certain prerequisites allowing—subject to a number of conditions—to deprive certain individuals of the freedom of scientific research. In the Polish legal order, their exhaustive list is contained in Article 31(3) of the Constitution.[27] Such method of determining the limits of a freedom is also well known to the international legislator (Article 29(1) and (2) of the UDHR; Article 19(3) of the ICCPR) and the European legislator (Article 10(2) of the ECHR; Article 52(1) of the CFR). For the sake of protecting the freedom of the individual, whenever restrictions on the freedom of research are introduced under Article 31(3) of the Basic Law—the legitimacy of the restriction imposed is assessed.

Freedom of scientific research can be defined from the positive perspective (by pointing to exemplary elements falling within its scope) or from the negative perspective (by pointing to exemplary elements that do not fall within its scope). Analysis of the content of this freedom led Mariusz Jabłoński to the conclusion that its essence is expressed in several partial freedoms, manifest in the possibility to undertake various thought processes in the pursuit of scientific cognition; the freedom to undertake and conduct research in any field; the freedom to choose the place of conducting scientific research; the freedom to choose research methods and techniques; the freedom to publish research results obtained; the freedom to disseminate information and knowledge obtained in the course of research in any form; the freedom to cooperate with many partners.[28] Leszek Garlicki, in turn, explains that the content of the freedom of scientific research includes the right

[27] "Any limitation upon the exercise of constitutional freedoms and rights may be imposed only by statute, and only when necessary in a democratic state for the protection of its security or public order, or to protect the natural environment, health or public morals, or the freedoms and rights of other persons. Such limitations shall not violate the essence of freedoms and rights."

[28] M. Jabłoński, "Wolności z art. 73 Konstytucji RP" [Freedom under Article 73 of the Constitution of the Republic of Poland], in *Prawa i wolności obywatelskie w Konstytucji RP* [Civil Rights and Freedoms in the Constitution of the Republic of Poland], ed. B. Banaszak and A. Preisner (Warszawa: Wydawnictwo C. H. Beck, 2002), 562.

to err, as well as the right to formulate a false scientific theory.[29] Wojciech Brzozowski emphasises that it cannot be considered as sufficient ground for denying constitutional protection to a given research that the public at large views it as controversial and its results may prove shocking or disturbing.[30]

1.2. Protection of Intellectual Property of Authors of Science

A significant shortcoming of the way in which the freedom of science is sanctioned (expressed) in the Polish Constitution and in international human rights legislation[31] is the lack of a clear formulation of guarantees for this freedom. Legislators in particular disregard the issue of protecting intellectual property rights to the fruits of a scientist's research work. There is a lack of a legal provision sanctioning a universal, independent of the medium of expression, right of the researcher to mark the results of their research activity with their name.[32]

However, it cannot be assumed that the recognition of the freedom of science as a separate category of individual freedom has no legal significance and does not give rise to any claims of the researcher against the state. Public authorities should not only refrain from taking measures that would restrict the freedom of research in a way violating the Constitution, but should also actively work to provide researchers, through lower-rank legal acts (statutory law), with the necessary guarantees for the exercise of this freedom, especially in the sphere of protecting the authorship of scientific discoveries and other fruits of the researcher's work. In literature, it is explicitly pointed out that

[29] L. Garlicki, "Nota 7 do art. 73 Konstytucji RP" [Note 7 to Article 73 of the Constitution of the Republic of Poland], in *Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 roku. Komentarz* [Constitution of the Republic of Poland of 2 April 1997. Commentary], T. 3, Chapter 2, ed. L. Garlicki (Warszawa: Wydawnictwo Sejmowe, 2003), 6–7.

[30] W. Brzozowski, Konstytucyjna wolność badań naukowych i ogłaszania ich wyników [Constitutional Freedom of Scientific Research and Publication of Its Results], in *Prawo nauki. Wybrane zagadnienia* [Law of Science. Selected Issues], ed. A. Wiktorowska and A. Jakubowski (Warszawa: Wydawnictwo Prawnicze LexisNexis, 2014), 33–34.

[31] "Art. 73. The freedom of artistic creation and scientific research as well as dissemination of the fruits thereof, the freedom to teach and to enjoy the products of culture, shall be ensured to everyone."

[32] Garlicki and Derlatka, "Komentarz do art. 73," 790.

nowadays it is impossible to ignore the close relations of human creative activity with both the freedom of economic activity (because in many cases exercise of the former freedom may constitute a source of income, e.g., commercialisation of scientific research results) and the right to property (because the constitutional concept of property also includes the so-called intellectual property).[33]

The Polish Constitutional Tribunal, in its case-law, explains that the right to property and its protection, as guaranteed in Article 64[34] and Article 21,[35] should be treated as a subjective right of an individual with the broadest possible content, which is expressed in the relation of the owner to the thing. This right includes a whole bundle of the owner's specific rights in relation to the thing, including the right to use the thing, to derive benefits and to dispose of the thing freely.[36] Following the civil law tradition, the following should be regarded as the attributes of the content of the owner's right to a thing: its absolute nature (effectiveness *egra omnes*), the exclusive authority of the owner, the owner's right to make any use of the object, transferability, indefiniteness in time, original flexibility.[37] This means that any right in rem showing the above-mentioned civil law attributes of the right to property should be qualified as "ownership" in the constitutional sense, subject to protection under Article 64(1) and (2) of the Constitution of the Republic of Poland.

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[33] Garlicki, "Nota 3 do art. 73 Konstytucji RP," 2.

[34] "1. Everyone shall have the right to ownership, other property rights and the right of succession. 2. Everyone, on an equal basis, shall receive legal protection regarding ownership, other property rights and the right of succession. 3. the right of ownership may only be limited by means of a statute and only to the extent that it does not violate the substance of such right."

[35] "1. The Republic of Poland shall protect ownership and the right of succession. 2. expropriation may be allowed solely for public purposes and for just compensation."

[36] E.g., Judgment of the Polish Constitutional Tribunal of 5.09.2006, K 51/05; judgment of the Polish Constitutional Tribunal of 7.11.2006, SK 42/05.

[37] L. Garlicki, "Komentarz do art. 64 Konstytucji" [Commentary on Article 64 of the Constitution], in *Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 roku. Komentarz* [Constitution of the Republic of Poland of 2 April 1997. Commentary], T. 3, Chapter 2, ed. L. Garlicki (Warszawa: Wydawnictwo Sejmowe, 2003), 7–8; Cf. K. Zaradkiewicz, *Instytucjonalizacja wolności majątkowej. Koncepcja prawa podstawowego własności i jej urzeczywistnienie w prawie prywatnym* [Institutionalization of Proprietary Freedom. The Concept of the Fundamental Right to Property and Its Realisation in Private Law] (Warszawa Biuro Trybunału Konstytucyjnego, 2013), 306–335.

At the same time, the Tribunal emphasises that the scope of the rights subject to constitutional protection is not limited to ownership in the civil law sense. The notion of the "right to property" from the cited Article 21(1) and (2) must be understood in an autonomous manner, as it goes beyond the civil law understanding of ownership, being a synonym of the entirety of property rights.[38] A similar view was formulated by the Tribunal in the context of previous Article 7 of the constitutional provisions amended in 1989 and maintained in force, which had an identical wording and function as Article 21(1) and (2) of the 1997 Constitution. The Tribunal's position was that property in the view of constitutional provisions forms a strictly constitutional category, more akin to the economic understanding of property, and thus being synonymous to the entirety of property rights. Moreover, it was added that the identification of the category "ownership" with the term "property" should result, first, from the institutional and guarantee meaning of constitutional provisions, and, second, from the normative approach of Article 1 of Protocol No. 1 to the Convention for the Protection of Human Rights and Fundamental Freedoms[39] (Journal of Laws 1995, No. 36, item 175/1), treating the notions of "ownership" and "property" as interchangeable or even synonymous.[40]

These findings lead to the conclusion that there is no obstacle for the constitutional concepts of "property" and "other property rights" (as expressed in Article 64) to include also broadly understood, so-called intellectual property.[41] The accuracy of this view was confirmed by the Polish Constitutional Tribunal in the justification of the judgment of 23.06.2015 in the case SK 32/14. In this case, the basis for the decision was Article 79 of the Polish

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[38] Judgment of the Polish Constitutional Tribunal of 13.12.2012, P 12/11; cf. judgment of the Polish Constitutional Tribunal of 03.04.2008, K 6/05.

[39] "Every natural or legal person is entitled to the peaceful enjoyment of his possessions. No one shall be deprived of his possessions except the public interest and subject to the conditions provided for by law and by the general principles of international law."

[40] See: the judgment of the Polish Constitutional Tribunal of 13.12.2012, P 12/11.

[41] L. Garlicki and S. Jarosz-Żukowska, "Komentarz do art. 64" [Commentary on Article 64], in *Konstytucja Rzeczypospolitej Polskiej. Komentarz* [Constitution of the Republic of Poland. Commentary], ed. L. Garlicki et al. (Warszawa: Wydawnictwo Sejmowe, 2016), 589; Garlicki and Derlatka, "Komentarz do art. 73," 789.

Copyright Act[42] [hereinafter: copyright], setting out the rights of the author of a work in relation to an infringement of the author's property rights to their work.[43] The Tribunal took the view that this provision sanctions the proprietary model of protection of author's economic rights and confers on the author a position similar to that of the owner of a thing. This is decided, inter alia, by the attributes the author holds, namely: the possibility to use the work to the exclusion of other persons or to authorise

[42] Act of 4 February 1994 on Copyright and Related Rights, Journal of Laws 2022, item 2509.

[43] Article 79.1. The rightholder whose economic rights have been infringed may request the person who has infringed those rights:

(1) Stop the infringement;

(2) Remove the effects of the infringement;

(3) Redress the damage caused:

a) in accordance with general practice, or

b) by paying an amount of money equal to double, or in the case of intentional infringement—triple the value of relevant remuneration which, at the time of its enforcement, would be due on account of the rightholder's consent to use a work;

(4) Surrender of any benefits gained.

2. Notwithstanding the claims referred to in paragraph 1, the rightholder may request the publication of one or more than one press statements having the appropriate content and form or the public announcement of the whole or part of a ruling issued by the court in the case concerned, in the manner and to the extent prescribed by the court.

3. The court may order a person who infringed economic rights, at the request of that person and subject to the rightholder's consent, if the infringement was not intentional, to pay an appropriate amount of money to the rightholder, if stopping the infringement or removing its effects would be disproportionately severe to that person.

4. The court, when ruling on the infringement of economic rights, may rule, at the rightholder's request, on illegally produced objects and means and materials used to produce them, in particular the court may rule that they be removed from the market, awarded to the rightholder on account of the compensation due to him, or destroyed. In its ruling, the court shall take into account the gravity of the infringement and third person interests.

5. It is assumed that the means and materials referred to in paragraph 4 are the property of the person who has infringed economic rights.

6. The provisions of paragraph 1 apply accordingly in the event of removal or circumvention of technical devices applied to protect a work from access, reproduction, or distribution, if those actions are aimed at illegal use of the work.

7. The provisions of paragraph 1 and 2 apply accordingly in the case of unauthorised removal or alteration of any electronic copyright or related rights management information as well as to intentional distribution of a work from which or in which such information has been illegally removed or altered.

other persons to such use in all fields of exploitation, or the right to dispose of the work in all fields of exploitation, or the right to obtain remuneration for the use of the work (Article 17 of copyright law).

A work is one of the categories of intangible goods specifically named in legal provisions, which is a product of the human intellect of a creative and individualised nature. Indeed, the law also defines other intangible goods, the creation of which is also the result of human activity. These are inventions and other protective rights protected under industrial property law, as well as human scientific creativity guaranteed under civil law (Article 23 of the Polish Civil Code).[44] Each of these intangible goods has characteristics analogous to a work. They are products of the human intellect of a creative and individualised nature. From the perspective of the constitutional principle of equality (Article 32)[45] they share the same essential characteristic (the so-called relevant characteristic) as the work. The cited principle requires that the legal situation of creators of products of the human intellect having the same nature (legal characteristic) should be analogous and therefore subject to analogous legal protection in terms of form and intensity.[46] The decision of the Constitutional Tribunal

[44] J. Greser, "Prawa autorskie a prawa człowieka" (§ 6. Prawa autorskie w Konstytucji RP) [Copyright and Human Rights (§ 6. Copyright in the Constitution of the Republic of Poland)], in *Granice prawa autorskiego* [Limits of Copyright], ed. J. Kępiński, K. Klafkowska-Waśniowska, and R. Sikorski (Warszawa: Wydawnictwo C. H. Beck, 2010), 197–200.

[45] A working definition of the constitutional principle of equality, stating that equality before the law "consists in the fact that all subjects of law (addressees of legal norms) characterised by a given essential (relevant) feature to an equal extent are to be treated equally, has become established in the Tribunal's case law. That is, according to an equal measure, without distinctions either discriminatory or favourable. […] Equality also implies acceptance of different treatment by the law of different subjects (addressees of legal norms), because equal treatment by the law of the same subjects in a certain respect usually implies different treatment of the same subjects in another respect." Judgment of the Constitutional Tribunal of 09.03.1988, in case U.7/87, OTK 1988, item 1, p. 14 (repeatedly cited in further case law).

[46] When illustrating the above mentioned arguments, it should be pointed out that the research problem of legal grounds and remedies defined in this way is not new to an author of a scientific creation which is not directly subject to statutory protection under a legal institution relevant to the form of presenting a scientific achievement. Such protection has been contemplated by lawyers for a long time and it has been expressed in formulated postulates to develop a code of protection of intellectual property, the subject of regulation of which would be a unified (identical, today we would say—corresponding

qualifying author's economic rights within the category of "other property rights" under Article 64 of the Constitution of the Republic of Poland should therefore be treated as exemplary, that is, requiring application to any analogous situation. In other words, when, at the statutory level, a category of "object of intellectual property" other than "work" is defined, having the characteristics of a creative and individualised product of human intellect, the position of the author of such intangible asset should be analogous to the position of the author of a work. It should be assumed that the constitutional guarantee of intellectual property rights under Article 21 and Article 64 also covers the rights of originators of "scientific creation," as well as inventions and other protective rights under industrial property law.

This conclusion remains valid even if we take into account that copyrights are considered in two aspects, namely: author's moral rights and author's economic rights. For it is impossible to

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to the constitutional principle of equality) model of protection of the subject of intangible property rights. It should be added that the notion of „rights to intangible property" has not been and is not a statutory one, but it has been developed by the science of law in order to collectively designate subjective rights vested in authors, their legal successors or other entities entitled by law to the exclusive use of the earning capacity or economic value inherent in such property. This, obviously, refers to works (including scientific works), inventions, utility and ornamental designs, trademarks expressly included in legal standards, but not only. The term should be used to cover all other categories which exhibit analogous features. The right to intangible property is a category existing independently of the physical object in which it is grounded and due to which it can be used. The common feature of all intangible goods is that they owe their existence to the creative activity of the human mind or at least to specific technical and organisational efforts of humans. From this perspective, intangible goods always represent an economic value and therefore become the subject of both economic and industrial trade. The subject of these rights is the creator of the intangible good. The essence of the subjective right held by the author is the possibility to use the object of this right to the exclusion of others for commercial and/or professional purposes. Thus, the author is solely entitled to dispose of the created good and use its economic value. In this way, intangible interests have been reconstructed as absolute property rights giving the possibility of exclusive use of the goods constituting their subject matter. Protection of a subjective right defined in this way may be sought by the author under the relevant specialised statutes relating to strictly specified intangible goods, and in the absence thereof—in reliance on the general civil law rules, specified in Articles 23 and 24 of the Civil Code. Cf. A. Kopff, "Prawo cywilne a prawo dóbr niematerialnych" [Civil Law and the Law of Intangible Property], in *Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Prace z Prawa Własności Intelektualnej* 5 (1975): 12–13, 15, 19–20, 24–25, 28–31.

assume that, in the case SK 32/14, the Constitutional Court extended the protection of Article 64(1) and (2) only to the sphere of author's economic rights. Both these categories of author's rights are not autonomous and independent with respect to each other. On the contrary, they depend on each other and do not constitute autonomous or independent legal categories. The right to dispose of author's economic rights is genetically and functionally linked to the primarily existing author's personal interest in a specific work. The holder of the author's economic rights must derive their rights either from the author's moral right to the work or from the fact that they have acquired or obtained a licence to use the work from the holder of the author's moral right. In other words, the author's moral right and the author's economic right to a specific work can only jointly be subject to the constitutional guarantee of Article 64 (1) and (2). Also, systemic interpretation of this Act can be used in support of such a statement. That is to say, taking into account the scheme (division of contents) and subsequent dispositions of the Copyright Law Act (i.e., Chapter 3. Scope of Copyright, divided into: Subchapter 1. Moral Rights of the Author and Subchapter 2. Author's Economic Rights; Chapter 8. Author's Moral Rights Protection and Chapter 9. Author's Economic Rights Protection), it should be assumed that the content of the "copyright" in the "work" admittedly consists of two elements: "author's moral rights" and "author's economic rights," however, these two are understood as a certain whole. Such whole (consisting of these two elements) of a copyright is subject to protection under Article 64(1) and (2) of the Constitution of the Republic of Poland.[47]

As a side note, attention should be drawn to one more question. Irrespective of whether "scientific creation" finds expression in a "work" within the meaning of copyright law (and fulfils the prerequisites of "author's economic rights") or not, constituting instead only the result of research of an undetermined form and a manifestation of a mere "human personal interest" under Article 23), it carries an element of economic value. It should be recalled that literature explicitly points to a close relationship of

[47] It may be noted that, analogous to today's regulation of copyright of 1994, the Act of 10 July 1952 on Copyright, Journal of Laws 1952, item 234; Journal of Laws 1975, item 184 and Journal of Laws 1989, item 192) in its Chapter 3, entitled *Contents of Copyright*, in Article 15, defined copyright as a complex category, consisting of the author's right to: protection of author's personal rights, exclusive disposal of the work and remuneration for the use of the work.

human creative activity with the freedom of economic activity and the right to property. Moral rights to scientific creativity in a broad sense constitute a source of funding for an individual's scientific research. Scientific output is one of the many factors conditioning a researcher's ability to obtain scientific grants for research projects for the institution where the researcher is employed.

Article 64 of the Constitution of the Republic of Poland should be understood as a norm offering the legal basis for granting protection to the creator of the results of scientific research, which supplements the content of the constitutional freedom of science under Article 73 with the necessary guarantees for the latter. The legislator, by sanctioning the freedom of science (i.e., the freedom of scientific research together with the freedom to publish its results and the freedom of science), imposed on the state, on the one hand, the prohibition of excessive intervention, regulation of this human activity and, on the other hand, the obligation to support the individual in their creative activity by creating appropriate conditions, both legal and financial, for its development. A natural consequence of the latter conclusion is the qualification of the broadly understood intellectual property right of the creator/researcher as "other property right" within the meaning of Article 64 of the Constitution of the Republic of Poland, which can give rise to the researcher's claim for non-interference in the object of their property by both public authorities and third parties. The individual also has the right to an institutional guarantee of the exercise of the property right held, including the right to declare authorship of the results of scientific research carried out.

Taking the above into account, in this study, the subject of further consideration will be the issue of mutual relations between constitutional values such as: freedom of scientific research and publishing its results and the guarantee of the right to mark the authorship of research results by their creator in the list of authors of a scientific publication (Article 73 in conjunction with Article 64 par. 1 and 2 and Article 31 par. 3 of the Constitution of the Republic of Poland), against the background of classical copyright regulations. At the same time, these considerations will be made through the prism of recognising it as a standard of the rule of law and democratic systems of human rights protection to provide necessary guarantees to scientific authors. These standards should guarantee every researcher the right to publish their scientific research along with the marking of their authorship of the scientific discoveries or other research results of which they are the creator (author).

1.3. Authorship in the Copyright System—Considerations on Polish Law against a Comparative Legal Background

From the intellectual property law perspective, authorship should be considered a matter of facts.[48] The legal paradigm of authorship is expressed in the relationship between the creator of a work and the external result of their creative activity, and its referents are "author" and "work." Although the terms "author" and "creator" are deeply rooted in intellectual property law,[49] at no jurisdiction level (international, regional or national) a legal definition of either term has been provided.[50] Analogously, also copyright case-law does not formulate a simple and unambiguous authorship benchmark.[51] Pursuant to Article 8 of the Polish Copyright law Act,[52] it can be concluded that copyright is vested in the author. Polish copyright law literature uses the terms "author" and "creator" interchangeably, treating them as syno-

[48] For more, see: M. Jankowska, *Autor i prawo do autorstwa* [Author and the Right to Authorship], (Warszawa: Wydawnictwo Wolters Kluwer Polska, 2011) and the literature cited therein.

[49] They were used during the communist period in Poland in the Act of 10.07.1952 on copyright (Journal of Laws No 34, item 234, as amended) and before World War II in the Act of 29.03.1926 on copyright (Journal of Laws 1935, No 36, item 260).

[50] E.g.: Berne Convention for the Protection of Literary and Artistic Works (1979), https://wipolex.wipo.int/en/text/283698 (30 March 2023); Code de la propriété intellectuel, loi n° 92–597 of the Republic of France (1992), https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000000357475/ (30 March 2023); Act on Copyright and Related Rights of the Republic of Germany (1965), https://www.gesetze-im-internet.de/englisch_urhg/englisch_urhg.html (30 March 2022); Copyright, Designs and Patents Act of the United Kingdom of Great Britain and Northern Ireland (1988), https://www.legislation.gov.uk/ukpga/1988/48/contents (30 March 2023); Copyright Law of the United States and Related Laws Contained in Title 17 of the United States Code (1976), https://www.copyright.gov/title17/ (30 March 2023).

[51] C. Buccafusco, "A Theory of Copyright Authorship," *Virginia Law Review* 102 (2016): 1229, 1233–1234; J. C. Ginsburg, "The Concept of Authorship in Comparative Copyright Law," *DePaul Law Review* 52, no. 4 (2003): 1063–1092, http://dx.doi.org/10.2139/ssrn.368481.

[52] The Polish Act of 4 February 1994 on Copyright and Related Rights, i.e. Journal of Laws 2022, item 2509.

nyms.[53] The Polish Copyright Law Act, on the other hand, uses only the term "creator" in different meanings, namely to denote: (1) the actual author, (2) another original subject of the author's economic rights, (3) the legal successor or heir exercising the author's rights. Strictly speaking, "creator" should be identified with the term "author of the work," that is, the authentic creator of the "work." Similarly, the Polish Act of 30 June 2000—Industrial Property Law[54] also uses the term "creator" without providing its legal definition. For the purposes of this Act, a creator is a person who creates various categories of intangible goods named in the Act. Thus, an author is the author of: a rationalisation project (Art. 7), an invention, a utility model, an industrial design or a topography of an integrated circuit (Art. 8), or an "invention project" (Art. 284 item 1). The legislator grants legal protection to creators of these goods, including guarantees for personal interests and property rights of an invention's creator. The inventor has the right to claim authorship of the invention project and to demand to be identified as the author (creator) in descriptions, registers, documents and publications concerning the invention. Consequently, in the literature, the inventor is referred to as the author of an intellectual work whose nature goes beyond routine or organisational activities. In summary, in intellectual property law the term "creator" is understood as: the author of a work holding the copyright to the work, the author of an invention (know how) or other intangible good within the meaning of Polish industrial property law.[55]

Due to the lack of a statutory definition of the terms "author" or "creator," these terms cannot be found in legal dictionaries or lexicons. However, in scientific works on intellectual property law, an attempt has been made to create a general definition of the term creator (author). This term is supposed to cover an individual introducing a change in the world by their own ef-

[53] K. Święcka and J. S. Święcki, *Prawo autorskie i prawa pokrewne: komentarz: wybór międzynarodowych aktów prawnych* [Copyright and Related Rights: Commentary: A Selection of International Instruments] (Warszawa: Kodeks, 2004), 32–33; M. Poźniak-Niedzielska, J. Szczotka, and M. Mozgawa, *Prawo autorskie i prawa pokrewne. Zarys wykładu* [Copyright and Related Rights. Lecture outline] (Bydgoszcz–Warszawa–Lublin: Oficyna Wydawnicza BRANTA, 2007), 32–33.

[54] Consolidated text Journal of laws 2021, item 324 as amended.

[55] For more, see: Jankowska, *Autor i prawo*, 84–114, and the literature cited therein.

forts, the nature of which exceeds ordinary, routine acts. Indeed, the nature of these acts is supposed to be strictly creative, intellectual, and they result in a new, specific intangible good (intellectual good). Such a broad definition allows to include under the concept of a creator various manifestations of intellectual creativity of an individual, which are defined as particular categories of intangible goods in copyright law (creator of a work) or in industrial property law (creator of an invention, utility model, industrial design, rationalization project or topography of an integrated circuit).[56]

Polish copyright law does not define the term "work," which in research activities is one of the basic forms of publishing research results. The Polish legislator provided in Article 1(1) that a "work" constituting the subject matter of copyright is every manifestation of creative activity of individual nature, fixed in any form, regardless of value, purpose and manner of expression.[57] By way of exemplification, the legislator adds in paragraph 2 that a work may be expressed in the form of: words, mathematical symbols, graphic signs (literary, journalistic, scientific, cartographic work, computer programmes), in the form of visual arts, photography, lutherie, industrial design, architecture, architecture and urban planning, music and words and music, stage, stage-music, choreography and pantomime, audio-visual (including film). Furthermore, as far as negative definition is concerned, the legislator explains what form a "work" cannot take, that is, what it is not. Article 1(2)1 sentence 2 excludes copyright protection of: discoveries, ideas,[58] procedures, methods, principles of operation and mathematical concepts. However, sentence 1 of this Article stipulates that only the method of expression[59] can be subject to copyright protection. Similarly,

[56] Jankowska, *Autor i prawo*, esp. 100–102 and the literature cited therein.

[57] Thus, taking into account the practice of other European legislators. See D. Sokołowska, "'Omnis definitio periculosa', czyli kilka uwag o zmianie paradygmatu utworu" ["Omnis definitio periculosa," or a Few Remarks on the Paradigm Shift of a Work], in *Granice prawa autorskiego* [Limits of Copyright], ed. J. Kępiński, K. Klafkowska-Wiśniowska, and R. Sikorski (Warszawa: Wydawnictwo C. H. Beck, 2010), 16 et seq.

[58] See K. Jasińska, "Ochrona idei—zagadnienia wybrane" [Protection of Ideas—Selected Issues], *Prace Instytutu Prawa Własności Intelektualnej UJ* 93 (2006), 9–23.

[59] Consequently, as such, a scientific idea (thesis, method), even when it constitutes the content of a scientific work, is not protected by copyright. Only the form of its expression, externalising it to the recipient as a work, is the sub-

the Polish Industrial Property Law Act (Article 28, paragraph 1) provides that inventions are not considered to be, in particular: (1) discoveries, scientific theories and mathematical methods; (2) creations of merely aesthetic nature; (3) schemes, rules and methods for carrying out mental processes, playing games or conducting business; (5) computer programs; (6) representation of information.

In the context of Polish copyright law or Polish invention law, we cannot use the terms: "author of an idea," "author of a discovery," "author of a scientific idea," "author of a scientific procedure," "author of a mathematical concept (method)" or "author of a scientific theory." It is only when an idea, discovery or scientific theory is expressed, for example, by words or a drawing in a scientific publication or in a patent application for an invention, that their author obtains legal protection indirectly, that is, with regard to the resulting patent application or work describing the effect of the individual's creative activities of individual character, which are fixed in the form of a scientific publication. This means that in order for the result of the research activity of a scientist to be covered by legal protection, it must have the capacity to be expressed as a patent application (invention description) or a work within the meaning of copyright law. Intangible goods expressed in this way may constitute either an independent work or a creative contribution to a multi-author invention and patent application or a contributory work within a multi-author work.

Interpretation of Article 1 of the Polish copyright law leads to the conclusion that in order to establish the existence of a work and copyright, the cumulative occurrence of three prerequisites in the characteristics of an intangible good, the creation of which is the effect of a conscious human action, is required. Firstly, the acts leading to its "coming into being" must be creative in nature. Secondly, it must exhibit the characteristic of individuality. Thirdly, it is necessary to fix the work in any form. In reference to the statutory definition of a work, the Polish Supreme Court characterised it as "a creative, subjectively new, original product of the intellect, brought about by the unique personality of the

ject of protection. See A. Górnicz-Mulcahy, "Utwór naukowy jako przedmiot ochrony autorskoprawnej" [Scientific Work as an Object of Copyright Protection], in *Aktualne zagadnienia prawa prywatnego* [Current Issues of Private Law], ed. E. Marszałkowska-Krześ (Wrocław: Prawnicza i Ekonomiczna Biblioteka Cyfrowa, 2012), 46.

creator, which—made by someone else—would look different."[60] In doing so, a work exhibits the characteristic of creativity[61] when it is new from the point of view of its creator.[62] This subjective characteristic of the work's novelty, as it is considered from the perspective of the creator alone, is referred to as the "originality of the work"[63] and may be subject to retrospective verification in court proceedings.[64] To establish the fulfilment of this characteristic in a human work, it must be demonstrated that an activity of a creative nature (the act of creation) led to its creation. The author of the work must therefore, during the act of creation, be convinced that the product of human intellect that is just being created is a projection of their personal imagination. At the same time, in the creative process defined in this way, it is possible for the author to use or be inspired by generally known or generally available elements, provided that their "selection, segregation, manner of presentation bears the hallmarks of originality."[65] The basic prerequisite distinguishing a creative act from an imitative act is the impossibility of predicting its final result. The result of human action during the creation of a work should be uncertain, impossible to determine in advance.[66] The prerequisite discussed above should only be of subsidiary use in distinguishing an original work from a non-original work. In practice, it is only in order to distinguish creative activity from activities undertaken

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[60] Judgment of the Supreme Court of 05.07.2002, III CKN 1096/00, Lex no. 81369.

[61] For more on this subject, see: D. Flisak, ed. "Komentarz do art. 1" [Commentary on Article 1], in *Prawo autorskie i prawa pokrewne. Komentarz LEX* [Copyright and Related Rights. LEX Commentary], ed. M. Bukowski, D. Flisak, Z. Okoń, P. Podrecki, J. Raglewski, S. Stanisławska-Kloc, and T. Targosz, (Warszawa: Wolters Kluwer Business, 2015), 20–72.

[62] Judgment of the Supreme Court of 22.06.2010, IV CSK 359/09, OSP 2011, 5, item 59.

[63] J. Barta and R. Markiewicz, "Komentarz do art. 1 ustawy o prawie autorskim i prawach pokrewnych" [Commentary on Article 1 of the Copyright and Related Rights Act], in *Prawo autorskie i prawa pokrewne. Komentarz* [Copyright and Related Rights. Commentary], ed. M. Czajkowska-Dąbrowska, Z. Ćwiąkalski, K. Felchner, E. Traple, J. Barta, and R. Markiewicz (Warszawa: Wolters Kluwer Polska, 2011), 22.

[64] Judgment of the Court of Appeal in Poznań of 7.11.2007, I ACa 800/07, Lex no. 370747.

[65] Judgment of the Supreme Court of 25.01.2006, I CK 281/05, OSNC 2006, no. 11, item 286.

[66] Judgment of the Supreme Administrative Court of 12.03.2010, II FSK 1791/08, Lex no. 595971.

routinely, in a repetitive, schematic manner, obvious to other potential performers, that this prerequisite, that is, the feature of complete predictability of the effects of human activity, may be referred to. It should be stipulated that performance of professional activities characterised by repetitiveness and predictability of the applied procedures of conduct does not, as such, exclude the possibility of the creation of a work within the meaning of copyright law. What is important is whether or not this repetitiveness and predictability of activities leads to reproductive imitation.[67]

It has been emphasised in judicial decisions that the mere creation of one's own original work does not yet mean creation of a work within the meaning of copyright law if it does not have an "individual character."[68] Indeed, in order to establish the existence of such a characteristic, it is necessary to examine not so much the process of creation of the work as the work itself. It is the work itself (the result of a human activity) that should show individual nature.[69] It is very difficult to define an appropriate, universal measure of the degree of individuality in a product of human intellectual activity the application of which could allow to determine the existence of a work. Moreover, due to the variety of forms a work may take, it is not possible to establish a single, universal benchmark for testing this necessary characteristic of a work.[70] Some guidelines have been formulated in relation to this issue in literature.[71] It is recommended to refer to the objectively experimental characteristics of a work in order to determine whether or not it differs from other works of the same genre. Consequently, works that follow a certain pattern, are routine or trivial in nature,[72] the result of which, in light of the task performed, is actually obvious, somehow automatic, will be devoid of individual character. When demonstrating the individual character of a work, the nature of the work must be

[67] Judgment of the Supreme Court of 30.06.2005, IV CK 763/04, OSNC 2006, no. 5, item 92.

[68] Judgment of the Court of Appeal in Warsaw of 18.02.2009, I ACa 809/08, Lex no. 1120180.

[69] Judgment of the Court of Appeal in Kraków of 29.10.1997, I ACa 477/97, Lex no. 533708.

[70] Barta and Markiewicz, "Komentarz do art. 1 ustawy o prawie autorskim," 23 et seq.

[71] Flisak, *Komentarz do art. 1.*

[72] Judgment of the Supreme Court of 15.11.2002, II CKN 1289/00, OSNC 2004, no. 3, item 44.

taken into account. Thus, certain factors will prove decisive in the case of a literary work, others in the case of works of a referential nature (choice of vocabulary and syntax, arrangement of individual issues presented within the framework of the study, manner in which subtitles are formulated), and still others in the case of compilations using publicly available data (in this case, the author's own choice of individual elements, their segregation or manner of presentation may be decisive). Determination of free creative space and its effective use by the author in the creative process will serve as supporting criteria for this assessment. In this matter, the existing case-law emphasises that "the opposite of a technical activity is such an activity aimed at achieving a specific result at least some elements of which cannot be foreseen in their entirety as they are left to the personal grasp (interpretation, vision) of the one who works out this result,"[73] and that "the decisive factor for the possibility of individual shaping of an intellectual creation is whether the author's work (irrespective of its amount and type) directed towards the formation of such creation involves a possibility of choosing elements of its content and/or form."[74] The criteria of a work within the meaning of copyright law do not cover a work the creation of which requires the application of special technical knowledge when the final result of the applied procedures is predetermined by "objective conditions and technical requirements and the nature of the handled (solved) technical problem (task)."[75]

It follows from the above that in order to develop rules for the test whether a human work fulfils the statutory characteristics of a work, it is not possible to develop criteria completely devoid of a subjective element of such evaluation. The subjectivity of assessment is inevitable, as it results from the indefinite nature of the phenomenon of creating a work itself. Nevertheless, regardless of the method chosen to verify the characteristic of individual nature of a work, in objective terms, this characteristic must be attributed to a human work at the latest at the time of deciding whether the properties distinguishing the work from other creations of the same genre—in the context of the differences

[73] Judgment of the Court of Appeal in Warsaw of 5.07.1995, I ACr 453/95, Lex no. 62609.

[74] Judgment of the Court of Appeal in Krakow of 18.06.2003, I ACa 510/03, *Transformacje Prawa Prywatnego* 1–2 (2004): 143.

[75] Judgment of the Court of Appeal in Poznań of 9.11.2006, I ACa 490/06, Lex no. 298567.

found—justify its qualification as a work,[76] that is, any manifestation of creative activity of a human being of an individual nature, fixed in any form.

Another important term in Polish copyright law is the phrase "fixation of a work."[77] This term is understood to mean the attainment by a work of "any form, however impermanent, yet stable enough for the features and content of the work to produce an artistic effect."[78] In order for copyright protection to be granted, it is therefore necessary for the work to be externalised in such a way that it can be individualised, that is, distinguished from other products of human creativity by persons other than the creator themselves. If such individualisation were to take the form of a mere description of a future, hypothetically possible work, it is not possible to establish the existence of a work within the meaning of copyright law.[79]

Under Article 2 of the Berne Convention, literary, scientific, and artistic works are "under protection," regardless of the style or form of their expression. Legislators in the countries that have ratified that Convention, for example, the UK or the USA, can stipulate that works shall not be protected in general or under specified categories unless fixed in some material form.[80] In this light, for example, §102 (Subject matter of copyright: in general) of the US Copyright Law Act provides that: "(a) Copyright protection subsists, in accordance with this title, in original works of authorship fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device […]. (b) In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work." Similarly,

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[76] For more on this subject, see: Flisak, "Komentarz do art. 1"; cf. Barta and Markiewicz, "Komentarz do art. 1 ustawy o prawie autorskim," 27.

[77] For more on this subject, see: Flisak, "Komentarz do art. 1."

[78] Judgment of the Supreme Court of 25.04.1973, I CR 91/73, OSNCP 1974, no. 3, item 50.

[79] Judgment of the Court of Appeal in Poznań of 17.12.2009, I ACa 893/09, Lex no. 628228.

[80] Ricketson and Ginsburg, *International Copyright and Neighbouring Rights: The Berne Convention and Beyond*, 2nd ed. (New York: Oxford University Press Inc., 2006), 358–359.

under the UK Copyright Law Act: Copyright is a property right which subsists, in accordance with this Part, in the following descriptions of work (a) original literary, dramatic, musical or artistic works, […] (Section 1.1. (1)), "Copyright does not subsist in a literary, dramatic or musical work unless and until it is recorded, in writing or otherwise; and references in this Part to the time at which such a work is made are to the time at which it is so recorded." (Section 3.2. (1)), "In this Part 'author,' in relation to a work, means the person who creates it." (Section 9.1. (1)). Legislators consider authorship as a matter of fact. In this regard, authorship refers to the relationship between the author (creator) and the result of their creative activity.[81]

In Polish court rulings, in order for the subsistence of a work to be established, it is required that the work be expressed in any form, however impermanent (e.g., oral), but sufficiently defined and stable to be perceptible by persons other than the creator themselves. The basic condition is therefore that the work must be capable of being perceived by persons other than the creator themselves, that is, externalised to the world. It is necessary for the creation of the work to be communicated to the outside world in such a way that its existence, from the legal perspective, can be objectively ascertained. The minimum prerequisite in this case is at least the possibility of reconstructing the features of the work in the course of evidentiary proceedings by reference to documentary evidence, witness testimony or with the help of other means of evidence.[82] As a result, in Polish literature and jurisprudence it is accepted that works are, for example, unrecorded theatrical productions or recitations, because, as the Supreme Court noted, an unrecorded work, that is, "a work in immaterial form, can be embodied merely by appropriate behaviour of the performer."[83] The objective, hypothetical possibility of the work being perceived by third parties other than the creator themselves through human senses, albeit with technical means,

[81] J. C. Ginsburg, "The Right to Claim Authorship in U.S. Copyright and Trademark Law," *University Houston Law Review* 41 (2004): 263–307; D. Simone, *Copyright and Collective Authorship. Locating the Authors of Collaborative Work* (Cambridge: University Printing House, 2019), 131–158.

[82] Judgment of the Court of Appeal in Poznań of 28.08.2009, I ACa 309/09, Legalis no. 260736.

[83] See: Judgment of the Supreme Court of 27.08.2013, II UK 26/13, Lex no. 1379926.

is sufficient to establish fixation of the work.[84] Whether there has been an actual communication of the work to third parties in the form of a private or public presentation is not legally relevant. Therefore, poems written and kept "in the sock drawer," paintings painted for one's own pleasure or the performance of one's own musical works in the privacy of one's home[85] can be subject to copyright. A qualified form of fixing a work should therefore be considered its recording on a tangible medium (so-called *corpus mechanicum*), of course, as long as this is objectively possible. In this way, the work only acquires the characteristic of permanence, making its reproduction (reproduction) possible. It should be noted, however, that in certain situations, although recording of a work in a permanent form is optional for the establishment of copyright therein, it becomes necessary when the very creation of a work depends on its material fixation, as in the case of photographic or audio-visual works. It should be emphasised here that, from a legal point of view, creation of a work, as a factual act, is fully informal. The establishment of the creation of a work and copyright in this work does not depend on the fulfilment of any formalities (e.g., registration of the work, obtaining a right of protection within the meaning of industrial property law).[86] In particular, the fact that a work is provided with any kind of annotation, symbol, mark (e.g., a copyright notice ©) or any kind of copyright disclaimer[87] is not decisive for the grant of copyright protection.

1.4. Scientific Authorship and Copyright Protection under Civil Law and Copyright Law

The need to address the issue of authorship of science and protection of copyrights (above all moral rights) held by creators of science materialises due to the revolutionary changes that

[84] Cf. Flisak, "Komentarz do art. 1."

[85] R. M. Sarbiński, "Komentarz do art. 1 [Commentary on Article 1], in *Prawo autorskie i prawa pokrewne. Komentarz* [Copyright and Related Rights. Commentary], ed. W. Machała and R. M. Sarbiński (Warszawa: Wolters Kluwer Polska, 2019).

[86] For more on this topic, see Flisak, "Komentarz do art. 1."

[87] Cf. Judgment of the Court of Appeal in Łódź of 5.05.2010, I ACa 224/10, unpublished; Judgment of the Supreme Court of 5.03.1971, II CR 686/70, OSNCP 1971, no. 12, item 213.

have taken place in the conduct of scientific research in the 21st century, especially in the area of hard sciences, natural sciences and technology. The problems posed for science are increasingly complex. In addition, technological progress, the phenomenon of data-driven science, as well as financial conditions and the scientific policies pursued by countries in the light of the standards set by the USA or the pressure exerted by China, which is developing rapidly both in terms of economy and science, significantly influence the directions and methodology of research. As a consequence of these changes, as early as the 1980s, research questions and approaches became more complex, the need to engage in even transdisciplinary research projects increased, carried out by interdisciplinary teams of researchers and technical support staff. The results of such research are published in multi-author papers or invention projects.[88] A researcher's participation in such a project and the fruits of their research activity can take many forms. It may consist only in the production of a research idea or thesis, in the making of a scientific discovery, as well as in the determination of scientific truth, in the acquisition of experimental data, in the process of measurement with research apparatus, or in the design of the research principles, methods and techniques used in the research process. Such research activities and their fruits might not be suitable to be expressed in a form appropriate to the categories of intangible property named in the law. As such, the results of human research activities are not subject to legal protection under copyright or invention law, or even civil law. It should be recalled that under Article 1 of Polish copyright law, protection can only be obtained by the author of an individualised scientific work, which has been created in a strictly creative act and fixed as an independent work or as a contribution to a multi-author publication. The general rules of copyright law require that contribution to research must take the form of an individualised intangible good, which has been fixed in any form, however impermanent, yet stable enough to be perceived by persons other than the creator themselves.[89] Protection under this right covers only the manner of expression; the Polish Act expressly excludes from its protection discoveries,

[88] M. T. Greene, The Demise of the Lone Author," *Nature* 450, no. 7173 (2007): 1165; G. L. Kiser, "No More First Authors, No More Last Authors," *Nature* 561 (2018): 435.

[89] Flisak, "Komentarz do art. 1"; Judgment of the Supreme Court of 25.04.1973, I CR 91/73, OSNCP 1974, no. 3, item 50.

ideas, procedures, methods and principles of operation as well as mathematical concepts.[90] An independent, substantial, original and creative contribution to scientific research therefore does not always meet the prerequisites for copyright protection.

The problem of the lack of adequate guarantees for the rights of authors and the legitimacy of their claims for legal protection has been recognised in the literature of intellectual property law.[91] Looking for a solution to this problem, Polish literature emphasises that, depending on the form of expression of the research result, a scientist may obtain protection under copyright law or under the provisions of Articles 23 and 24 of the Polish Civil Code, which situate any scientific, inventive and rationalisation work of a human being among ordinary personal interests.[92] Ideas and solutions, although not protected under copyright law, may therefore be protected under the general rules of civil law.[93] The existing case law demonstrates, however, that both legal bases, copyright and civil law, will not always afford protection to the creator of science. In judicial practice, it was explained[94] that

[90] Article 1(2).1.

[91] A. Kopff, "Dzieło sztuk plastycznych i jego twórca w świetle przepisów prawa autorskiego" [The Work of Visual Arts and Its Creator in the Light of Copyright Law], *Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Rozprawy i Studia* T. 36 (Kraków: Uniwersytet Jagielloński, 1961), 65–66.

[92] R. Markiewicz, "Ochrona prac naukowych" [Protection of Scientific Works], *Zeszyty Naukowe Uniwersytetu Jagiellońskiego* [Prace z Wynalazczości i Ochrony Własności Intelektualnej], vol. CMLV, no. 55 (1990): 95–105.

[93] Judgment of the Supreme Court of 8.02.1978, II CR 515/77, OSPiKA 1979, no. 3, item 52.

[94] These findings were made on the basis of the following facts: The plaintiff was employed at the Scientific and Research Centre for Fire Protection in J. as a scientific and research worker. At the request of the Public Prosecutor's Office, the Centre's employees carried out a number of experiments to reconstruct the spread of fire at the FSO plant. During the experiments, the plaintiff measured temperature changes, which he then presented in the form of tables and graphs. The research carried out by various Departments of the Centre was to be used to prepare the final conclusions of the experiment in question. This expertise was available to the research staff, as it constituted the statutory output of the Scientific and Research Centre for Fire Protection. In the statement of claim filed in the discussed case, the plaintiff sought protection of his personal interests by requesting the defendant Jerzy W. to include the following statement in the *Scientific Notebooks of the Main School of Fire Service* in W.: "I declare that the study of temperature changes during the experiment reproducing the course of the fire in the FSO plant in 1987, and presented in Fig. 12, p. 124 in *Zeszyty Naukowe Szkoły Głównej Służby Pożarniczej*, Zeszyt 1 (Warszawa 10.12.1987), and presented in Fig. 5.6 on p. 304 of the book study titled *The study*

> personal interests, which Article 23 of the Civil Code defines as "scientific, artistic, inventive and rationalization creativity" remain under the protection of civil law independently of the protection provided by other provisions, in particular, the provisions of copyright law or invention law. It is clear that Article 23 of the Civil Code does not use the term "creativity" in the colloquial sense, according to which creativity is the effect of a specific intellectual activity of a human being, as well as the overall output and the creative process. […] Even the creative contribution of a member of the Team or of a person participating in the conduct of an experiment as a result of which the person presented in a table and on a graph the result of the measurements carried out by him does not enjoy the protection provided for by the Copyright Law since this contribution in the final version of the elaboration of the experiment loses the features of an individual and self-contained work within the meaning of Art. 1 of the Copyright Law Act, both that of 10 July 1952 and that of 4 February 1994. Nor can it be concluded that the mere technical presentation of the results of the measurements made without mentioning the research methods used by the plaintiff constitutes a "scientific creation" subject to the protection provided for under Article 23 of the Civil Code. Nor was the action of the defendant providing the results of the temperature measurements alone an unlawful act, since, by its very nature, the results of the work of all the Centre's employees involved in the experiment made up the final result and led to the preparation of the expert report, which was prepared only by the members of the appointed Team, and the plaintiff was not such member.[95]

The legal protection afforded to authors by the general rules of civil law or by copyright law or invention law has therefore significant shortcomings. A number of actions infringing personal interests of scientists may not only avoid adequate sanctions but even may be regarded as legally permissible. It becomes necessary to undertake studies intended to identify the legal

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of temperature changes during the experiment reproducing the course of the fire in FSO in 1987. Matematyczno-komputerowy model kryminalistycznego badania przyczyn i okoliczności pożarów—rozprawa habilitacyjna [Mathematical-Computer Model of Forensic Investigation of Causes and Circumstances of Fires—habilitation thesis] published by the Ministry of Internal Affairs, Department of Training and Professional Development (Warsaw 1989)—was performed and developed by Dr J. B. K. at the Scientific and Research Centre for Fire Protection in J. See Judgment of the Court of Appeal in Warsaw of 29.03.1994, I ACr 104/96, LEX no. 62572.

[95] Judgment of the Court of Appeal in Warsaw of 29.03.1994, I ACr 104/96, LEX No. 62572.

basis for the guarantee of the rights held by the authors of science, which will provide them with legal protection equivalent to that offered by copyright law and the general rules of civil law as regards the results of their scientific work, regardless of the form expressing such results. Accordingly, the subject of further consideration must be terminological issues and the relation of intellectual property law to the national and universal system of human rights.

1.5. The Need to Constitutionalize the Subjective Rights of Scientific Creators

Against the background of the previous findings, it is necessary to consider the interplay between human rights and the right to the protection of personal interests and property rights of science creators to the fruits of their research activities[96] as a standard in democratic states and societies.[97]

All legal constructions of human and personal interests and goods find their source in the constitutional inherent and inalienable dignity of man.[98] This category, which is only stated in the Polish Constitution (art. 30) and derives from natural law, integrates "all intangible values connected with the personality and uniqueness of every individual."[99] In turn, the concretisation of the set of values referred to as personal interests of and, accordingly, personal interests in intangible property belongs to

[96] Term proposed by C. Ingleby, "Creators of Science," *Nature* 5 (1871): 62.

[97] I have addressed this issue in: A. Chorążewska, "Konstytucyjne prawa osobiste i majątkowe twórców nauki de lege lata i de lege ferenda. Zagadnienia konstrukcyjne w kontekście uniwersalnego systemu ochrony praw człowieka" [Constitutional Moral and Economic Rights of Science Creators de lege lata and de lege ferenda. Structural Issues in the Context of a Universal System of Human Rights Protection], *Przegląd Prawa Konstytucyjnego* 3, no. 67 (2022): 39–51.

[98] Cf. K. Czub, *Prawa osobiste twórców dóbr niematerialnych. Zagadnienia konstrukcyjne* [Moral Rights of Creators of Intangible Property. Structural Issues] (Warszawa: Wolters Kluwer Polska, 2011): 26–29, 32–47 and the literature cited therein.

[99] M. Safjan, "Refleksje wokół konstytucyjnych uwarunkowań rozwoju ochrony dóbr osobistych" [Reflections on the Constitutional Conditions for the Development of the Protection of Personal Interests], *Kwartalnik Prawa Prywatnego* 1 (2002): 226–227.

the domain of civil law. The concept of personal interest itself, however, has not been defined in law. The legislator decided to sanction in Article 23 of the Polish Civil Code only the very notion together with an indication of exemplary interests, supplementing that regulation by constitutional provisions, for example, in Articles 38, 41(1), sentence 1, 47, 49 or 73. The task of constructing a definition of this concept was, therefore, entrusted to the science of law and judicature. In this context, the literature explains that "personal interests" are non-material values closely related to the personality of a human being, which are expressed in the physical and mental integrity of a human being and in all manifestations of human creative activity. Accordingly, on the basis of objectified or relativised standards of a juridical, ethical or moral nature, they have then become generally recognised in a given society. In consequence of the above, an individual was granted subjective rights the scope of which includes a catalogue of remedies protecting the individual against another person's actions threatening or infringing the individual's personal interests (e.g., Article 24 of the Civil Code). It is emphasised at the same time that objective criteria are decisive in distinguishing individual categories of interests, as well as in assessing whether a particular interest and the subjective right protecting it have been infringed in a particular case.

The copyright system is considered to be the prototype of all juridical constructions protecting moral rights. It constitutes a kind of keystone and model regime for legal institutions serving as a guarantees for moral (non-economic) and economic interests of creators of intangible goods, including creators of science.[100] Coming back to the observations made in the context of work and copyright, an "intellectual (intangible) good/interest" can be characterised as a creative, subjectively new, original (and therefore non-trivial and non-routine) product of the human intellect, which shows characteristics deriving from the unique personality of its creator and which would undoubtedly take a different form if created by anyone else.[101] This good may or may not have the capacity to be fixed as a work under copyright law or to be an object of protection under invention or ration-

[100] See Czub, *Prawa osobiste twórców*, 52.

[101] Judgment of the Supreme Court of 05.07.2002, III CKN 1096/00, Lex no. 81369; Barta and Markiewicz, "Komentarz do art. 1 ustawy o prawie autorskim i prawach," 22 et seq.

alisation law. Non-fulfilment of these prerequisites, however, cannot deprive such product of human intellect of constitutive features characteristic of an intellectual good and, accordingly, exclude the correlated subjective right for the protection of the interests of its author. In accordance with the theory of rights in intangible property formulated at the end of the 19th century by J. Kohler and widely recognised today,[102] a subjective right arises from the fact of subsistence of a specific intellectual good characterised by autonomous status detached from the human originator,[103] the content of which consists of the author's rights of a twofold nature: economic and non-economic. The rights in intangible property *sensu stricto* are of economic nature, absolute and expressed in the exclusive right to dispose of and use the object of the right. In addition to these rights and independently of them, the general rules of civil law, as well as special acts, such as the Copyright Law Act, establish non-economic rights protecting personal goods/interests directly correlated to and following from the emergence of an intellectual value represented by the good.[104] The object of protection under these rights, in reference to the regimes under Article 23 of the Civil Code and Article 16 of the Copyright Law, can be defined as the emotional bond of the author with the intellectual value created by the author, which is unlimited in time and cannot be waived or sold. This bond is an emanation of the creator's personality, dignity and individual attitude to the result of the creative activity, and its original source should be traced to the inherent and inalienable dignity of a human being. The content of the rights in question covers the author's right to the attribution of authorship of the intellectual good created by the author and a binding requirement to exploit the good fairly, that is within the limits set by the

[102] Cf. J. Sieńczyło-Chlabicz and J. Banasiuk, "Czas ochrony autorskich praw majątkowych do utworu jako przedmiotu prawa autorskiego" [Term of Protection of Author's Economic Rights to a Work as an Object of Copyright], *Białostockie Studia Prawnicze* 7 (2010): 103–105.

[103] Cf. J. Preussner-Zamorska, *Prawo do autorstwa wynalazku* [The Right to Authorship of an Invention], (Kraków: Wydawnictwo Naukowe PWN, 1974), 22.

[104] Cf. A. Kopff, "Prawo cywilne a prawo dóbr niematerialnych" [Civil Law and the Law of Intangible Property], *Zeszyty Naukowe Uniwersytetu Jagiellońskiego. PWiOWI* 5 (1975): 15–16; M. Pyziak-Szafnicka, Prawo podmiotowe [Subjective Right], in *Prawo cywilne—część ogólna* [Civil Law—General Part], T. 1, ed. M. Safjan (Warszawa: Wydawnictwo C. H. Beck, 2007), 719–720.

law (e.g., principles of quotation) or at the author's consent, and respecting the good's form and content.[105]

Intellectual goods/interests, thus understood, belong to the catalogue of human rights, qualified as a set of subjective rights vested in every human being—irrespective of race, colour, sex or other prohibited discriminating features—vis-à-vis other people and public authorities. Such catalogue of rights is characterised by universal, inalienable and indivisible nature and by its natural law origin. Indeed, the nucleus of the concept of human rights is the construction of inherent and inalienable human dignity understood, at the same time, both as a value and a legal norm. According to the former approach, human dignity constitutes a central constitutional value of supraconstitutional (natural law) status, enshrined in the Basic Law as the fundamental norm (*Grundnorm*) for the entire constitutional order, in logical, ontological and hermeneutical terms, while according to the second approach, it constitutes both the source of all individual freedoms and rights provided by law and a subjective right of man to respect for their dignity and thus their subjectivity (autonomy) and freedom in both positive and negative aspects.[106]

The term "intellectual property" is defined in Article 2(viii) of the Convention establishing the World Intellectual Property Organisation[107] (hereinafter: WIPO) as "rights relating to: literary, artistic and scientific works; artistic performances, phonograms, radio and television broadcasts; inventions in all fields of human activity; scientific discoveries; industrial designs; trade and service marks, trade names and signs; protection against unfair competition, as well as all other rights emanating from intellectual activities in the industrial, scientific, literary and artistic fields." Textual and purposive interpretation of this norm leads to the conclusion that the catalogue of intangible assets contained therein is of an exemplary nature, and its rationale is

105 Cf. Czub, *Prawa osobiste twórców*, 52–53.

106 M. Granat, "Godność człowieka z art. 30 Konstytucji RP jako wartość i jako norma prawna" [Human Dignity under Article 30 of the Constitution of the Republic of Poland as a Value and as a Legal Norm], *Państwo i Prawo* 8 (2014): 3–22; F. J. Mazurek, *Godność osoby ludzkiej podstawą praw człowieka* [Dignity of the Human Person as the Basis of Human Rights] (Lublin: Redakcja Wydawnictw KUL, 2001).

107 Journal of Laws 1975, No. 9, item 49; signed at Stockholm on 14 July 1967 and as amended on 28 September 1979.

to provide grounds for deducing, in the interpretation process, the definition of rights in intangible (intellectual) assets. Against the background of the quoted norm, it may be assumed that such rights constitute a set of subjective rights arising from any human intellectual activity in the field of industry, science or art the object of which is to protect the interests of the author in the product of their intellect, regardless of the product's form. Consequently, as long as the product of human thought, arising from a strictly creative act, has an individualised and original character and exists on its own, independently of its author, showing the capacity to be perceived by persons other than the creator themselves, it is subject to legal protection. This qualification of a product of the human intellect is not determined by whether it was created as a result of planned and premeditated actions or completely by accident. From the perspective of the subjective rights of the creators of science, an intangible asset defined in this way implies their protection not only with regard to the created scientific works and works contributing to multi-author publications but also with regard to all scientific findings regardless of their form of expression, including ideas, theories, hypotheses, concepts and discoveries (truths, facts) of science, as well as methods and principles of operation which are denied legal protection under Article 1(2)1 of the Copyright Law Act and Article 23 of the Civil Code.

When constructing a mandatory principle of guaranteeing moral and economic rights of creators of intangible property, it is necessary to indicate its institutional basis. Such basis should be sought in the Constitution and in the pillars of the universal system of human rights protection. The common conceptual category, uniting the national and universal system of human rights protection in the sphere of intellectual property of an individual, are the terms "property" and "human dignity." When analysing their relevance to the construction of the principle of protecting all manifestations of human intellectual property, two circumstances should be considered as incontrovertible. Firstly, the economic rights of an individual in intangible goods, forming the content of intellectual property rights and the concept of intellectual property in the understanding of the broad definition of Article 2, item (viii) WIPO, fit into the category of "property" under Articles 64 and 21 of the Constitution of the Republic of Poland and under Art. 17 of the Universal Declaration of Human Rights of 1948. Secondly, the sources of protecting intellectual property, in the context of guarantees for the personal interests of creators in the products of their intellect, should be sought in the concept of "human dignity" under Article 30 of the Constitution of the Republic of Poland and under Article 1 of the Universal Declaration of Human Rights of 1948.

As regards the first issue, the view that in constitutional terms property is an economic category synonymous with the entirety of an individual's economic rights should be regarded as prevailing. The identification of the notion of "property" with the term "possessions" is supposed to follow, firstly, from the institutional and guarantee meaning of the constitutional provisions, and, secondly, from the normative approach of Article 1 of Protocol No. 1 to the Convention for the Protection of Human Rights and Fundamental Freedoms,[108] treating "property" and "possessions" as interchangeable notions. At the same time, under Article 64(1) and (2) of the Constitution, constitutional protection covers expressly not only property, which can be interpreted strictly and limited to the civil law understanding of the term, but also "other property rights." The latter concept undoubtedly has an autonomous nature and is expressed in the granting of subjective rights to the individual in the sphere of protection of all the individual's economic interests.[109] For these reasons, it is incumbent upon the ordinary legislator, on the one hand, to sanction the provisions and procedures granting them legal protection and, on the other hand, to refrain from enacting regulations that could deprive these interests of legal protection or limit such protection.[110] Therefore, it should be assumed that, from the constitutional point of view, "property" is an autonomous concept and its scope covers not only property in the civil law sense but also intellectual property and economic rights which are not qualified as property by the

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[108] Journal of Laws 1995, no. 36, item 175/1.

[109] Such a basis for the protection of intellectual property is indicated by T. Dybowski, "Ochrona prawa własności na tle konstytucyjnej koncepcji źródeł prawa w orzecznictwie Trybunału Konstytucyjnego" [Protection of Property Rights against the Background of the Constitutional Concept of Sources of Law in the Case Law of the Constitutional Court], in *Trybunał Konstytucyjny. Księga XV-lecia* [Constitutional Tribunal. The 15th Anniversary Book], ed. F. Rymarz and A. Jankiewicz (Warszawa: Wydawnictwo Trybunału Konstytucyjnego, 2001), 111–112.

[110] Cf. Judgment of the Polish Constitutional Tribunal of 13.04.1999, K 36/98, OTK 1999, No. 3, item 40.

civil law, for example, industrial property.[111] Consequently, the existence of constitutional guarantees of economic interests of the creators of intangible goods, as the content of the intellectual property right, cannot be disputed. It can only be debated whether the basis of such guarantees is provided directly by the term "property" or by "other property rights" under Article 64(1) and (2).

On the other hand, the sources of the protection of personal interests of the creators of intangible property should be sought in human dignity. Notably, understood as a value and a legal norm, dignity also gives rise to a subjective right[112] defining the position of an individual in the society, as well as the manner of conduct of state authorities in the event of violation of this right. From this perspective, man is seen as a free being, autonomous and capable of self-development. In civil law terms, however, human personal interests are treated as a category covering the sphere of physical and psychological integrity of an individual, expressed in their individuality, expressly, dignity and position in the society, but also in the capacity for self-fulfilment as a human person. Such characteristics of the human being are also supposed to be inseparably connected with the essence of humanity, and this is the case regardless of one's mental state and degree of sensitivity. Personal interests understood in this way belong to the category of non-economic interests.[113] This analysis leads to the conclusion that the basis for the sanctioning of individual types of personal interests in legislative acts of lower rank (their mere pronouncement due to the natural law character of dignity) and the source of rights protecting these goods is the Constitution itself. The catalogue of these goods, in fact, makes an emanation of the rights and values expressed therein and realises human dignity (Article 30), the protection of which as a subjective right has an absolute value.

The universal system of human rights protection provides a legal basis of analogous content for the recognition of the bind-

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[111] L. Garlicki, "Komentarz do art. 64 Konstytucji RP" [Commentary on Article 64 of the Constitution of the Republic of Poland], in *Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 roku. Komentarz* [Constitution of the Republic of Poland of 2 April 1997. Commentary], T. 3, Chapter 2, ed. L. Garlicki (Warszawa: Wydawnictwo Sejmowe, 2003), 8–9.

[112] Granat, *Godność człowieka*, 3–22.

[113] Z. Radwański and A. Olejniczak, *Prawo cywilne—część ogólna* [Civil Law—General Part] (Warszawa: Wydawnictwo C. H. Beck, 2015), 157, 158.

ing force of the principle of guaranteeing moral (personal) and economic rights of creators of intangible property. Such basis can be found in the Universal Declaration of Human Rights[114] of 1948. In many places, including Article 1, it enshrines the principle of protecting human dignity, understood also as a subjective right. Under Article 17 of the Declaration: "1. Everyone has the right to own property alone as well as in association with others." "2. No one shall be arbitrarily deprived of his property." Then, Article 27(2) expressly sanctions the principle of protecting moral and economic rights of creators of intangible property, providing that: "Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author." The national as well as the universal system of human rights protection in force in Poland provides grounds for interpreting from their provisions the principle of protecting moral and economic rights of creators of intellectual property. It is therefore incumbent on the legislator to ensure effective regulations and procedures guaranteeing the author's copyright in the results of their intellectual activity and this regardless of the form of their expression, and to refrain from adopting regulations that would render it impossible to grant such protection.

In the area of scientific creativity, regulations protecting the rights of authors of scientific works and invention projects or other intellectual goods are sanctioned in law under invention and rationalisation law and under Article 23 of the Civil Code. Scientific creativity understood as the totality of human research achievements is thus protected. Nevertheless, if the fruit of the work of a scientific creator does not take the form of one of the above-mentioned categories of goods, the right to legal protection of its author may be questioned. In this way, the constitutional requirement to provide legal protection to every creator of science on an equal basis is violated. Creators, within the meaning of copyright law, industrial property law and general rules of civil law, will receive—by virtue of specific statutory regula-

[114] Today, there is no doubt that the Declaration constitutes a legally binding act. This is because the norms contained therein are considered to be a component of customary international law and their binding force is not questioned. W. Brzozowski, "Uniwersalny system ochrony praw człowieka" [Universal System of Human Rights Protection], in *Prawa człowieka* [Human Rights], ed. W. Brzozowski, A. Krzywoń, and M. Wiącek (Warszawa: Wolters Kluwer Polska Sp. z o.o., 2019), 107.

tions—due guarantees of intellectual property rights, while the others may be deprived of them. It is therefore necessary for the legislator to take action to adopt equivalent legal regulations in this area to protect the rights of science creators. It should be added that the subsidiary protection created in this area in the Law on Higher Education and Science[115] (disciplinary liability for the infringement of another's copyright or related rights in a manner other than specified in points 1–3 of Article 287(2)) is ineffective and insufficient. At the same time, it seems that the change required in the current law will not take place without an appropriate impulse from the legislator. As a postulate *de lege fundamentali ferenda*, the need for constitutionalisation of the subjective rights of creators of science and their rights in intangible property in terms of protecting their interests arising from any research activity can be put forward. This could be done by supplementing the content of Article 73 of the Constitution of the Republic of Poland with a norm sanctioning such an individual right. The provision under analysis would then consist of two paragraphs. The already existing content, formulated as the first paragraph, enshrining the individual's creative freedom: "The freedom of artistic creation and scientific research as well as dissemination of the fruits thereof, the freedom to teach and to enjoy the products of culture, shall be ensured to everyone," and a second paragraph reading as follows: "Everyone shall have right to the protection of the moral and material interests resulting from any artistic, literary, scientific or educational activities of which he is the author. The intellectual property of the creators of intangible goods shall be subject to equal legal protection for all."

[115] Act of 20 July 2018—The Law on Higher Education and Science, consolidated text: Journal of laws 2023 item 742.

Chapter II

Creators of Science and Scientific Authorship

> […] the scientist is a completely altruistic being, devoting himself selflessly to the pursuit of truth, solely in order to contribute to the welfare of humanity. […] That they do, in fact, expend themselves in activities which are a very real contribution to humanity is the good luck of society. That what they do does make such a social contribution may, indeed, give great satisfaction to them and may even make the meagreness of their financial rewards more tolerable. (I do feel that this meagerness does not speak well for society which derives such great profit for so little expenditure of support or recognition.) There are those among them, however, who have never given spontaneous thought to such considerations.
>
> Anne Roe, *The Making of a Scientist* (New York: Dodd, Mead and Co., 1953), 232.

1.1. Intellectual Property Protection System for the Creators of Science[1]

The conclusion that an individual's subjective right expressing the freedom of science can be interpreted from the provisions of the Polish Constitution, Article 73 in conjunction with Article 64 and Article 21(1), as well as the regulations of the universal system of human rights, entails a number of consequences.

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[1] I have written about it: A. Chorążewska, "Część druga. Utwór naukowy a ochrona pracy naukowej" [Part Two. Scientific Work and the Protection of Scientific Work], in *Konstytucyjna wolność badań naukowych a ochrona pracy*

Firstly, such conclusion affects the content scope of this right, that is, the identification of the essence of the legal interest and the set of rights resulting from the freedom of science the researcher will be able to enforce vis-à-vis the public authorities and other subjects of law. The systemic interpretation of Articles 73 and 64 of the Constitution leads to the conclusion that the subjective right expressed therein consists of a number of rights (specific rights) whose common sense and object of protection is concretised in two different aspects. Namely, in the individual's freedom to undertake and conduct scientific research and in the individual's right—realised on an equal basis for all creators of science—to the protection of moral and material benefits arising from any of their scientific activities. This means that any research result (scientific data) that is concretised and perceivable by anyone else than the creator themselves should be assigned the status of an "intangible good" subject to protection as the object of the individual's intellectual property.

Secondly, the rights of the researcher thus defined must be correlated with the corresponding claims of the individual against public authorities and other subjects of law. It must therefore be possible to derive from the legal system the corresponding rights of the researcher to request other subjects to behave in a certain way in response to a threat or violation of the freedom of research or intellectual property rights to the fruits of creative work. In the following discussion, it will become necessary to reconstruct the claims of the researcher, including to indicate their legal bases making up the system of protection of intellectual property of authors of science.

Thirdly, this conclusion implies that the individual's freedom to exercise their scientific freedom may be limited. The legal basis for the establishment of such limitations is provided by Article 8(2) of the European Convention on Human Rights or Article 19(3) of the International Covenant on Civil and Political Rights, as well as in Article 31(3) of the Polish Constitution.

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naukowej. Studium przypadków z nauk ścisłych eksperymentalnych [Constitutional Freedom of Scientific Research and the Protection of Scientific Work. A Case Study in Experimental Hard Sciences], ed. A. Chorążewska and A. Biłgorajski (Katowice: Wydawnictwo Uniwersytetu Śląskiego, 2018), 81–143; A. Chorążewska, "Scientific Creation as a Constitutionally Protected Category and the Rules of Collective Attribution of Authorship to Scientific Works in Exact Sciences," *Przegląd Prawa Konstytucyjnego* 3, no. 55 (2020): 35–52.

These provisions allow public authorities to interfere in the sphere of freedom of science when this is necessary in a democratic state ruled by law for the protection of important values of public interest (under Article 31(3) these are: state security, public order, protection of the environment, public health, public morals or the freedoms and rights of other persons) and, at the same time, does not lead to a violation of the principle of proportionality as well as the essence (core) of the limited freedom.[2]

[2] Polish judicature emphasises that restrictions exceeding a certain degree of inconvenience, and in particular violating the proportion between the degree of infringement of an individual's rights and the rank of the public interest to be thus protected, cannot be introduced. When examining the adequacy of the aims and means of the restriction introduced, reference should be made to the proportionality benchmark developed in judicial practice, consisting of three tests: the suitability of the norm, the necessity (necessity) of the restriction for the protection of the public interest with which it is associated, and proportionality *sensu stricto*. It is therefore necessary to demonstrate the existence of a real need, desirability, necessity and effectiveness for the protection of the constitutional value of an interference with individual freedoms in a given factual situation. At the same time, the attainment of the objective—the protection of the constitutional value—should take place with the application of the least onerous measures possible for the individual. The Constitutional Tribunal has consistently indicated that if a given objective is achievable through application of another measure imposing lesser restrictions on rights and freedoms, the application of the more onerous measure by the lawmaker goes beyond what is necessary and thus violates the Basic Law. The prohibition of undue interference and the proportionality of the introduced restrictions thus have a protective function in relation to the freedom of science. See judgments of the Constitutional Tribunal of: 12.01.2000, P 11/98; 20.02.2002, K 39/00; 10.04.2002, K 26/00; 13.03.2007, K 8/07. Cf. K. Wojtyczek, "Granice eringencji ustawodawczej w sferę praw człowieka w Konstytucji RP" [Limits of Legislative Interference in the Sphere of Human Rights in the Polish Constitution] (Kraków: Kantor Wydawniczy "Zakamycze," 1999), 150 et seq. Cf. A. Łabno, "Istota zasady proporcjonalności" [The Essence of the Principle of Proportionality], in *Zasada proporcjonalności w prawie karnym* [The Principle of Proportionality in Criminal Law], ed. T. Dukiet-Nagórska (Warszawa: Oficyna Wydawnicza Wolters Kluwer business, 2010); A. Łabno, "Ograniczenia wolności i praw człowieka na podstawie art. 31 Konstytucji III RP" [Restrictions on Human Freedoms and Rights under Article 31 of the Constitution of the Third Republic of Poland], in *Prawa i wolności obywatelskie w Konstytucji RP* [Civil Rights and Freedoms in the Constitution of the Republic of Poland], ed. B. Banaszak and A. Preisner (Warszawa: Wydawnictwo C. H. Beck, 2002); A. Łabno, "Ograniczenia wolności i praw człowieka w polskiej konstytucji i w prawie europejskim" [Restrictions on Human Freedoms and Rights in the Polish Constitution and in European Law], *Zeszyty Naukowe Beskidzkiej Wyższej Szkoły Turystyki w Żywcu* T. 1, no. 3 (2004): 67–80.

The provision of Article 31(3) of the Polish Constitution restricts not only the legislator in regulating constitutional freedoms and rights, but also the individual in exercising them. The values expressed in this norm should be interpreted as delimiting the principles of exercising constitutional freedoms and rights of man and citizen. In exercising their subjective rights, an individual may not infringe the objects of public interest subject to state protection under Article 31(3). They may not harm state security, public order, the environment, health, public morals, but neither may the individual infringe on the freedoms and rights of others. It must therefore be accepted that the limit of an individual's freedom and rights is the freedom and rights of others. This aspect is concretised in the limitations imposed by the legal system on the individual in the exercise of their constitutional freedoms and rights. Such restrictions may or may not be legally regulated. Legally regulated restrictions are orders and prohibitions which, in accordance with Article 31(3), are explicitly expressed in the system of law in force. Legally unregulated restrictions are those actions of the individual which do not fall within the limits of their freedom. This is a situation where, under the guise of exercising a right, an individual in fact seeks to violate values that are subject to special protection in a democratic state ruled by law by virtue of Article 31(3). Such actions of an individual, as being carried out *in fraudem legis*, are not subject to legal protection under the principle of freedom because they cannot be regarded as manifestation of the exercise of individual freedoms within the limits set by the law.

1.2. Reconstructing the System of Intellectual Property Protection for the Creators Science[3]

The lack of precise protection of rights in intangible assets produced in the area of human research activities implies the necessity to reconstruct the legal basis of scientific authorship

[3] I have written about it: Chorążewska, "Część druga. Utwór naukowy a ochrona pracy naukowej" [Part Two. Scientific Creation and the Protection of Scientific Work]; A. Chorążewska, "Scientific Creation as a Constitutionally Protected Category and the Rules of Collective Attribution of Authorship to Scientific Works in Exact Sciences," *Przegląd Prawa Konstytucyjnego* 3, no. 55 (2020): 35–52.

and the right to be an author of multi-author scientific works. This issue gives rise to serious discrepancies in the literature due to the legal definition of a scientific work and the requirements for a work contributing to a multi-author work. A contributory work should meet the statutory definition of a work and thus be a result of human creative work of a cognitive nature. Its fixation should give rise to an objective representation of existing reality.[4]

A scientific work at the various stages of its creation—from making a research thesis, through the performance of various studies or findings, to the formulation of the text of a work within the meaning of the Copyright Law Act—may involve cooperation of many persons, including scientists representing various scientific disciplines, as well as technical personnel. In hard sciences or natural sciences, in which the research process is based not only on theoretical research, but also on experimentation and laboratory work, it is customary to distinguish in a manuscript of a scientific publication several essential parts, that is, theoretical introduction with an indication of the object and purpose of the research, description of the state of the knowledge as reflected in literature, description of the applied research method or methods, presentation of the results of the experiment and so-called discussion allowing to draw conclusions from the entirety of the research work conducted, as well as a bibliography. It may happen that the person identified as an author of the research paper does not participate in the creation of the manuscript of such paper. This author's participation in the research may be limited to conducting the experiment and presenting the results, which, however, affects the final findings presented in the scientific work. In the situation described, the researcher's contribution to the scientific project has an individualised and creative character, but does not materialise as work within the meaning of copyright law.

When considering the right to scientific authorship and the right to be the author of a scientific work, Ryszard Markiewicz expresses the view that co-authorship occurs only when each researcher individually makes their own contribution, distinguished by the feature of creativity. The object of copyright protection is the creative contribution, not the scientific result

[4] Cf. J. Barta and R. Markiewicz, "Utwory naukowe" [Scientific Works], *Rzeczpospolita* (18.10.1994).

of the work itself as devoid of the feature of individuality.[5] The value or insightful nature of the research work is therefore legally irrelevant under copyright law. In this matter, a liberal conception is proposed in the American literature according to which the fact that the prerequisite of creativity is not fulfilled by an independent component of a work does not prejudge the inability to recognise its creator as an author within the meaning of copyright law. Even a contribution taking the form of an idea may predetermine the acquisition of the right to co-author status, provided, however, that it has become a necessary condition for the existence of the work.[6]

Ryszard Markiewicz, addressing the issue of an experimenter's contribution to the research process, proposes preconditions to their right to be the author of a scientific work. The creator of a research result is to obtain the right of co-authorship of scientific work when: (1) it is customary in the scientific community to cite the creators of the research result as co-authors; (2) this person has participated in the scientific research presented in the publication; (3) this participation was not limited to mechanical, routine or administrative tasks.[7] The cited author adds that in affording legal protection to the effects of scientific creativity, the prevailing moral and customary views in a given society (scientific community), in particular the ethical codes applied,[8] may be decisive.

The right to authorship of a scientific work, as understood in academic or scientific circles, may therefore be interpreted differently than under copyright law.[9] The literature emphasises that in different scientific disciplines the issue of co-authorship may be dealt with differently. In the case of sciences involving both experimental and theoretical work, it is assumed, for example, that the status of a research project leader who does not directly participate in the theoretical solution of the problem posed may constitute sufficient grounds for co-authorship of a scientific publication. However, the manager's contribution to the research should at least consist of searching out the prob-

[5] For more on this subject, see: Markiewicz, *Ochrona prac*, 95.

[6] For more, see: Jankowska, *Autor i prawo*, 108–114 and the literature cited therein.

[7] Cf. Markiewicz, *Ochrona prac*, 105.

[8] For more on this topic, Markiewicz, *Ochrona prac*, 96.

[9] For more, see: Jankowska, *Autor i prawo*, 403–404 and the literature cited therein.

lem, directing the work and formulating the final conclusions to the project.[10]

As regards works in the area of experimental, technical or natural sciences, it is customary that the status of co-author of a scientific publication is granted to persons who participated in the process of obtaining the scientific data used in the publication. The circle of authors of a scientific paper includes persons whose contribution to the research consisted not only in the creative provision of a research idea, a research hypothesis, but also in the technical execution of a scientific experiment.[11] Evaluating this practice, Markiewicz treats it as legally permissible but refuses to recognise on its basis the right of co-authorship within the meaning of copyright law. In Markiewicz's opinion, acceptance of such practice means that scientists (research team) abandon the attribution of authorship of a scientific work according to the principles of copyright law and, instead, indicate all co-authors of a scientific work who participated in the research at all its stages, including the elaboration of research results.[12]

It is worth noting that the described practice, which in the Polish literature is allowed only with the above-mentioned reservation, has gained normative support under German law. The German lawmaker has adopted such provision in the Framework Act for Higher Education (Hochschulrahmengesetz, 1976),[13] that is, the legislative act derogating copyright law's application to scientific authorship. §24 entitled "Publication of Research Results" provides that "[i]n the publication of research results, staff members who have made their own scientific or other significant contribution shall be named as co-authors; where possible, their contribution shall be identified." That norm protects the authorship rights of each team member, creators of scientific products and performers of technical products. It is a good solution and should be commonly adopted in national legislation on higher education. The Polish Act of 20 July 2018 The Law on Higher Education and Science should derogate the application of copyright law to establish scientific authorship and authorship of scientific works.

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[10] K. Daszkiewicz and W. Daszkiewicz, "Glosa do wyroku SN z dnia 18.11.1969, V KRN 267/69," *Państwo i Prawo* 5 (1973): 175.

[11] Cf. Markiewicz, *Ochrona prac*, 52.

[12] Cf. Markiewicz, *Ochrona prac*, 53.

[13] BGBl. I S. 1622 of 19 January 1999 Hochschulrahmengesetz (1976), http://www.gesetze-im-internet.de/hrg/BJNR001850976.html (30 March 2023).

Regulations similar to the German one protecting the intellectual property rights of creators of science to the fruits of their research work have not been adopted by legislators in other countries. The system of protecting intellectual property of creators of science therefore shows significant deficiencies. This was already pointed out by Andrzej Kopff, who argued that "the legal protection afforded to creators by the provisions of copyright law has quite significant deficiencies, with such result that a number of acts undoubtedly detrimental to the legitimate interests of creators are not met with adequate repression, but may even be generally regarded as permissible."[14]

This raises the question about the legal basis for the right to be the author of a work with regard to a person whose product of intellect has been used in a specific scientific work but has not been expressed as a work within the meaning of copyright law. Such contribution to research may not qualify as a work for three reasons. First, when it has not been obtained through a strictly creative process. Secondly, when it does not show the capacity to be individualised, as any other researcher, a specialist in the relevant scientific area, would have obtained a product of scientific work of the same content and form. Thirdly, it may take the form of protectable ideas, research ideas or theses or scientific truths.[15]

Under the copyright regime,[16] authors of such research contributions are deprived of the right to co-authorship of a scientific

[14] Kopff, *Dzieło sztuk plastycznych i jego twórca*, 65–66; Cf. Kopff, *Co chronimy w dziełach naukowych?* [What Do We Protect in Scientific Works?], *Państwo i Prawo* 6 (1978); for more, see: Jankowska, *Autor i prawo*, 396–404 and the literature cited therein.

[15] As J. Barta and R. Markiewicz point out, this is about the protection of the content (contents) of such elements of scientific works as: the topic, research idea, scientific fact, hypothesis, which in specific cases may fulfil the premise of creativity, and to which the protection under the Copyright Act is not granted, because the cited Act protects the form of expression and not the skills or work. See J. Barta and R. Markiewicz, *Prawo autorskie i prawa pokrewne* [Copyright and Related Rights] (Warszawa: Wydawnictwo Wolters Kluwer Polska, 2014), 30. Cf. E. Ferenc-Szydełko, "Komentarz do art. 1," in *Ustawa o prawie autorskim i prawach pokrewnych. Komentarz* [Copyright and Related Rights Act. Commentary], ed. E. Ferenc-Szydełko, edition 3 (Warszawa: Wydawnictwo C. H. Beck, 2016), 41–43; D. Flisak, ed., "Komentarz do art. 14," in *Ustawa o prawie autorskim i prawach pokrewnych. Komentarz LEX* [Copyright and Related Rights Act. LEX Commentary], ed. M. Bukowski, D. Flisak, Z. Okoń, P. Podrecki, J. Raglewski, S. Stanisławska-Kloc, T. Targosz (Warszawa: Wolters Kluwer Business, 2015), 205–208.

[16] Cf. Jankowska, *Autor i prawo*, 397.

publication, even though their intellectual contributions may have been as high as or even higher than those of other researchers.[17] The Copyright Law Act grants protection only to the form of presenting a discovery or idea or scientific truth, and protects such discovery, idea or scientific truth only in the form in which they are fixed. The discoveries themselves, ideas, procedures, methods and principles of operation or mathematical concepts do not enjoy protection under this Act. As a result, the content itself is either not protected at all or protected in a way that does not satisfy the legitimate interests of the authors of scientific discoveries.[18] What becomes decisive for granting legal protection to a researcher is the ability to demonstrate that a particular, specific "scientific" product of their intellect is a creative idea, scientific discovery or other material result of scientific work, the existence of which conditioned the creation of a manuscript of a scientific publication, thus leading to a specific bond between the creator and the result of their work.[19]

In the light of these considerations, it has become necessary to reconstruct the legal basis for the protection of authorship and the right to be an author in case of members of the research team whose participation in the research did not consist of the creation of the manuscript of the publication, that is, a work within the meaning of copyright law. Answers to the following questions are required: Who has the right to hold the status of co-author of a scientific publication? Does each creator of an individualised and creative contribution to a research project acquire the right of authorship? Does the creator of an intangible good unnamed in the law but having the characteristics of an individualised intellectual product developed in a creative process obtain the right to authorship? Does this right accrue to every participant in the research process or not?

1.2.1. Scientific Creativity as a Personal Interest of Man and the Right to Scientific Authorship

The legitimacy of scientists' claims for respect for their authorship and the right to mark authorship of the research results

[17] See Judgment of the Court of Appeal in Warsaw of 29.03.1994, I ACr 104/96, LEX No. 62572, discussed above.

[18] J. Szwajna, "Ochrona dóbr osobistych twórców nauki" [Protection of Personal Interests of Authors of Science], *ZNUJ PWiOWI* no. 67 (1996), 101.

[19] Cf. Janowska, *Autor i prawo*, 397.

obtained by them, which take the form of an idea, discovery, method or other product of the intellect not subject to copyright protection, has been recognised in the literature.[20] Ryszard Markiewicz[21] argues that authors of such products of research work are granted protection under Article 23[22] of the Polish Civil Code. In this provision, all scientific, inventive and rationalisation creations of a human being are qualified as personal interests of an individual, with the legal effect of being subject to legal protection, and this independently of the protection provided for in other provisions. In case of a threat to or infringement of these personal interests by another person's action, the legislator, in Article 24 of the Civil Code,[23] grants the creator a number of claims. For example, the creator may demand that the action be discontinued if it is unlawful, and, in the case of infringement, that the infringer perform the actions necessary to remove its effects, in particular, make a statement of appropriate content and form. In addition, the author may demand the payment of monetary compensation or an appropriate sum of money for a specified social purpose, as well as compensation for pecuniary damage caused by the infringement of personal interests.

As Markiewicz observes, application of the protection under Article 23 requires a precise determination of the relation be-

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[20] For more, see: Jankowska *Autor i prawo*, 407–411 and the literature cited therein.

[21] For more on this subject, see: Markiewicz, *Ochrona prac*, 95–105.

[22] "Personal interests of a human being, such as in particular health, freedom, dignity, freedom of conscience, surname or pseudonym, image, confidentiality of correspondence, inviolability of home as well as scientific, artistic, inventive and reasoning activities shall be protected by the civil law regardless of the protection provided for by other provisions."

[23] "§ 1. A person whose personal interests are jeopardized by another person's action may demand that the action be abandoned, unless it is not illegal. In the case of actual violation, he may also demand that the person who committed the violation perform acts necessary to remove its consequences, in particular that the latter make a statement of a relevant content and in a relevant form. On the basis of the principles provided for by the Code he may also demand pecuniary compensation or a payment of an adequate amount of money for a specified community purpose.

§ 2. If, as a result of a personal interest damage to the property was inflicted, the injured party may demand it to be redressed on the basis of general principles.

§ 3. The above provisions shall not prejudice the entitlements provided for by other provisions, in particular by copyright law and by patent law."

tween personal interests listed in this provision and moral rights protected under copyright law and industrial property law. Reconstructing rights analogous to moral rights of the author of a work should be done considering the specificity of an intangible good to be protected under civil law. Notably, the analysis of the nature of a specific idea, an idea or a broadly understood effect of a research work may lead to the conclusion that it exhibits the features of individuality or even creativity.

Application of civil law protection requires that a proper understanding of the term "scientific creation" be established. It needs to be clarified whether this personal interest protects the author's moral interest in authorship on account of an intellectual product, or whether it already covers the mental or experimental process taking place before the product is attained. Ryszard Markiewicz[24] opted in this respect for the liberal position, stating that under the term "scientific creation" one should understand both the indicated aspects of scientific work, that is, both its results and the creative thinking process itself. Consequently, if the intellectual contribution of the researcher to the research results published in a scientific publication meets the requirement of creative character in the above-mentioned sense, the legal basis for granting protection to the right to authorship of a scientific work should be sought either in copyright law or in Articles 23 and 24 of the Civil Code.[25]

Inclusion of an author's moral rights in the category of ordinary civil law personal interests is also supported by case-law.[26] At the same time, the question is asked about the mutual relations between copyright law provisions and civil law provisions on the protection of personal interests, including those providing guarantees for scientific, inventive and rationalisation creativity. In the literature of the subject, we can find different opinions. Some authors take a view that the provisions of the Civil Code cover only such non-economic interests of creators that do not enjoy protection under copyright law.[27]

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[24] Markiewicz, *Ochrona prac*, 53.

[25] Barta and Markiewicz, "Komentarz do art. 1 ustawy o prawie autorskim," 35–37.

[26] Cf. Judgment of the Supreme Court of 03.09.1998, I CKN 818/97, OSP 1999, no. 7–8, item 142; Judgment of the Supreme Court of 05.01.2001, V CKN 499/00, Lex no. 53112.

[27] J. Błeszyński, *Prawo autorskie* [Copyright Law] (Warszawa: Wydawnictwo Naukowe PWN, 1988), 116 et seq.; A. Wojciechowska, "Czy autorskie

Another opinion found in literature is that author's moral rights are only one form of the personal interest defined in Article 23 and referred to as "scientific, inventive and rationalisation creativity," and therefore it is permissible to apply the provisions of the Civil Code and the Copyright Law Act cumulatively when granting protection.[28] Supporters of the latter view argue that in case of a difference between the two regimes, the provisions more favourable to the person whose interest is to be protected should apply.[29] There are also opinions formulated in judicial practice assigning to the provisions of the Civil Code the status of *lex generalis*, applicable to issues not regulated in copyright law.[30]

Notwithstanding the above-mentioned disputes, it may be assumed that if the fruits of scientific creativity fall outside the scope of copyright law, it is necessary to resort—in order to protect the entitled person—to the provisions of the Civil Code (Articles 23 and 24). Pursuant to the copyright regulations, the author's moral rights held by a science creator arise upon fixation of the work. Thus, until that moment, the creator of science can enjoy the protection under Articles 23 and 24 of the Civil Code.[31] Scientific results not embodied in a work are protected by these provisions. In addition, civil law provisions may also serve as

dobra osobiste są dobrami osobistymi prawa cywilnego" [Are Author's Moral Rights Personal Interests under Civil Law], *Kwartalnik Prawa Prywatnego* 3 (1994): 371 ff.

[28] R. Markiewicz, *Dzieło literackie i jego twórca w polskim prawie autorskim* [Literary work and its author in Polish copyright law] (Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego, 1984), 89–91; J. Preussner-Zamorska, *Prawo do autorstwa wynalazku* [Invention Authorship Rights] (Kraków: Wydawnictwo Naukowe PWN, 1974), 5 et seq.; Szwaja, *Ochrona*, 185 et seq.; B. Giesen, E. Wojnicka, "Autorskie prawa osobiste," in *System Prawa Prywatnego* [Private Law System], T. 13, ed. J. Barta (Warszawa: Wydawnictwo C. H. Beck, 2017), 313; Barta and Markiewicz, "Komentarz do art. 16 ustawy o prawie autorskim," in *Prawo autorskie i prawa pokrewne. Komentarz* [Copyright and Related Rights Act. Commentary], ed. M. Czajkowska-Dąbrowska, Z. Ćwiąkalski, K. Felchner, E. Traple, and J. Barta (Warszawa: Wolters Kluwer Polska, 2011), 169–171.

[29] Barta and Markiewicz, "Komentarz do art. 16 ustawy o prawie autorskim," 169–171. Judgment of the Supreme Court of 3.09.1998, I CKN 818/97, OSN 1999, No. 1, item 21; judgment of the Supreme Court of 5.01.2001, V CKN 499/00, Legalis no. 304593.

[30] Judgment of the Court of Appeal in Krakow of 7.02.1995, I ACr 697/94, OSA 1996, No. 3, item 5.

[31] Barta and Markiewicz, "Komentarz do art. 16 ustawy o prawie autorskim," 169–171.

a basis for the protection against the misappropriation by a third party of the name or pseudonym of the creator.[32]

Jurisprudence of the Polish Supreme Court back in the communist period explained[33]: "[t]he applicable copyright law does not provide, when it comes to scientific works, for independent legal protection of scientific discoveries (scientific truths). They can be protected under copyright law norms within the framework of the protection of a scientific work, in the understanding of Article 1 of copyright law, the content of which they form." At the same time, the Court emphasised that it does fall within the sphere of copyright protection "with all legal rigours (apart from the obvious cases of plagiarism) when a content or excerpt is taken from another's work without mentioning the creator or the source in one's work." In support of this position, it was emphasized in the cited judgment that "considerations of socialist morality concerning relations between people, the duty of mutual respect owed to an individual, in the social interest, justify indicating in one's own work the known and available statements of authors of scientific works on specific issues resolved in a new, creative, original manner, especially if reference is made to them in the content of the work."[34]

In this way, the protection of scientific authorship has been linked not only to the right of authorship of a work using the result of creative work but also to the requirement of reliable citation of scientific works. In this context, the case law emphasised: "The omission, in a scientific paper dedicated to the results of a specific research, of the information about who initiated, conducted, developed and elaborated the research may, in specific circumstances, jeopardise or even infringe the scientific creativity of a person. This is particularly the case if the said omission is of such a kind that—especially in relation to the content or nature of the study—according to objective assessments, it diminishes or threatens another"s scientific output. In such situations, the person concerned is entitled to the protection provided for in Articles 23 and 24 of the Civil Code."[35]

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[32] Markiewicz, *Ochrona prac*, 87 et seq.; Barta and Markiewicz, "Komentarz do art. 16 ustawy o prawie autorskim," 171.

[33] Judgment of the Supreme Court of 24.11.1978, I CR 185/78, LEX no. 8151.

[34] Judgment of the Supreme Court of 24.11.1978, I CR 185/78, LEX no. 8151.

[35] Judgment of the Supreme Court of 22.03.1973, I CR 3/73, LEX no. 63268. In the case under consideration, the plaintiff claimed that the defendants, in their publications—in a paper entitled. "Influence of soil tillage on the

At the same time, in the cited case, the Court defined the limits of the obligation to cite the publications of other researchers in references to scientific works. The Court explained that when the circumstances described above do not arise, "a mere omission in a scientific publication of another's scientific achievements in the area of specific research cannot be seen as an unlawful act that infringes or threatens another's scientific creation. A different interpretation would lead to the unacceptable conclusion that the author of a scientific paper should cite in their work not only a complete bibliography of scientific works in a particular field but, in addition, include information about scientific research carried out in that field by specific scholars of whom he may not even be aware."[36] Illustrating this view, the Court explained that the mere fact that the name of a particular researcher as the initiator, in the case at hand, of a study of the effect of soil tillage on poplar growth is omitted from a scientific paper is not sufficient to accept that the scientific work of that researcher has been infringed.

In another case,[37] the Supreme Court assumed that "[i]n case of use without the authors' consent of an elaboration made by them—depending on the type and consequences of the infringement—the authors may have property claims and claims for the protection of authors' moral rights. […] apart from the form of this study, whose legal value is emphasised by the provisions of the Copyright Law (Article 1 of the Copyright Act of 10 July

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growth of poplars in plantations" (a) printed in German translation in 1967 in Volume IV on pages 278-292, "XIV IufroKongressReferate" and (b) printed in 1968 in *Prace Instytutu Badawczego Leśnictwa* No. 365, item 9, p. 91—committed an infringement of the author's moral rights of the plaintiff by using in the above-mentioned publications material taken from the plaintiff's works without stating the sources from which they took verbatim excerpts. In addition, the plaintiff claimed that the defendants, in the above-mentioned publications, infringed the plaintiff's personal interest, in particular his scientific and rationalisation work, ignoring the fact that the plaintiff was the organiser and head of the Poplar Cultivation Unit and that it was the plaintiff that initiated and promoted intensive cultivation of poplars in plantations by presenting, as early as 1956, a programme of cultivation research, included in the report on the activities of the Forest Research Institute, which gave rise to the assumption that not the plaintiff but the defendants were the authors of these concepts and works.

[36] Judgment of the Supreme Court of 22.03.1973, I CR 3/73, LEX no. 63268.

[37] Judgment of the Supreme Court of 8.02.1978, II CR 515/77, LEX no. 5087. In this case, the plaintiffs sought protection in relation to the use without their consent of a "study" of cost indicators developed by them.

1952), it has […] a specific content. The content of a scientific work in the broad sense of the word, the essential elements of the content of such a work in combination with its objective form, regardless of whether it has been published or remains in manuscript (typescript), are also subject to copyright protection against their use without the author's consent, or against any other encroachment on the author's sphere of rights. Unauthorised use of another's work generally occurs when there are materially, objectively identifiable manifestations of such an infringement. This is both a question of substantive law itself and a question of evidence. However, there can be no such unauthorised use of another person's work as the mere act of familiarising oneself with its content, in particular, if this is in close connection with the communication of the work to another person or institution, that is, in the case of voluntary communication to another person. It is necessary to prove that another person used the form and content of another's work in their professional (practical) activity or in a scientific or similar activity, which was reflected in another work made by such person. Under the provision of Art. 1 of the Copyright Act, an infringement of the author's right does not occur when another person, even against the author's will, only becomes familiar with certain content of the elaborated work, without using the work or its fragments in a formal and substantive sense. This is because ideas themselves, theses and scientific solutions in a broad sense, as such, are in principle not subject to copyright protection, which does not, however, exclude possible protection under the general rules of civil law."

In summary, copyright law protects the product of human intellect and the result of research work fixed in any form, however impermanent, that meets the legal definition of a work. Scientific ideas and concepts as well as methods of operation, as long as they do not find expression in the form of a work, enjoy protection under civil law. Invocation of the guarantee under the Civil Code provides the scientist with universal protection.[38] The status of co-author of a scientific work may be claimed by all co-authors of the research process whose use of intellectual potential contributed to the creation of research results and their subsequent fixation in the form of a scientific work. This group includes both

[38] Gajdus, "Utwór naukowy i jego ochrona" [Scientific Work and Its Pro tection], in *Prawo nauki. Zagadnienia wybrane* [The Law of Science. Selected Issues], ed. A. Wiktorowska, A. Jakubowski (Warszawa: Wydawnictwo Lexis-Nexis, 2014), 112.

the authors of the research concept, thesis or hypothesis and the creators of the research method and the technique used in the research process. Adoption of such rules means that participants of a research team will abandon the attribution of co-authorship according to the principles of copyright law in favour of—as Ryszard Markiewicz pointed out—the indication in the list of authors of all participants in the research work, the result of which is a given scientific publication.[39]

It seems that, in reference to the views presented in the literature in the past,[40] the following conclusions can be formulated. Firstly, the fruit of scientific research taking the form of scientific data, achieved as a result of scientific activity of a human being, is subject to constitutional legal protection vested in the creators of science as far as certain prerequisites are met. The fruit of such research should constitute an "intangible good" produced by a human being in an individualised, original creative process or at least an individualised, original (in the sense of performed for the first time) technical or organisational process. Secondly, the existence of such an "intangible good," whether or not it is fixed as a work (a contribution to a collective work) within the meaning of copyright law, gives rise to a "subjective right" on the part of its creator. The content of this right is expressed in the creator's right to protection of their moral and material benefits resulting from the scientific creation materialised as this intangible good. The creator has the exclusive right to use this good to the exclusion of others and to dispose of it for gainful and/or professional purposes. Thirdly, when the decoded "intangible good" has the characteristics of other "intangible goods" named in the law as work and invention, the constitutional principle of equality before the law requires that the intellectual property of creators of intangible goods be subject to equal legal protection for all. The legal basis for such protection is provided by Article 24 of the Civil Code when the result of the research activity meets the definition of scientific creation under Article 23 of the Civil Code.[41] However, if the result of scientific activity does not meet the definition of either intangible goods named in the law or the general concept of scientific creativity, the creator of science does not obtain legal protection. It should be recalled that it has been

[39] Markiewicz, *Ochrona prac*, 53.

[40] Cf. Kopff, *Prawo cywilne a prawo dóbr niematerialnych*, 12–13, 15, 19–20, 24–25, 28–31.

[41] Cf. Jasinska, *Ochrona idei—zagadnienia wybrane*, 17–18.

explained in case law that "[e]ven the creative contribution of a member of the Team or of a person participating in the conduct of an experiment as a result of which such person presented in a table and in a graph the result of the measurements carried out by them does not enjoy the protection provided by the Copyright Law since this contribution in the final version of the elaboration of the experiment loses the features of an individual and self-contained work within the meaning of Art. 1 of the Copyright Law Act, both that of 10 July 1952 and that of 4 February 1994. Nor can it be concluded that the mere technical presentation of the results of the measurements made without mentioning the research methods used by the plaintiff constitutes a 'scientific creation' subject to the protection provided for under Article 23 of the Civil Code."[42] It therefore becomes necessary to undertake research so as to identify other bases for the protection of the rights of authors of science to the results of their scientific activity.

1.2.2. The Creator of Science as a Contributor to Research According to Codes of Ethics for Scientists. Do Codes of Ethics Have Binding Force?

The already analysed provision of Article 31(3) of the Polish Constitution and the universal systems of human rights protection, provide legal grounds for the imposition of restrictions on the individual in the exercise of the freedom of science. In the sphere of conducting scientific research and publishing its results, the individual's freedom may be limited both vertically and horizontally.[43] One of the purposes of sanctioning such re-

[42] Judgment of the Court of Appeal in Warsaw of 29.03.1994, I ACr 104/96, LEX no. 62572.

[43] The phenomenon described in the doctrine of constitutional law as the horizontal impact of constitutional freedoms and rights, consisting in the fact that the addressee of the obligations deriving from their content is not only the state and public authority but also other individuals, so as to ensure the possibility of their exercise by an individual. Indeed, my freedoms and rights are limited by the freedoms and rights of others, and I should therefore exercise my freedoms and rights in such a way as not to limit the exercise of the same categories of freedoms and rights by others. Obviously, this limitation applies not by means of arbitrary prohibitions and injunctions but by reference to the principles of fairness and decency defined by civil law, that is, by the requirement to respect the rules of social coexistence and established customs in a given type of interpersonal relationship. Cf. A. Łabno, "Zasada

strictions may be the need to protect the freedoms and rights of others, including the right of another researcher to freely exercise their freedom to conduct scientific research and to publish the results of their research activity under their own name. In this context, the question arises as to who and how should define the other forms of intangible goods subject to legal protection under Article 73 and Article 64 of the Constitution of the Republic of Poland, which may arise as the fruits of research activity and, at the same time, do not correspond to the characteristics of the categories of intellectual goods named in the law (i.e., a work or scientific creation).

The specific nature of scientific research and its highly specialised character, as well as the importance of scientific progress for the economic development of countries, determines that the manner of exercising the freedom of science, including the introduction of limitations on this freedom of the individual, should be regulated not only by the legislator, but also by the scientific community itself. With reference to the provision of Article 31(3) of the Constitution, the Polish legislator has limited the freedom of research in numerous laws (e.g., the issue of conducting research with the involvement of humans). In addition, the legislator, in the law in force in Poland, has empowered a specialised entity, that is the Polish Academy of Sciences, to determine the rules for exercising the freedom of research and publishing its results. Pursuant to the Act of 30 April 2010 on the Polish Academy of Sciences[44] [hereinafter: the Act on the Polish Academy of Sciences], the Polish Academy of Sciences was established to serve the development, promotion, integration and dissemination of science and contributes to the development of education and enrichment of national culture. Its tasks include: conducting scientific research and development work, supporting the development of persons embarking on scientific careers, but also formulating the principles of ethics in science. According to the Act, the governing bodies of the Academy are: General Assembly of the Academy, Presidium of the Academy, President

bezpośredniego obowiązywania konstytucyjnych praw i wolności jednostki. Analiza prawnoporównawcza" [The Principle of Direct Effect of Constitutional Rights and Freedoms of the Individual. Comparative Legal Analysis], in *Podstawowe prawa jednostki i ich sądowa ochrona* [Fundamental Rights of the Individual and Their Judicial Protection], ed. L. Wiśniewski (Warszawa: Wydawnictwo Sejmowe, 1997), 64–81.

[44] Journal of Laws 2020, item 1796 as amended.

of the Academy, Chancellor of the Academy. The legislator has assigned particularly important tasks to the General Assembly of the Academy. The body was obliged, among other things, to elect a Commission for Ethics in Science and to adopt, at the request of this Commission, a code of ethics for a scientific worker. Consequently, the tasks of the Commission for Ethics in Science, appointed by the General Assembly of the Academy, include the development of a draft code of ethics for a scientific worker and proposals for amendments to its provisions, as well as conducting activities for the dissemination of standards of scientific research integrity (Article 39(3) of the Act on the Polish Academy of Sciences). In addition, the Commission for Ethics in Science is entitled to express its opinion in cases concerning violations of the principles of ethics in science by an employee of a university, a scientific unit of the Polish Academy of Sciences or a research institute (Article 39(1)).[45]

The Commission for Ethics in Science, operating at the Academy, exercising its competence under Article 39 of the Act on the Polish Academy of Sciences, since the beginning of the 1990s, has created and then updated sets of principles, recommendations and standards, called the Code of Ethics for Researchers. It has also repeatedly issued opinions in cases of violations of ethical principles in science.[46] In this way, the Commission in-

[45] The following provisions of Article 39 provide that: "(2) [t]he Commission for Ethics in Science may, on its own initiative, refer cases of violations of the principles of ethics in science by staff members referred to in paragraph (1) to the competent disciplinary committees with a recommendation to conduct an investigation. Information on the results of such investigations shall be forwarded by the competent disciplinary committee, upon completion of the investigation, without undue delay, for the attention of the Commission for Ethics in Science. […] 4. The term of office of the Commission for Ethics in Science shall be 4 years and shall correspond to the term of office of the governing bodies of the Academy."

[46] Act of 20 July 2018 The Law on Higher Education and Science:

"Art. 275 (1) An academic teacher shall be subject to disciplinary liability for any disciplinary misconduct which constitutes an act which defaults on the duties of an academic teacher or which offends the dignity of the academic profession.

Art. 287 (2) The investigation process [the disciplinary case] shall be initiated ex officio in the case of an act consisting in:

(1) misappropriating the authorship or misleading as to the authorship of the whole or part of another person's work or artistic performance;

(2) distribution, without providing the name or pseudonym of the author, of another person's work in its original version or in the form of a derivative work;

terpreted the provisions of the successively applicable Codes of Ethics of a Scientific Worker, formulating binding instructions for disciplinary committees adjudicating individual cases as regards proper understanding and application of those provisions. In the context of specific allegations of violations of the rules of scientific research and publication of its results, as examined by the Commission, the ethical standards of scientific authorship and the right to be an author of a scientific work were established.

As early as the 1960s, it was recognised that the number of authors per scientific work was systematically increasing along with advances in technology. At that time, almost worldwide attention was drawn to the importance of defining ethical standards for the fair attribution of authorship of scientific works with a view to the integrity of the research process.[47] In the absence of reaction from the legislator to the fact that the rules of copyright law were not compatible with the attribution of scientific authorship, the scientific community began to develop, through custom, good practices for the fair attribution of collective authorship in scientific works. This issue was also addressed by the American physicochemist, E. B. Wilson Jr. In a 1952 paper entitled: "An Introduction to Scientific Research"[48] he explained: "After the title comes the author's name or a list of names. Here is a golden opportunity for losing friends. The decision as to what names should be included, and in what order, requires fair-mindedness and objectivity above the ordinary." Wilson formulated the following authorship attribution rules: (1) The author whose name comes first on the paper should be the main creator of research deserving the most credit for the work; (2) The following persons on the list of co-authors of a paper should be listed in the equivalent order to the amount and value of their contribution to the research. Wilson added that "to be a co-author is both an

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(3) distribution, without providing the name or pseudonym of the author, of another person's artistic performance or public distortion of such work, artistic performance, phonogram, videogram or broadcast;

(4) infringement of someone else's copyright or related rights in a manner other than specified in points 1–3;

(5) falsification of scientific research or its results or other scientific fraud; […]."

[47] M. K. McNutt, M. Bradford, and J. M. Drazen et al., "Transparency in Authors' Contributions and Responsibilities to Promote Integrity in Scientific Publishing," *PNAS* (2018). Epub ahead of print 27 February 2018. http://orcid.org/10.1073/pnas.1715374115.

[48] E. B. Wilson Jr, *An Introduction to Scientific Research* 3rd edition (New York: Dover Publications, INC, 1990), 287.

honour and a responsibility. Many make it a rule not to accept (or impose!) co-authorship unless they have done a good deal more than suggest the problem or even than guide its solution somewhat remotely from on high." Furthermore, the author highlights that it is extremely important that proper credit is given for support from other scientists. Appropriate acknowledgements (such as thanks) should be given to anyone who suggested a problem/hypothesis, provided useful suggestions with regard to the method, solution or interpretation of results. In this context Wilson argues: "Few secrets are hidden, and a man who infringes on the intellectual property of others will have his sins passed around the world with amazing rapidity by the gossip of his fellow scientists. Careers have been damaged for life by a few thoughtless acts of kind."

In the ensuing years, scientific institutions and associations of scientific journal publishers around the world began to adopt documents setting out principles for the attribution of scientific authorship. Initially, these were given the form of informal recommendations on preferred or desirable practices in science. Then, as in Poland, such institutions and research-related international organisations began the process of codifying moral principles defining the conditions for scientific authorship in the form of codes of ethics for scientists. Currently, we are witnessing the final stage in the process of unification of international ethical standards in scientific research.[49] The provisions of these documents have been unified to establish the common highest international ethical standards in research. A declaration of support for the European Charter for Researchers has also been issued.[50] These documents apply at different levels of regulation.

[49] European Charter for Researchers & The Code of Conduct for the Recruitment of Researchers (2005), https://euraxess.ec.europa.eu/sites/default/files/am509774cee_en_e4.pdf; Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations (2013), https://www.wcrif.org/downloads/main-website/montreal-statement/123-montreal-statement-english/file; Singapore Statement on Research Integrity (2010), https://www.wcrif.org/downloads/main-website/singapore-statements/224-singpore-statement-lettersize/file, accessed 1 October 2023.

[50] E.g. Declaration of support for the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers of the Foundation for Polish Science (2011), https://www.fnp.org.pl/assets/Declaration-for-support-for-CC.pdf; Declaration VP European of Ben-Gurion University of the Negev (2015), http://in.bgu.ac.il/en/Global/Documents/BGU%20-%20Declaration%20VP%20European.pdf, accessed 29 March 2022.

The codes of ethics for researchers summarised in Table 1 can be considered the most representative ones.

Table 1. List of codes of ethics included in the analysis. Source: own study.

Level of ethical regulation	Region, country, institution or organisation adopting the ethical regulations	Title of the ethical regulation
1. Examples of World level of regulation	The 2nd World Conference on Research Integrity, Singapore, 22 September 2010	Singapore Statement on Research Integrity (2010)[2)]
	The 3rd World Conference on Research Integrity, Montréal, 5–8 May 2013	Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations (2013)[3)]
	European Parliament & UNESCO[1)]	The TRUST Code—A Global Code of Conduct for Equitable Research Partnerships (2018), previously Global Code of Conduct[4)]
European level of regulation	The European Union	The European Charter for Researchers & The Code of Conduct for the Recruitment of Researchers (2005)[5)] The European Code of Conduct for Research Integrity by ALLEA—All European Academies (2017)[6)]
Examples of national level of regulation	France	Integrity and responsibility in research practices, Guide of CNRS Ethics Committee (2017)[7)]
	Denmark	The Danish Code of Conduct for Research Integrity (2014)[8)]
	Poland	Code of Ethics for Researchers of the General Assembly Polish Academy of Science (2020)[9)]
	Israel	Integrity in Research of the Israel National Council for Research & Development (1998)[10)]
	Czech Republic	Resolution of the Government of the Czech Republic of 17 August 2005 No. 1005 on the draft Ethical Framework for Research[11)]

	Spain	Code of Good Scientific Practices of the Spanish National Research Council (CSIS) (2011)[12)] Spanish National Statement on Scientific Integrity (2015)[13)]
Examples of binding at universities of recognised repute	USA	Conduct of Research at Stanford University (2007)[14)] Authorship Guidelines of Harvard Medical School (1999)[15)] Guidance on Authorship in Scholarly or Scientific Publications of Yale University (2023)[16)]
	United Kingdom	Authorship Guidelines of the University of Manchester (2021)[17)] Code of Practice on Authorship of University of Cambridge School of Clinical Medicine (2014)[18)]
	International level—Europe	Code of Ethics in Academic Research of European University Institute (EUI)[19)] in Florence (2022)[20)]
	Israel	Code of Academic Ethics—Ben-Gurion University of the Negev (2007)[21)]
	Czech Republic	Code of Ethics for Students and Researchers of Faculty of Electrical Engineering Czech Technical University in Prague (2006)[22)] Code of Ethics of Charles University (2018)[23)] Code of Ethics of the Silesian University in Opava (2022)[24)]
Examples of binding at research institutions of recognised repute	The Max Planck Society (Germany)	Rules of Good Scientific Practice of the Max Planck Society (2000, amended 2009)[25)]
	The Czech Academy of Sciences (Czech Republic)	Code of Ethics for Researchers of the Czech Academy of Sciences[26)]
Examples of binding adopted by scientific associations and scientific publishers	The American Educational Research Association (USA)	The Code of Ethics of the American Educational Research Association (2011)[27)]

	The British Sociological Association (United Kingdom)	Authorship Guidelines for Academic Papers of the British Sociological Association (2001)[28)]
	Universities of UK[29)] (United Kingdom)	The Concordat to Support Research Integrity[30)]
	Authorship guidelines of scientific publishers	Guidelines of the Committee on Publication Ethics (COPE) How to handle authorship disputes: A guide for new researchers (2003)[31)]
		Guidelines of the International Committee of Medical Journal Editors (ICMJE), Defining the Role of Authors and Contributors (version 2023)[32)]
		International Committee of Medical Journal Editors, Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals (Updated 2023)[33)]
		Nature Research journals' authorship policy (2021)[34)]

[1)] In 2018, the TRUST consortium launched the Global Code of Conduct for Research in Resource-Poor Settings in the European Parliament. Five years later and the Code is successfully used all over the world to promote equitable research partnerships, having been adopted across the research cycle by funders (e.g., European Commission), research organisations and publishers (e.g., NATURE). On 7th June 2023, at a champagne reception in the UNESCO headquarters, the code received a new name.

[2)] https://www.wcrif.org/guidance/singapore-statement & https://www.wcrif.org/downloads/main-website/singapore-statements/224-singpore-statement-lettersize/file, accessed 1 October 2023.

[3)] https://www.wcrif.org/guidance/montreal-statement & https://www.wcrif.org/downloads/main-website/montreal-statement/123-montreal-statement-english/file, accessed 1 October 2023.

[4)] The development of the Code is the result of the TRUST project (Creating and enhancing TRUST worthy, responsible and equitable partnerships in international research) funded by the European Commission under Horizon 2020, https://orcid.org/10.48508/GCC/2018.05, https://www.globalcodeofconduct.org/the-code/, accessed 1 October 2023.

[5)] https://euraxess.ec.europa.eu/sites/default/files/am509774cee_en_e4.pdf, accessed 1 October 2023.

[6)] https://www.allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf, accessed 1 October 2023.

[7)] https://comite-ethique.cnrs.fr/wp-content/uploads/2020/09/COMETS-GUIDE-EN.pdf, accessed 1 October 2023.

[8] https://ufm.dk/publikationer/2014/the-danish-code-of-conduct-for-research-integrity/, accessed 1 October 2023.

[9] https://instytucja.pan.pl/images/2021/CodeofEthicsForResearchersThird-Edition.pdf, accessed 1 October 2023.

It should be recalled that Article 15(2)(9–10) and Article 39 of the Act on the Polish Academy of Sciences obligate the General Assembly of the Polish Academy to elect the Commission for Ethics in Science, which is obliged to establish and revise a code of ethics for a scientific worker.

[10] https://in.bgu.ac.il/en/Global/Documents/General/ethicseng.pdf, accessed 1 October 2023.

[11] In the document:

(1) it is recommended to members of the government and heads of other central government bodies with competence in the field of research and the President of the Academy of Sciences of the Czech Republic to recommend research organisations established to develop or update their own research codes of ethics using the Research Ethics Framework;

(2) the Minister for Education, Youth and Sports recommends that universities develop or update their research ethics codes using the Research Ethics Framework. https://www.msmt.cz/file/35782_1_1/ (accessed 1 October 2023).

[12] https://www.cnb.csic.es/documents/CBP_CSIC.pdf, accessed 1 October 2023. Article 10 of the Law 14/2011 of 1 June on Science, Technology and Innovation (2011) created the Spanish Research Ethics Committee, attached to the Council for Scientific, Technological and Innovation Policy, as a collegiate, independent and consultative body on matters relating to professional ethics in scientific and technical research. The functions of the Spanish Research Ethics Committee include:

(a) To issue reports, proposals and recommendations on matters relating to professional ethics in scientific and technical research.

(b) To establish the general principles for drawing up codes of good practice in scientific and technical research, which shall include the resolution of conflicts of interest between public and private activities. The Research Ethics Committees and the Spanish Bioethics Committee shall develop these codes.

(c) Represent Spain in supranational and international forums and bodies related to research ethics, except in bioethics matters, where the Spanish Bioethics Committee shall represent Spain.

(d) To promote the creation of ethics commissions linked to the Spanish Science, Technology and Innovation System executing agents. https://www.boe.es/eli/es/l/2011/06/01/14, accessed 1 October 2023.

[13] The Statement establishes ethical principles and professional responsibilities relating to research activity and, at the same time, calls for joint efforts and commitment. Thus, each institution or entity that joined this document is responsible for its development and implementation, facilitating and promoting awareness of ethical matters in general and ensuring that research activities are carried out responsibly based on good scientific practice. The Statement applies to all fields of research and scientific disciplines, and its aims are consistent with those of other essential statements, codes and reports of relevance in this area. http://www.enrio.eu/wp-content/uploads/2017/03/csic-national-statement-on-scientific-integrity.pdf, accessed 1 October 2023.

14) https://doresearch.stanford.edu/policies/research-policy-handbook, accessed 1 October 2023.

15) https://hms.harvard.edu/sites/default/files/assets/Sites/Ombuds/files/AUTHORSHIP%20GUIDELINES.pdf, accessed 1 October 2023.

16) https://provost.yale.edu/policies/academic-integrity/guidance-authorship-scholarly-or-scientific-publications, accessed 1 October 2023.

17) https://www.staffnet.manchester.ac.uk/rbe/ethics-integrity/author-guidance/, accessed 1 October 2023.

18) https://www.medschl.cam.ac.uk/wp-content/uploads/2014/02/CoS14_68-Authorship_Code_of_Practice-FINAL.pdf?04c0fc, accessed 1 October 2023.

19) EUI is an international postgraduate and post-doctoral teaching and research institute and an independent body of the European Union with juridical personality, established by the member states to contribute to cultural and scientific development in the social sciences, in a European perspective. EUI is designated as an international organisation.

20) https://www.eui.eu/Documents/ServicesAdmin/DeanOfStudies/CodeofEthicsinAcademicResearch.pdf, accessed 1 October 2023.

21) http://in.bgu.ac.il/en/Global/Documents/General/EthicalCodeenglishversion.pdf, accessed 1 October 2023.

22) https://intranet.fel.cvut.cz/en/education/code-of-ethics, accessed 1 October 2023.

23) https://cuni.cz/UKEN-731.html, accessed 1 October 2023.

24) https://www.slu.cz/slu/en/file/cul/cecb723e-ce1c-4b17-bee8-4be5176ae5a3, accessed 1 October 2023.

25) https://www.mpg.de/16404553/rules-scientific-practice.pdf, accessed 1 October 2023.

26) https://www.avcr.cz/en/about-us/legal-regulations/code-of-ethics-for-researchers-of-the-czech-academy-of-sciences/, accessed 1 October 2023.

27) https://journals.sagepub.com/doi/abs/10.3102/0013189X11410403?journalCode=edra, accessed 1 October 2023.

28) https://www.britsoc.co.uk/publications/guidelines-reports/authorship-guidelines/, accessed 1 October 2023.

29) It is the collective voice of 142 universities across the UK. It mission is to help UK universities be the best in the world, through their research and teaching, and the positive impact they have locally, nationally and globally. Members: Abertay University, Aberystwyth University, Anglia Ruskin University, Aston University, Bangor University, Bath Spa University, Birkbeck, University of London, Birmingham City University, Bishop Grosseteste University, Bournemouth University, Brunel University London, Buckinghamshire New University, Canterbury Christ Church, University Cardiff Metropolitan University, Cardiff University City, University of London, Courtauld Institute of Art, Coventry University, Cranfield University, De Montfort University, Durham University, Edge Hill University, Edinburgh Napier University, Falmouth University, Glasgow Caledonian University, The Glasgow School of Art, Goldsmiths, University of London, Guildhall School of Music and Drama, Heriot-Watt University, Imperial College London, Keele University, King's College London, Kingston University, Lancaster University, Leeds Beckett University, Leeds Trinity University, Liverpool Hope University, Liverpool John Moores University, London Business School, London Metropolitan University,

London School of Economics and Political Science, London School of Hygiene and Tropical Medicine, London South Bank University, Loughborough University, Manchester Metropolitan University, Middlesex University, Newcastle University, Northumbria University, Norwich University of the Arts, Nottingham Trent University, The Open University, Oxford Brookes University, Plymouth Marjon University, Queen Margaret University, Queen Mary University of London, Queen's University Belfast, Regent's University London, Robert Gordon University, Royal Central School of Speech & Drama, Royal College of Art, Royal College of Music, London, Royal Holloway, University of London, The Royal Veterinary College, Sheffield Hallam University, SOAS, University of London, Solent University, St George's, University of London, St Mary's University, Twickenham, Staffordshire University, Swansea University, Teesside University, Trinity Laban Conservatoire of Music and Dance, Ulster University, University College London, University for the Creative Arts, University of Aberdeen, University of Bath, University of Bedfordshire, University of Birmingham, University of Bolton, University of Bradford, University of Brighton, University of Bristol, University of Buckingham, University of Cambridge, University of Central Lancashire, University of Chester, University of Chichester, University of Cumbria, University of Derby, University of Dundee, University of East Anglia, University of East London, University of Edinburgh, University of Essex, University of Exeter, University of Gibraltar, University of Glasgow, University of Gloucestershire, University of Greenwich, University of Hertfordshire, University of Huddersfield, University of Hull, University of Kent, University of Leeds, University of Leicester, University of Lincoln, University of Liverpool, University of London, University of Manchester, University of Northampton, University of Nottingham, University of Oxford, University of Plymouth, University of Portsmouth, University of Reading, University of Roehampton, University of Salford, University of Sheffield, University of South Wales, University of Southampton, University of St Andrews, University of Stirling, University of Strathclyde, University of Suffolk, University of Sunderland, University of Surrey, University of Sussex, University of the Arts London, University of the Highlands and Islands, University of the West of England, Bristol, University of the West of Scotland, University of Wales Trinity Saint David, University of Warwick, University of West London, University of Westminster, University of Winchester, University of Wolverhampton, University of Worcester, University of York, Wrexham University, York St John University, accessed 1 October 2023.

30) https://www.universitiesuk.ac.uk/sites/default/files/field/downloads/2021-08/Updated%20FINAL-the-concordat-to-support-research-integrity.pdf, accessed 1 October 2023.

31) https://publicationethics.org/files/2003pdf12_0.pdf, accessed 1 October 2023.

32) https://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html, accessed 1 October 2023.

33) http://www.icmje.org/icmje-recommendations.pdf, accessed 1 October 2023.

34) https://www.nature.com/authors/policies/authorship.html, accessed 1 October 2023.

Textual interpretation in combination with systemic interpretation, taking into account the comparative analysis, allows to establish that the rules of scientific authorship and the right to be a co-author of a collective scientific work adopted in these documents are principles of identical content. The analyses carried out allow to reconstruct an ethical paradigm of scientific authorship, based on moral principles, which forms part of a universal code of ethics for scientists, grounded in universally recognised common principles. This paradigm, within the framework of comparative analysis, is presented in Part II of this book, in Chapter 4, Contribution to Research versus Authorship of a Scientific Work and Attribution of Scientific Works. In this part of the study, a conceptual framework for the moral obligations of scientists with regard to the fair and ethical attribution of scientific authorship is reconstructed in the form of a table.

Against the background of these considerations, the question arises as to the legal status of the rules of attribution of authorship of scientific works expressed in the recommendations and codes of ethics and, more precisely, whether they are legally binding. Undoubtedly, the provisions contained in these documents should be assessed as rules established by the scientific community itself for the exercise of the freedom of scientific research. Their primary purpose is to limit this freedom by defining the ethics of conducting scientific research and publishing its results. The legal basis for such self-limitations of the scientific community is to be found in Article 8(2) of the European Convention on Human Rights or Article 19(3) of the International Covenant on Civil and Political Rights. These international legal acts make up a universal system of human rights protection. On the basis of these acts, national legislatures can mandate authoritative scientific bodies, scientific institutions as well as international organisations to prepare and adopt codes of ethics for researchers. In this way, codes of ethics have acquired the status of legally binding regulations in the scientific world and have thus become part of the generally applicable law addressed to researchers.

The cited acts of international law provide a legal basis for the restriction of every human freedom and right in order to achieve the objective of protecting values that are important to democratic states and societies. These values include the respect for the rights or reputation of others or the protection of public morals. This is because democratic states and the democratic and civilised international community have reserved the right to require scientists to comply with basic ethical norms. On the one hand, these standards, compiled in the form of legally binding codes of ethics for researchers, restrict the freedom of scientific research, but, on the other hand, protect the right to scientific authorship and public morality, thereby ensuring transparency in research and fairness in the publication of results.

In the Polish legal system, the legal basis for the Code of Ethics for Researchers is provided by Article 31(3) of the Constitution. The provisions of this Code and their legal interpretation, offered in the opinions of the Commission for Ethics in Science, should be regarded—on the one hand—as the formulation by the scientific community itself of the rules for the exercise of the freedom of science, as they restrain the freedom with the obligation to observe the principles of ethics. This self-limitation of the scientific community is achieved through setting, under the Code of Ethics, limits on the freedom of science, with the proviso that infringement of such limits would amount to an encroachment into the sphere of legally protected freedoms and rights of another subject enjoying a subjective right of the same content. In this way, the provisions of the Code of Ethics are intended to limit the freedom of the individual based on the concept of horizontal validity of norms governing rights and freedoms, which sanctions the self-limitation of the individual by applying to scientific work the maxim—"the limits of my freedom and rights are the freedoms and rights of other subjects."[51]

On the other hand, the regulations of the Code of Ethics, inasmuch as they restrict the freedom of the individual in the exercise of the freedom of science, should be interpreted as a vertical restriction of this freedom introduced on the basis of the delegation under Article 39(3) of the Act on the Polish Academy of Sciences,[52] within the framework of the provision of Article 31(3) of the Constitution of the Republic of Poland. Such a solution seems to be literally incompatible with Article 31(3)

[51] Cf. Łabno, "Zasada bezpośredniego obowiązywania konstytucyjnych praw i wolności," 64–81.

[52] The adopted construction of sanctioning restrictions on the rights and freedoms of an individual by a third party under a statutory delegation is not an exceptional solution. A similar solution has been applied in the Law on Spatial Planning and Development, which empowers the municipal planner to determine the terms of an individual's use of the right to property, including limitations of this right.

of the Constitution of the Republic of Poland, which requires that limitations on the rights and freedoms of an individual be imposed only in a legal act of statutory rank. The issue of admissibility—in compliance with Article 31(3) of the Constitution of the Republic of Poland—of granting, under a statutory provision, to a specific professional association the competence to formulate limitations of constitutional freedoms and rights in a code of ethics binding on that association and adopted by its bodies, has been examined by the Polish Constitutional Tribunal. The Tribunal did not question the correctness of such a solution. In its judgment of 23.04.2008, SK 16/07, the Tribunal explained: "[T]he delegation of authority to intervene in certain constitutional freedoms of persons pursuing a profession of public trust to professional bodies may be justified under certain conditions and may even be considered compatible with the needs of the '"proper exercise" of regulated professions. However, this authorisation may not be of a blanket nature (so the Constitutional Tribunal in the judgment of 22 October 2003 in the case ref. P 21/02[53]). At the same time, it is worth emphasising that a slightly more liberal approach to this premise is supported by the specific nature of the professions of public trust, as regulated professions, subject to compulsory membership in the professional association.

In the cited case SK 16/07,[54] concerning the binding force of the Code of Medical Ethics established—similarly to the Code of

[53] In case ref. P 21/02, the Court explained, joining a particular professional association […] by a person—after fulfilling the statutory conditions—is tantamount to voluntarily, 'submitting oneself to the supervision over proper exercise of the pursued profession" and thus, constitutes voluntary submission to the association's internal norms […]'.

[54] "In reference to the preceding observations, and in particular in view of the content of Article 188 (1)–(3) in conjunction with Article 79(1) of the Constitution, it is therefore impossible to conclude that the subject of the Tribunal's review can only be the aforementioned internal provision of a deontological nature and the relevant fragment of the Medical Pledge considered independently (i.e. in isolation from the provisions of the Act on Chambers of Physicians, hereinafter the A.i.l.). The provisions of the Commission on Medical Ethics (hereinafter KEL), analysed in isolation from the relevant statutory provisions, belong to a separate normative (deontological) order and acquire legal value as generally applicable law precisely by virtue of the Act on Chambers of Physicians and within the scope defined by its provisions, in particular under Article 4 of that Act, constituting the legal basis for the issue of KEL. Consequently, the object of the Constitutional Tribunal's review is the provision of Article 52(2) of the KEL in conjunction with the relevant provisions of

Ethics for Researchers by the Polish Academy of Sciences—under a statutory delegation by the Commission of Medical Ethics, the Constitutional Tribunal had no doubts that the provisions of the Code had a binding force. At the same time, the Tribunal explained that although codes of ethics belong to a separate normative order—deontological one—they acquire legal validity as generally applicable law by virtue of the statutory norm that provides the legal basis for issuing a particular code of ethics. Thus, deontological documents acquire the value of generally binding law due to the existence in the legislative system of an act authorising their issuance and within the scope defined by the provisions of such act. In this way, the Polish Constitutional Tribunal referred to a well-known from earlier case-law construction of "complex statutory norm," which at the statutory level has blanket nature, to be subsequently specified by concrete provisions of an act passed a body of the authorised professional association.

It is worth adding that the Polish Commission for Ethics in Science in shaping the content of the provisions of the Code of Ethics for Researchers is bound by the constitutional principles on the restriction of constitutional freedoms and rights under Article 31(3). The introduction of restrictions must therefore be necessary in a democratic state ruled by law to protect one of the values protected under this constitutional provision. Restrictions may therefore be introduced to protect the freedom of science and the related legitimate interests of other subjects of this individual freedom. Of course, these restrictions must not infringe the essence of the freedom of science, that is, deprive an individual of the possibility to exercise this freedom. The sanctioned restric-

the A.i.l., and, strictly speaking, the legal norm derived from the cited provisions and clauses. An analogous concept of a ,'complex statutory norm" (albeit essentially blanket at the statutory level), subsequently specified by a specific provision of an act adopted by a body of the professional association, was already adopted by the Court in its judgment of 7 October 1992, ref. U. 1/92 (OTK in 1992, part II, item 38). […] Taking into account both the objectives of the constitutional complaint and the allegations formulated therein, the Constitutional Tribunal in the present adjudicating panel is of the opinion that the object of review is the legal norm derived from Article 52(2) KEL in conjunction with Article 15 item 1, Article 41 and Article 42(1) of the A.i.l. Thus, the scope of the Court's review covers the above-mentioned provisions and clauses, with emphasis on Article 52(2) of the KEL, which contains the description of the prohibited and sanctioned behaviour of a physician that is essential in the case under consideration."

tion should also satisfy the principle of proportionality, that is, be introduced to the extent necessary and least burdensome to protect the freedom of science of the various subjects whose interests may conflict.

In conclusion, it is beyond dispute that the Polish Code of Ethics for Researchers has universal validity in the scientific community. Anyone conducting research in Poland is obliged to comply with the provisions of this code when undertaking and carrying out scientific projects. The currently binding Code of Ethics for Researchers[55] was developed by the Commission for Ethics in Science and adopted by the General Assembly of the Polish Academy of Sciences on 25 June 2020. Its provisions formulate binding recommendations concerning, inter alia, handling scientific data, research procedures, publishing practices, reviewing and expressing opinions on scientific works. In this respect, normative character should be attributed to the very preamble of the quoted Code, which, by defining the "spirit of the Code," determines the manner and context of interpretation of its provisions, which is binding on the interpreter. Notably, the very first item of the aforementioned preamble to the Code contains a clause authorising the interpreter of the Code to apply broad interpretation, opening its regulations to the system of ethical principles in force in our cultural circle. Indeed, the Code states that "it is based on the fundamental principles of ethics that have been developed within our cultural realm and are recognized as natural and universally applicable. The fundamental principles of ethics refer to respect for human dignity and life in all its manifestations, truthfulness, honesty, integrity, the obligation to observe commitments taken on, and the recognition of the right to freedom of belief and the right of ownership." A person's conscience is the gatekeeper in ethical matters, while the assessment of facts and external acts that violate the welfare of others is subject to the judgement of credible bodies. In the next paragraphs of the preamble of the Code, we read: "3. Ethical values, the standards of research integrity, and good practices in research highlight the ethical and social responsibility of researchers. Researchers must be aware of their special responsibility towards society, humanity at large, and the natural environment. 4. This Code of Ethics for

[55] https://instytucja.pan.pl/images/2021/CodeofEthicsForResearchersThird-Edition.pdf (30 March 2023).

Researchers presents the principles established by the research community in the belief that the primary duty of researchers is to observe the established principles and to maintain honesty, truthfulness, and impartiality during research work. The Code defines the criteria of good practices, identifies ethical violations in the conduct of research work, and establishes procedures to be followed in the event dishonest research behaviour is revealed. […].”

The analysed Code of Ethics for Researchers already in the very preamble imposes on every researcher the obligation to observe in scientific work such requirements as conscientiousness, objectivity, reliability, criticism, honesty, care and responsibility for the word. Broken down into thematic units, it further specifies, inter alia, the rules for designating the authorship of a scientific publication in which the research results are published. Chapter III of the Code, entitled Good practices in research, lays down “detailed and rationally substantiated rules of proper conduct that are possible to introduce in individual research units, related to the conduct, presentation, and review of research, and intended to ensure the fulfilment of ethical requirements. All researchers from the beginning of their activity should be aware of these rules and know the consequences of violating them.” The principles of good practice formulated in the Code set out, among other things, the rules for: handling scientific data; research procedures; authorship; and rules for publishing research results. At the same time, it is stipulated that these practices may be subject to cultural differences; definitions, traditions, legal regulations and institutional rules may differ significantly from one scientific discipline to another. The following provisions of the part of the Code under review set out mandatory requirements for authorship and publishing practices. Section 3.3, “Authorship and Publication” reads: “The authorship of a scientific publication must be based on the fulfilment of at least one of the following conditions: a creative and significant contribution to the research, which means a significant contribution to creating scientific ideas, formulating concepts, and designing research, an unquestionable active involvement in the acquisition of data, in the analysis and interpretation of the findings, as well as a substantive and reliable contribution to preparing and critically drafting the article from the point of view of the applicable scientific criteria” (subsec. 2). “Obtaining funding, providing access to equipment and related training, collecting data, or exercising general administrative supervision of a research group do not give anyone the right to claim co-authorship. The head of a research unit may not be listed automatically as a co-author of articles published by their subordinates" (subsec. 3). "All authors are fully responsible for the content of the publication unless otherwise specified (for example, that they are responsible only for a specific portion of the research in their area of expertise). When the affiliations of authors are listed, it is recommended that the nature of their contribution be specified" (subsec. 4). "Names of the authors of a publication should be listed in the order that is customary in a given scientific discipline and should be accepted by all co-authors at the initial stage of drafting the publication. Intellectual contributions of other individuals who have a significant impact on the published research should be appropriately acknowledged" (subsec. 6). In subsection 4.3 of the Code, entitled "Other Types of Misconduct," in the discussed area, it is specified that "in addition to gross violations of scientific integrity [...], there are many other misconducts" occurring in the conduct of scientific research. Their catalogue cannot be exhaustive, however, by way of example, the following were identified as undesirable behaviours: using the contributions of others—students, postgraduates, collaborators—in the conduct of scientific research without adequate financial compensation or without indicating these contributions in the publication; allowing co-authorship of a publication by persons who did not sufficiently contribute intellectually to its creation.

According to the principles quoted, any direct and substantial intellectual contribution to the research process concluded with a specific publication entitles its author to the status of co-author of that scientific publication. A condition for the formulation of such a claim is that it must be possible to prove that the contribution to the research was individual, original, creative and significant. It may consist in a significant involvement in the initiation of a scientific idea or hypothesis, the formulation of a concept or design of a study, including a significant contribution to the acquisition of data (experimental or otherwise), the editing of an article or its critical revision for important intellectual content, or the preparation of significant parts of the work, for example, literature review, findings or results.

1.2.3. Case Studies from the Jurisprudence of the Commission for Ethics in Science at the Polish Academy of Sciences

In order to properly interpret the obligations of the researcher sanctioned by the Code of Ethics for Researchers arising from the requirement to respect the intellectual contributions of others to a scientific project, it is helpful to carry out an analysis of the jurisprudence of the Commission for Ethics in Science formed in cases related to scientific authorship and the right to be an author of a scientific collective work. An analysis of successive reports of the Commission for Ethics on its jurisprudential activities unfortunately does not provide significant research material. Nevertheless, a few of the decisions of this Commission may prove useful for the formulation of some general findings.[56]

Thus, in case ref. I/2015 (16/2015), the subject matter of the dispute were charges brought against a researcher with a doctoral degree for violating ethical principles by, inter alia, continuing and publishing the results of research previously conducted in teams led by Prof. Y, despite the fact that in a statement signed by the defendant he undertook to refrain from such research and its publishing. Meanwhile, the defendant, without the knowledge and consent of the co-authors of the papers, published the results of these studies and attributed to himself the role of lead author. After a thorough analysis of the documentation of the case, the Commission concluded that a demand that a young researcher, upon changing the scientific team, undertake to abandon the research in the direction on which he had worked so far, is not in accordance with good manners and has no legal justification. With regard to the second allegation, it was pointed out that the co-authors did not dispute the substantive content of the articles, the final editing of which was carried out by Dr X, but only claimed a failure to obtain from them formal consent to send the articles for publication. It was stated that Dr X should, if applicable, compensate the co-authors for the damage they had suffered as a result and, if applicable, be advised of the impropriety of his conduct.[57]

[56] https://instytucja.pan.pl/index.php/sprawozdania-z-dzialalnosci-komisji-do-spraw-etyki-w-nauce; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[57] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2015 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for

Another case, reference IV/2014, dealt with the issue of copyright infringement formulated as a question "whether the defendant's publications should be considered as plagiarism of a co-authored manuscript that was previously submitted for publication and then rejected after reviews." The material provided to the Commission showed that the defendant had revised the text of the co-authored manuscript herself and was the only author to send it to another journal. In resolving the question of the rules applicable to the conduct of joint research, the Commission pointed out that the undertaking of joint research involves a mutual commitment to cooperate, with a view to bringing the research to its intended conclusion and publishing and editing the results in a form accepted for publication. Only substantive considerations, for example, a legitimate refusal of acceptance of the final text or a proposal to introduce changes to an already agreed text, were identified by the Commission as obstacles to such an objective. It was also stated that in case of a declaration by one of the authors to unilaterally withdraw from further work on the manuscript without giving any valid substantive reasons, the author has the right to continue working on the work and publish it under their own name. In such a situation, however, they should omit from the publication those excerpts from the original manuscript that contain original and relevant thoughts, as well as the research results of the scientist who has withdrawn from co-authorship and who has not consented to their publication. However, this does not apply to passages where standard research methods are used. Evaluation of the situation may be complicated by the issue of third-party intellectual property rights. Addressing the question of whether there was plagiarism in the case presented, the Commission held that the determination would depend on the form of use of the co-author's results. It indicated that it could not assess whether, in this particular case, the changes made to the publication by one of the authors were substantial enough to be considered a new work.[58]

2015], https://instytucja.pan.pl/images/2016/komisja_etyki/spraw_kom_etyki_15.pdf.

[58] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2014 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2014], https://instytucja.pan.pl/images/2014/Komisja_Etyki/Sprawozdanie_z_działalności_KEwN_w_2014_r.pdf.

In case ref. 105/2014, the Commission commented on a reviewer's use of data contained in a scientific publication they were reviewing, which use was evaluated through the prism of the Code of Ethics for good practice in scientific research, under which, allegedly, both reviewers and editors of scientific works may not use the data or concepts contained in texts provided to them without the author's consent (section 3.4.4.). The Commission pointed out in this regard that, in accordance with the provisions of the Code, research and scientific inquiry cannot be practised without drawing on the work and achievements of predecessors. At the same time, however, it recalled the content of Chapter 2, point 9, from which it follows that among the universal ethical principles and values one can find honesty in recognising the scientific achievements of those to whom they are truly due. In turn, this honesty is expressed in the appropriate citation of sources and fair recognition of the share of other researchers, be they collaborators, competitors or predecessors.[59]

In case ref. III/2013, the Commission examined an allegation that clinical material had been stolen and then, based on deceitfully obtained consent, used by a former employee of a research unit to conduct a doctoral dissertation at another university. In this case, there was a doubt as to whether there had not been a copyright infringement as the subject of the dissertation was, among other things, research on bone prostheses, which had been transferred from one institution to another. In the Commission's analysis of the case, particular attention was drawn to the fact that, in the case file, there was a letter granting permission to use the clinical material, medical and radiological records for scientific purposes—for doctoral dissertation and publication. There was no stipulation in the letter that the doctoral dissertation was to be prepared under the direction of Prof. X from the applicant academic unit. In its statement, the Commission expressed the view that, contrary to accepted academic custom, the defendant did not inform Prof. X, the defendant's previous academic supervisor of his intention to do his doctorate at another university.[60]

[59] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2014 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2014].

[60] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2013 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the

It seems that the requirements of personal culture and respect for the previous supervisor required such information to be communicated to him.

Two cases resolved by the Commission for Ethics in 2017[61] are especially relevant to the subject matter of the present study. Namely, in the case ref. 06/2017, 21/2017, 30/2017 (cd. V/2015), the Commission for Ethics considered anew the application brought by the University of Wrocław concerning copyright infringement and irregularities in the course of the investigations conducted by the Senate Ethics Commission of this University, as well as violations of ethical principles by Prof. Y. In this case, the head of the research team, Prof. Y, accused Dr X of removing his name from the list of authors of the publication A. The defendant explained that the first version of the paper had not been accepted for publication and that Prof. Y had then been granted the status of co-author solely by virtue of his position as head of the research team. Then, after the rejection of the paper by the journal editor, corrections were introduced in the paper, whereby the first and the second version of the publication showed considerable similarity of over 90%. In the second version of the paper, accepted for publication, Prof. Y was no longer named as a co-author. In resolving this legal issue, the Commission for Ethics took the view that the basis for obtaining the status of co-author of a scientific work, pursuant to para. 3.3.2. of the Code of Ethics for Researchers, could only be a creative and substantial contribution to the research, at the same time ordering the University's Ethics Commission to determine what Prof. Y's contribution to the disputed publication was. The similarity of the first, unpublished version of the article with the indication of Prof. Y's co-authorship to its second version, already published without his authorship, is not conclusive in favour of Prof. Y's right to be listed as an author.

In another case, also decided in 2017, the Commission for Ethics addressed an important issue of students' participation in

Commission for 2013; https://instytucja.pan.pl/images/2013/Komisja_Etyki/Sprawozdanie.pdf.

[61] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2017 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2017, *NAUKA* 3 (2018): 177–182, https://instytucja.pan.pl/images/2018/komisja_etyki/Sprawozdanie_z_dzia%C5%82alno%C5%9Bci_Komisji_do_spraw_etyki_w_nauce_za_2017.pdf.

research conducted by their supervisors (promoters). Namely, in the cases ref. 25/2017, 40/2017 and 52/2017, the application by MA X and MA Y concerning the violation of the principles of scientific integrity by employees of the J. Piłsudski Academy of Physical Education in Warsaw was examined. In the report of the Chairman of the Commission, Prof. Andrzej Zoll, it was not made clear whether the case concerned research included in diploma theses or participation of the students in a target research of a scientific employee. The essence of the case boiled down to the allegation that the list of authors of article A omitted the names of MA X and MA Y, ladies who had participated in the research conducted by Dr Z. In this respect, it was established that the aforementioned had participated in the research of Dr Z, and that their involvement in it had required a significant amount of time. However, it was unequivocally established that the nature of the activities they performed at the project carried out by Dr Z was of a purely technical nature. Then, a scientific article without co-authorship by Ms X and Ms Y was written on the basis of the research carried out, however, separately from the research and only a few years after its completion. In resolving the application, the Commission for Ethics ordered an errata to the article, the object of which would be to expand the list of authors. Thus, not only a creative contribution but also a purely technical and therefore non-creative one, however, one that was independent and of such a nature that it conditioned the creation of the scientific work (because it was used in it) was classified as a significant contribution to the research, justifying the status of co-author of the scientific work.

In the context of the above considerations, it seems appropriate to address the issue of the importance of student participation in the research of academics, including in connection with and within the scope of a thesis being developed.[62] It seems that mere participation of a student in the research of a researcher should not automatically imply their right to become a co-author of the research process and the resulting scientific papers. In this matter, the student's actual role in the research should be decisive. In particular, it seems necessary to

[62] This subject was discussed by Barta and Markiewicz, "Prace studenta wykonywane w toku studiów" [Student Works Performed during the Course of Studies], in *Własność intelektualna w szkołach wyższych i instytutach naukowych (Raport)* [Intellectual Property in Universities and Research Institutes (Report)], (Warszawa: Wydawnictwo KBN, 1993), 20–21.

establish whether the student took on the position of an independent actor in the research process or was only a technical executor of the instructions of his supervisor (of the research objectives in a previously designed experiment), and this within the framework of the didactic process carried out by the supervisor, which boiled down to the transfer of knowledge, competences and skills in a specific area. If we are dealing with the former case, that is, the student's active and independent involvement in the research process, the student must of course be recognised as a co-author of the research and, consequently, as a co-author of the publication or even the invention. On the other hand, when we are dealing with the second situation under consideration, that is, when the student participates, in a technical sense, in the collection of scientific data by their supervisor, on this account they cannot claim co-authorship of either the research and its results or the ensuing scientific publication. This determination seems valid even if the student's thesis and their supervisor's scientific publication are produced almost simultaneously using the same experimental data. The analysed factual situation should be assessed in such a way that it is the supervisor who, as part of the didactic process carried out with respect to the student in connection with the preparation of the diploma thesis, involves the student in their research, at the same time imparting to them knowledge, competences and skills (thus making it possible to follow the research being conducted or to technically participate in it). For it is the supervisor who allows the student to use, in the student's thesis, the experimental data they have collected, and not vice versa. It seems irrational to claim that a student with no research experience acquired the experimental data for the promoter and allowed it to be used in the scientific thesis, especially taking into account that they acted in the experimental process as a student (a journeyman, so to speak) and not as the designer and independent performer of the scientific experiment.[63] To sum up, when the student's contribution to a scientific research, although undoubtedly existing, has nevertheless a purely technical nature and, therefore, is not independent and creative, it is not of such importance that its author could obtain the status of co-author of the scientific work. Consequently, it

[63] Cf. Barta and Markiewicz, "Prace studenta wykonywane w toku studiów" [Student Works Performed during the Course of Studies], 20–21.

must be assumed that, in the second situation considered, the student's co-authorship of a scientific work requires that they perform more work than that of a technical nature and under the supervision of a supervisor. They should, for example, interpret the results of scientific research and then contribute such interpretation to a scientific publication.

Concluding reflections on purely technical participation of a student in the research process, it seems that a possible and appropriate solution would be to sanction the custom of recognising the student's contribution to the publication of research results by including a thank-you note or information about the nature and subject of their participation in the acquisition of experimental data or technical participation in the elaboration of the results (such as collection of relevant literature, preparation of a discussion against the background of published statements (positions) of scientists on a given research subject). Legitimacy of such a solution and of the sanctioning of an appropriate academic custom was pointed out in the past by Jan S. Knypl.[64]

Another issue to be considered is the question of a diploma thesis as work within the meaning of copyright law. The rules adopted at universities require that only the student be designated as the author of the thesis. The thesis supervisor is not formally designated as its co-author although in many cases their contribution to its creation is significant or even predominant. In the same context, a serious legal problem arises if the supervisor makes direct use of the thesis in a later scientific publication, not only with regard to the results of the research but also with regard to the findings made therein, interpretation of the results, etc. If, substantively, the content of the student's thesis and their promoter's publication is identical, it can even be argued that it is the student's exclusive work, and they certainly have the right to co-author the scientific publication (which cannot be disputed). Changing the language of the text of a published scientific paper is irrelevant when it appears in print in English. The supervisor becomes the sole author of the work, which is a translation of the thesis prepared in Polish, still, there is a direct link (relationship) between the Polish-language version of the study and its English-language version, namely the former is the original work while

[64] See J. S. Knypl, "Autorstwo pracy naukowej" [Authorship of a Scientific Work], *Nauka Polska* 5–6 (1984): 146.

the latter is a dependent work in the sense that it constitutes an elaboration of the former work in a foreign language.

In the case GP.KEwN.051.1.2018, the Commission for Ethics addressed the manner in which the obligation imposed on researchers in the Code of Ethics to correctly cite the works of other authors in their publications was implemented (point 3.3.9.) and the allegation of a violation of the prohibition under the Act of 4 February 1994 on Copyright and Related Rights of appropriating the authorship or misleading as to the authorship of the whole or a part of a third person's work,[65] against the background of the following facts. Ms X, MSc, reported to the Commission possible plagiarism committed by an employee of a university and the university's failure to respond to the allegation. In a monograph of his authorship, the defendant was alleged to have based one of the subsections of the work on an article published in the journal Roofers & Carpenters. The Disciplinary Officer of the university employing the defendant refused to initiate disciplinary proceedings, stating that "the academic community, in monographs and scientific papers, does not accept the citation of articles of an informative, advertising or popular science nature. Therefore, one should not demand that article 'B' be cited in a scientific monograph." The Commission for Ethics in Science disagreed with this position and highlighted that all authored texts were subject to legal protection. The Commission concluded that the Disciplinary Officer had demonstrated a lack of knowledge of the ethical rules applicable to science and ordered the Rector of the University to consider if the Officer should not face official consequences. The Commission also ordered the university to thoroughly investigate the report.[66]

The case GP.KEwN.051.2.2018 also dealt with an allegation of violating the prohibition of appropriating the authorship or

[65] "Article 115. 1. Anyone who appropriates the authorship or misleads as to the authorship of the whole or a part of a third person's work or performance, shall be liable to a fine, restriction of personal liberty or imprisonment for up to 3 years. (2) The same penalty may be imposed on a person who distributes, without giving the name or pseudonym of the author, a third person's work in its original version or as a derivative work, or a performance, or deforms such work or a performance, phonogram, videogram or broadcast in public. […]."

[66] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2018 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2018], https://instytucja.pan.pl/images/2018/komisja_etyki/sprawozdanie_z_dzia%C5%82alno%C5%9Bci_Komisji_do_spraw_etyki_w_nauce_w_2018.pdf.

misleading as to the authorship of the whole or a part of a third person's work. The breach of this prohibition was alleged to have occurred in the content of a grant application. In response to a notification of the possible commission of this act, the Rector of the university refused to initiate an investigation on the grounds that the case should be investigated by an ordinary court and not by the disciplinary committee. The Commission for Ethics in Science disagreed with this stance, recalling that the scope of disciplinary liability of academic staff, as defined by the Act, includes acts of violation of the principles of ethics in science, including acts of copyright infringement. The case was not finally resolved through disciplinary proceedings due to the personal nature of the dispute between the informer and the person accused of committing the disciplinary act. The Commission in this situation pointed to the jurisdiction of the court to resolve the dispute.[67]

In the case GP.KEwN.051.6.2018, the Commission for Ethics once again addressed the way in which the obligation imposed on researchers under the Code of Ethics to correctly cite the work of other authors in publications (point 3.3.9.) was implemented. The interpretation of the terms of applying this principle was provoked by the following questions: (1) "whether, when discussing certain past events in a scientific study in the area of historical sciences, it is in each and every case required to indicate in a footnote that the occurrence of these facts was also commented on in earlier studies by other authors, and whether this is required even in such situations when the facts and events in question are not extremely difficult to establish […], when the facts and events could possibly also be established on the basis of sources other than archival sources […]. (2) whether the manifestation of possible unreliability in documenting the sources used in a scientific study in the field of history, consisting in the citation in footnotes of sources and documents not directly connected with the events, facts and circumstances which are the subject of one's own study […] which may also be the result of an error, constitutes a breach of the principles of ethics in science of such a nature that it justifies an assumption of a disciplinary offence […]." Upon considering the case, the Commission concluded that

[67] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2018 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2018].

"it is customary in the scientific community to indicate where a given topic has been discussed and, then, to refer to the most authoritative or recognised sources, monographs, studies, and this should be sufficient. […] In the Commission's view, the scientific output is the property of the author, but as soon as it is published, it becomes public domain and everyone has the right to cite it. It is therefore possible to refer to a source/text that has been developed before, however, the names of its authors must not be omitted.[68]

In the case KEwN.GP.004.32.2019, the charge of committing self-plagiarism under Paragraph 3.3.8. of the Code of Ethics[69] was resolved. The defendant in this case was accused, inter alia, that "the literary output documenting some research areas pursued by Prof. Y […], is a clear example of a text prepared by rewriting large portions of previously published works without indicating such previous works, usually in extenso and often including footnotes." Demonstrating the unacceptability of such a practice in the publication of research results, the applicant argued that "such manipulation of research material in the presentation of research results constitutes unreliable multiplication of one's scientific output, which, juxtaposed against the criteria for the evaluation of scientific achievements, among which the productivity of publication is the most important parameter, leads to unauthorised acquisition of further academic honours, degrees and titles." In this case, the Commission did not share the applicant's position and accepted as correct the factual findings of the Disciplinary Committee of the University investigating the case. In its position, this Commission, concluding that the accused had not committed the alleged self-plagiarism, made the following findings of fact: "In an overt and always documented manner, he [the defendant—A.Ch.] only used his earlier work, especially where their research was of a pioneering nature. […] perhaps

[68] Sprawozdanie prof. A. Zolla, Przewodniczącego Komisji ds. Etyki w Nauce z działalności Komisji za rok 2018 [Report of Prof. A. Zoll, Chairman of the Commission for Ethics in Science on the activities of the Commission for 2018].

[69] "Republication of the same work (or significant portions thereof) may be accepted only with the permission of the editors, and it should always include a reference to the first publication. Such studies that are related to one another in significant portions and in significant scope should be included in the list of the author's achievements as a single item. Artificially inflating the list of publications by multiple mentions of the same scientific achievement under different titles is a reprehensible practice."

only in a few cases he could have indicated in a footnote in a little more detail the reason why some texts (e.g., post-conference materials from different sessions on similar topics) were strongly similar."[70]

The issue of the boundaries of plagiarism and self-plagiarism and it ethical reprehensibility was addressed by the Commission for Ethics in the case KEwN.GP.004.3.2020. Regarding the phenomenon of self-plagiarism, the Commission took the view that "it is common for authors to quote their own texts in subsequent publications. However, certain authors show a lack of diligence in citing such data appropriately, as exemplified by Dr X." It was also emphasised that the omission of legitimate citation of other authors, regardless of sometimes accidental causes—is reprehensible." In the facts under consideration, the Commission imputed to the defendant a failure to cite an article by another Polish author from 2003. At the same time, the Commission pointed out that either work was not a research paper, however, their contents coincided and in both of them the authors cited several works by another author in relation to the methodology discussed therein, which were published in 2000–2001. All of this led the Commission to the conclusion that there was a possible infringement of copyright or related rights in the case under review. In consequence, proper examination of the case required substantive assessment by an expert in economic sciences.[71]

The cases under reference numbers KEwN.GP.004.4.2020, KEwN.GP.004.6.2020, and KEwN.GP.004.42.2019 related to violations of scientific ethical standards by employees of one university, including, among others, a thread concerning the possibility of the defendant's unauthorised use of laboratory works performed by a scientific team led by the current Rector in a thesis entitled "A" (2018). These works had been previously used by MSc Y to prepare his doctoral dissertation entitled "B." A request for an opinion on this matter from the Commission for Ethics in Science was submitted by the Rector of the University. Notably, in 2016, MA Y defended her doctoral dissertation at her home University.

[70] Załącznik do sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2020 [Annex to the Report on the Activities of the Commission for Ethics in Science in 2020]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[71] Załącznik do sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2020 [Annex to the Report on the Activities of the Commission for Ethics in Science in 2020].

The doctoral student did not wish to publish the results of the doctoral dissertation; the defendant undertook to prepare an English-language version of the publication. This publication was included as a part of the scientific achievements assessed in the defendant's habilitation proceedings. Examination of the application through the prism of determining the defendant's contribution to the publication based on MA Y's doctoral thesis raised doubts in the Commission. In the English-language publication, MSc Y was placed in the fifth position among eleven authors. In contrast, in the scientific achievements described in the habilitation application, the defendant listed this publication in the second place and valued his contribution at 65% and that of the doctoral student at 2%. In this case, the Commission for Ethics in Science found that "mere translation and adaptation of results from a PhD does not entitle any person to be the first author of a publication. Translation cannot be considered a scientific achievement."[72]

Case KEwN.GP.004.5.2020, on the other hand, involved an allegation of using someone else's research ideas. A doctoral student from a Polish university stated to be a victim of unethical behaviour on the part of a colleague who received her materials and then allegedly used them and her research topic as well as work by publishing them as his alleged discovery. On the basis of the documentation provided by the doctoral student, the Commission came to the conclusion that she might be a victim and requested the Rector of the university to initiate appropriate investigation.[73]

An allegation of copyright infringement was also made in the case KEwN.GP.004.31.2020. The aggrieved party in that case made an allegation against the defendant that a book published by him in 2018 contained an article entitled "B" which had been translated into English. This article, in turn, was said to be almost entirely made up of sentences transcribed from the victim's doctoral thesis, defended in 2014. The victim asked the publisher to publicly retract this chapter and to announce this fact on the publisher's website, including the reason for the retraction. In

[72] Załącznik do sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2020 [Annex to the Report on the Activities of the Commission for Ethics in Science in 2020].

[73] Załącznik do sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2020 [Annex to the Report on the Activities of the Commission for Ethics in Science in 2020].

this case, the Commission asked the Rector of the University to clarify the matter and Dr X was notified about this action.[74] The case was remanded to and examined by the Commission the following year under the reference number: KEwN.GP.004.31.2020. It turned out that the investigation activities carried out at the university employing the defendant confirmed the charge against him. The Commission for Ethics in Science was informed that the Editorial Board of the publishing house that had published the book unanimously decided to withdraw the book and a retraction note had been issued.[75]

Case KEwN.GP.004.14.2021 related to an allegation of possible ethical misconduct by scientific and research and technical staff, which allegedly consisted in misappropriation of authorship and misrepresentation as to the authorship of a scientific article accepted for publication in 2019. In examining this case, the Commission held that "inclusion of co-authors of a research project or of previous articles is not necessary for the creation of a new publication by the lead author. In the opinion of the Commission, research material and clinical data of patients collected several years earlier within the framework of the above-mentioned project, could not be 'endlessly' a source of the current scientific output of the performers. In the subsequent years, the persons holding the collected material may but do not have to invite specific specialists to collaborate scientifically. According to the Commission, it was not reasonable to include all the 2004–2009 project implementers as co-authors in the 2019 article. In contrast, including other specialists in the research is acceptable and even advisable when methodological or intellectual 'support' of the research is necessary. In the opinion of the Commission, it is not enough to be the head of a Clinic or Department, or to provide equipment or a laboratory with routine specifications, to become a co-author of a scientific article, unless the regulations of the specific scientific unit provide otherwise. Accordingly, the Commission concluded that it was not a breach of ethics not to include some of the former project implementers among the co-authors

[74] Załącznik do sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2020 [Annex to the Report on the Activities of the Commission for Ethics in Science in 2020].

[75] Załącznik nr 4 do Sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2021 [Annex 4 to the Report on the Activities of the Commission for Ethics in Science in 2021]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

of the 2019 article. The Commission also pointed out that the lead author is the decisive person and should objectively assess the contributions of individuals to the research related to the publication. The rules for the publication of results and co-authorship should be agreed within the team before the research starts."[76]

In the next three cases examined by the Commission for Ethics in Science, the requirements were considered for candidates for the academic title in Poland. Thus, the subject matter of the case KEwN.GP.004.25.2021 was a request from the Council for Scientific Excellence for an opinion on the possibility of copyright infringement by a candidate for the title of professor. Among other things, the Commission's adjudication panel found that the copyright infringement by the candidate for the title of professor took place in June 2013. Namely, in a review article co-authored by the candidate for the title, 90% of the content was rewritten from two book chapters by other authors. In assessing this factual situation, the Commission took the view that "plagiarism is reprehensible even if it concerns a review article in a minor scientific periodical."[77]

In turn, in the case KEwN.GP.004.27.2021, the Commission for Ethics addressed the limits of a researcher's right to republish scientific content previously released in print. An allegation of self-plagiarism was made against a candidate for the academic title. The Commission held the position that "the author has the right to use in his work fragments of previous research to which he attaches appropriate references, since references and repetitions are natural in scientific discourse."[78]

In a further case, KEwN.GP.004.28.2021, at the request of the Council for Scientific Excellence, the Commission examined the validity of one of the opinions of an expert appointed in the proceedings for the award of the academic title of professor.

[76] Załącznik nr 4 do Sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2021 [Annex 4 to the Report on the Activities of the Commission for Ethics in Science in 2021]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[77] Załącznik nr 4 do Sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2021 [Annex 4 to the Report on the Activities of the Commission for Ethics in Science in 2021]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[78] Załącznik nr 4 do Sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2021 [Annex 4 to the Report on the Activities of the Commission for Ethics in Science in 2021]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

In this case, it was assessed that "the Expert's opinion is very detailed, insightful and comprehensive and points to a number of shortcomings of the Candidate with regard to the principles of scientific correctness, integrity and honesty […]." The expert drew attention to the far-reaching irregularities and the "successful circumvention" of the requirements in the habilitation procedure conducted at one of the Universities—the Candidate did not have habilitation rights and there are premises "for the resumption of the proceedings for the award of the habilitated doctor degree." In the opinion of the expert, the output of the Candidate in the period recognised as post-doctoral, in particular, the so-called professorial monograph "definitely does not reflect the real scale of the borrowings made and does not clearly indicate the sources of the presented results, which provides further evidence of legally and ethically unauthorised abuse of the achievements of the co-authors […]." The expert pointed in his opinion to misrepresentation of figures "close to fabrication and falsification of results, constituting a violation of the principles of thoroughness in the presentation of research results and indeed a violation of fundamental ethics of a research worker." In reference to the allegations thus formulated and to the documentation gathered in the promotion procedure under examination, the Commission considered the negative assessment of the applicant's application to be justified. In this matter, the Commission took the view that "[t]he candidate for the title of professor should be characterised by impeccable ethical conduct. The Council for Scientific Excellence should pay attention to the ethical aspects of the Candidate's professional activities throughout his or her academic career. The argumentation that only post-habilitation achievements are subject to the Council's assessment cannot be accepted, especially when the attainment of this degree is disputed. In the Commission's view, the Council was wrong to disregard, in reaching its decision, the insightful opinion of the appointed Expert. The Commission reached the conclusion that the suspicions of ethical misconduct in the achievements of Dr hab. X should be analysed and clarified by the Disciplinary Committee of the Candidate's home university."[79]

[79] Załącznik nr 4 do Sprawozdania z działalności Komisji do Spraw Etyki w Nauce w 2021 [Annex 4 to the Report on the Activities of the Commission for Ethics in Science in 2021]; https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

The analysis of cases examined by the Commission for Ethics relevant to the subject matter of this study allows to determine the prerequisites of the right to be a scientific author, co-author of a collective scientific work, in view of the Code of Ethics for Researchers. It follows from the provisions of the Code that any creative and substantial contribution to research implies the right to be an author of a collective work. Such contribution may be concretised in the researcher's significant participation in the formulation of a scientific idea, in the conception and design of the research, in their significant participation in the acquisition of data, in the analysis and interpretation of the results obtained, and in a significant contribution to the drafting and writing of the article or its critical revision in terms of its intellectual content. In the jurisprudence of the Commission for Ethics to date, this general principle has been concretised in several specific rules:

— In case of continuation and publication of the results of research previously carried out in another research team, the Commission pointed out the inappropriateness of this practice to the extent that it infringed the rights of the co-authors of the research. It was pointed out that the defendant should possibly compensate for the resulting damage suffered by the co-authors and, respectively, be instructed about the impropriety of their conduct. It was left to the relevant disciplinary committee to determine how the accused should compensate the other authors of the research results printed in a scientific publication. It would seem that one possibility would be to properly mark the authorship of the research described in the publication by correcting the original list of its authors (Case ref. I/2015 (16/2015)); the Commission drew attention to the limits of the researcher's right to use the research results obtained with their participation, explaining that the failure to include some of the former executors of the project among the co-authors of an article published many years after the end of their collaboration by the holder of the source data (research results that do not meet the characteristics of a work) does not violate the principles of ethics since the lead author is the decisive person and should objectively assess the participation of other individuals in the research related to the publication; however, the Commission recalled, on this occasion, that the rules for publishing results and co-authorship should be agreed within the team before the research starts (case ref. KEwN.GP.004.14.2021).

— With regard to the allegation of plagiarism—the use by the defendant of research results made available by another person—the Commission took the view that the omission of the designation of authorship of another scientist's research results and the failure to mark them in the list of authors could only take place if the defendant, in the published work, completely omits those parts of the original manuscript that contain the original and relevant thoughts and research results of the scientist who withdrew from co-authorship and did not consent to their publication. Otherwise, if someone else's research results were used, this should be reflected in the list of authors of the publication (Case ref. IV/2014, and also: KEwN.GP.004.5.2020).

— With regard to self-plagiarism qualified as an unethical act, the Commission clarified that an author has the right to use extracts from previous research and published works in their work provided that they include references to these works in the new publication; on this occasion, the Commission recalled that references and repetitions are natural in scientific discourse (cases ref. KEwN.GP.004.27.2021 and KEwN.GP.004.32.2019).

— With regard to the rules for quoting other people's work and including references to it, the Commission expressed the view that all authors' texts are subject to legal protection and that, therefore, in scientific work, the rules for including references to other people's work, as set out in copyright law[80] and the Code of Ethics, apply also to articles of an informative, advertising or popular science nature (case ref. GP.KEwN.051.1.2018; and also: KEwN.GP.004.3.2020).

— The Commission also took the view that, in scientific work, citation of sources and fair acknowledgement of contributions due to other researchers, be they collaborators, competitors or predecessors, is a fundamental rule that must be followed if the research is to be considered reliable and ethical (Case Ref. 105/2014).

— The Commission noted that the researcher's claim to cite their own work has its limits, as it is customary in the scientific community to cite the most authoritative or recognised sources,

[80] Art. 29. Polish Act on Copyright and Related Rights: "Works constituting an independent whole may quote fragments of distributed works and entire distributed graphic works, photographic works, and minor works, to the extent that it is justified by the purpose of the quotation, such as explanation, polemics, critical or scientific analysis or teaching, or by the rights of an artistic genre."

monographs, studies, and this should be considered sufficient; the Commission added that the scientific output is the property of the researcher, however, as soon as it is published, it becomes public domain and everyone has the right to make use of it, as far as they respect the principles of citation and provide correct references to other people's work (case ref. GP.KEwN.051.6.2018).

— The Commission accepted that the basis for obtaining the status of co-author of a scientific work can only be actual contribution of the person claiming such status to the research announced in the publication, whereby the nature of this contribution should be independent and relevant to the creation of the work (case nos. 06/2017, 21/2017, 30/2017 (cont. V/2015)), even if it was of a purely technical nature (case nos. 25/2017, 40/2017 and 52/2017). In doing so, the Commission referred to the views presented in the jurisprudence and stating that "[t]he inclusion of the name of a certain person as an author of the work cannot prejudge the question of authorship definitively. Such designation of a name thus merely creates a presumption of authorship that may be rebutted."[81] The commission held that "[i]n order to determine whether, in case of a scientific work to be published by the author as their own, the contribution of another person was so substantial that the work should be published as a joint work, the decisive factors are the extent and value of that contribution. Appointment of experts to clarify these circumstances may only be necessary if this requires specialised knowledge. Expert evidence is, however, superfluous if the size and value of another person's contribution to the scientific work has already been established by other evidence."[82]

— In cases involving allegations of copyright infringement, misappropriation of authorship and misrepresentation as to the authorship of a work, as well as the determination of the order in a list of authors of a multi-authored work, the Commission took the view that the mere translation and adaptation of results from a Polish-language work of another person does not entitle the translator to be listed as the first author of the publication, and that the translation alone cannot be regarded as a scientific achievement; consequently, a work containing such borrowings

[81] Judgment of the Supreme Court of 9.05.1969, I CR 77/69, in A. Korpala, *Prawo autorskie. Orzecznictwo* [Copyright Law. Case Law], ed. S. Stanisławska-Kloc and A. Matlak (Warszawa: Wydawnictwo Wolters Kluwer Polska, 2010), 108.

[82] Judgment of the Supreme Court of 18.11.1969, V KRN 267/69, in Korpala, *Prawo autorskie. Orzecznictwo*, 406.

from the works of others should, in certain circumstances, be subject to retraction with an indication of the cause (cases ref. KEwN.GP.004.4.2020, KEwN.GP.004.6.2020, KEwN.GP.004.42.2019 and KEwN.GP.004.31.2020).

Summarising the body of jurisprudence of the Commission for Ethics in Science, it should be noted that the cases considered by the Commission in 2021 concerning the requirements for candidates for scientific degrees led to the issuance on 3 November 2021 of the Position of the Commission for Ethics in Science on the analysis of scientific achievements, in terms of compliance with the principles of ethics in science, in promotion proceedings.[83] In the cited position, the Commission noted that "the current wording of the Law on Higher Education and Science approaches too narrowly violations of the principles of ethics in science, taking into account only copyright violations. In fact, the list of such violations is much broader and also includes data falsification, unreliable reviewing, conflicts of interest, etc. (listed, inter alia, in the Code of Ethics for Researchers, prepared by the Commission)." Furthermore, the Commission questioned the legitimacy of the position taken by the Council for Scientific Excellence, in which the Council stated that in the proceedings for the award of the title of professor only those scientific achievements and scientific activities of the candidate for the title as submitted for evaluation by the applicant are subject to verification. It is the application that determines the scope of the proceedings, including the analysis as to whether the evidence so presented justifies the conclusion that the substantive legal grounds for that academic promotion have been met. In consequence, this apparently leads to a conclusion that "the current legislation allows persons who violate the principles of ethics in science to obtain the title of professor provided that the violations do not involve the scientific output of their choice, on which the scientific promotion is to be based."[84]

With regard to these two issues, the Commission for Ethics in Science is of the opinion that action by the Polish legislator is necessary since "such a situation cannot be tolerated. We are of the opinion that a substantive analysis should encompass the entirety of a professorial candidate's scientific output and not

[83] KEwN.GP.004.30.2021, https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[84] KEwN.GP.004.30.2021, https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

just a fragment of such output arbitrarily chosen by the candidate for academic title. Consequently, also the potential analysis for compliance with the principles of ethics in science (and not only copyright, as it is currently the case) should cover the entire scientific output. The introduction of this change is undoubtedly correlated to the introduction of a requirement for an overall merit review—as we suggest. The current situation is not conducive to upholding the standards of ethics in science—especially with regard to persons applying for the highest status in the scientific and academic world—and, unfortunately, may provide an incentive to violate such standards."[85]

1.3. Nature of the Scientific Work

Concluding this part of the discussion on scientific authorship and the right to be an author of a scientific work, the question of the definition of a scientific work and of its characteristics arises. This concept has not been specified in any legal act, particularly, in copyright law. Literature of the subject[86] explains that scientific works are all works containing scientific content that has been collected, systematised and established as a result of a previously designed, implemented and successfully executed research process. The latter procedure means an organisational mode of operation designed by the scientist, which is determined by the subject matter and specificity of the scientific method of a particular scientific discipline. The aim of the research process is to bring about an increment of knowledge as a result of investigating, from a scientific perspective, into a phenomenon or object of interest to the researcher or research team. The activities

[85] KEwN.GP.004.30.2021, https://bip.pan.pl/artykuly/230/sprawozdanie-z-dzialalnosci-komisji.

[86] Cf. A. Szewc, "Dzieła naukowe i ich status w prawie autorskim" [Scientific Works and Their Status in Copyright Law], *Państwo i Prawo* 10 (1997): 24; A. Kędzierska-Cieślak, "Pierwszeństwo instytucji naukowej do opublikowania utworu jej pracownika" [Priority of a Scientific Institution to Publish the Work of Its Employee], *Państwo i Prawo* 8–9 (1996): 81; J. Barta and R. Markiewicz, *Prawo autorskie* [Copyright Law] (Warszawa: Wydawnictwo Wolters Kluwer Polska, 2010), 161; J. Barta and R. Markiewicz, "Komentarz do art. 1 i 14" [Commentary on Articles 1 and 14], in *Prawo autorskie i prawa pokrewne. Komentarz* [Copyright and Related Rights. Commentary], ed. Barta and Markiewicz, 35–37 and 156; Kopff, *Dzieło sztuk plastycznych i jego twórca*, 10–18; Gajdus, *Utwór naukowy*, 114–117.

undertaken by a person in the course of the process are creative in nature and should lead to the creation of an intangible good of an individualised and original nature. Pursuing the cognitive and communicative function of science, the researcher discovers and determines the content of the objectively existing reality or the laws governing it, and then communicates them to the public in the form of, inter alia, a scientific work, whose actual form is appropriate to the specific field of knowledge. A scientific work may be fixed in any form, including a book, a film, a poster with graphic elements (i.e., as a visual work), or a delivered lecture (reading) or paper.

However, mere mention of a scientific matter in the content of a work aspiring to the status of a scientific work is not sufficient to ascribe to it the value of substantial scientific significance. It is the scientific community that decides on the significance of a work and authoritatively attributes a cognitive value to it. In this evaluation, it is important to accept the methods and techniques applied in the research process and to confirm the substantive and methodological correctness of the scientific findings made. The work should, in its content, contain an argument, which in the view of a professional recipient appears to be based on a logically and substantively justified inference and subsumption of the research results obtained in the research process.

These requirements for a scientific work lead to the conclusion[87] that the function of a scientific work is to persuade the reader to step out of the area of the scientific argument itself, as contained in the work, into the world of objects existing independently of it. Indeed, the purpose of a scientific work is to announce to the world the content of the results of a previously designed, implemented and successfully concluded research process. The result of the research announced in the work should—in accordance with the knowledge gathered following legitimate research methods and techniques—correspond closely to the objectively existing reality in the given matter and, additionally, in case of a flawlessly executed work, even become its photographic reflection. Presentation and communication of the content of research results, in accordance with the binding standards of publishing the results of scientific works, assumes an individualised form, designed, for example, by the author/authors of the publication manuscript, however, in compliance with the rules applicable

[87] Kopff, *Dzieło sztuk plastycznych i jego twórca*, 12.

in the scientific world. Namely, the author/authors in their argumentation deployed in the work should make use of the reasoning processes relevant to the subject and scope of research, as well as styles, methods of selecting and grading arguments, bearing in mind that the employed means of presenting the effect of a creative work play a subsidiary role in relation to the research result itself. The originality of scientific works, as well as the fact that their value is expressed in a proof, that is, the process of evidencing contained in the work, individualised by its creator, is manifest in the comparison of the thesis/research hypothesis with the objectively existing (outside the creator and independent of their will) reality by means of appropriate means of expression. The latter should take the form of a set of logically ordered, unambiguously formulated sets of concepts and judgements addressed to the recipient's mind.

The publication of a work in an international, reputable journal is customarily considered to confer scientific status on the work. Its scientific significance does not always have to be linked to the presentation of scientific findings characterised by novelty in the sense of addressing a given issue for the first time. Scientific publications (works created by competent scientists) can take different forms.[88] Firstly, they can be original works, the content of which, by definition (in terms of non-confidential information), adds (new) value to the state of scientific knowledge in a certain subject or field. Secondly, they may be works that disseminate knowledge in a specific area of a scientific discipline in the form of monographic or review publication. Among the latter, a distinction should be made between scientific works with didactic aims[89] or with the function of disseminating familiar knowledge and review-type articles. Traditionally, didactic works include textbooks and academic scripts. To deprive them in advance of the qualities inherent to scholarly works seems erroneous.[90] Academic

[88] In each of these publication types, the determination of co-authorship should be based on different criteria. However, it is clear that in original publications, co-authorship should be based mainly on creative and substantial contributions. Consequently, the analysis of what is a creative contribution and what is not is very important.

[89] J. Błeszyński and M. Staszków, *Prawo autorskie i wynalazcze* [Copyright Law and Invention Law] (Warszawa: Państwowy Instytut Wydawniczy, 1983), 103.

[90] So P. Stec, "Uczelnie jako podmiot praw na dobrach niematerialnych" [Universities as the Subject of Rights in Intangible Assets], *Państwo i Prawo* 1 (2008): nop. 51–52.

textbooks customarily present the state of the art of a particular scientific discipline, as established by legitimate scientific centres and research teams, using a prior critical analysis of their findings and discoveries and offering the highest possible level of scientific reflection.[91] As a result, they provide an individualised, original, critical account of the state of knowledge in a particular scientific discipline, presenting disputed or unsolved or unexplored elements. The author(s) may also formulate their own findings or novelties of cognitive value.

Scientific nature should also be attributed to articles published in peer-reviewed, internationally renowned review-type journals.[92] Their essence is to offer a work providing a comprehensive overview of the state of scientific knowledge in a well-defined, even narrow topic. However, this is not a uniform category. The nature of these types of articles may even vary significantly depending on the area of knowledge. What they have in common is that the author(s) of such works should have a thorough mastery of the matters subject to their synthetic analysis. They should be undisputed experts in this area of knowledge. In this type of work, the very concept and form of presenting the subject matter undertaken in the work is also important. The scientific quality of this work, on the cognitive level, is expressed in the very formulation of an interesting issue, including the demonstration that the state of knowledge accumulated in that area (published research results) requires systematisation and formulation of conclusions and guidelines. The scientific value of review-type articles is expressed in the analytical and critical evaluation of the state of scientific findings made by various research centres and teams on the scientific issue under scrutiny. When preparing such an article, its authors propose to reject past theses and conclusions that have proved to be wrong, and indicate those that have been verified as correct.

[91] Cf. A. Chobot, *Regulacja prawna twórczej pracy badawczej w stosunkach pracy* [Legal Regulation of Creative Research Work in Employment Relations] (Warszawa: Wydawnictwo Szkolne PWN, 1975), 28–30.

[92] For example, the peer-reviewed scientific journal *Chemical Reviews* [Chem. Rev.], published by the *American Chemical Society*. Its current editor-in-chief is Josef Michl, professor at the University of Colorado at Boulder. This periodical publishes comprehensive refereed articles on current research issues in every field of chemistry. According to ISI, the journal's 2014 *impact factor* was 46,568. *Chemical Reviews* is indexed by: CAS, British Library, CABI, EBSCOhost, Pro- quest, PubMed, Scopus, SwetsWise and Web of Science, https://pl.wikipedia.org/wiki/Chemical_Reviews, accessed: 20.07.2018.

Such papers also evaluate the effectiveness and efficiency of research techniques that have been applied in the given field. Articles of the review type exhibit their cognitive value in an original synthetic and critical review of the state of knowledge and scientific findings in the area under study. In an age of information overload and a large number of internationally renowned periodicals for researchers, the cognitive value of review articles cannot be overestimated, especially when we realise that it is considered an honour to be entrusted, as a scientific team, with the task of their preparation, and the task is assigned to recognised specialists in the research field to be analysed in the review article.

Within the group of review papers under consideration, a separate category consists of scientific articles published in the field of medical and health sciences as so-called meta-analysis.[93] The term "meta-analysis" itself is derived from data analysis and statistical inference. The term describes a new research method, which consists of secondary knowledge discovery by generalising information contained in publications or primary sources.[94] Consequently, the object of a meta-analysis publication is not only the intellectually creative generalisation and systematisation of the state of knowledge on a well-defined topic (which amounts to a systematic review of the literature or other types of databases containing primary sources of research results) but also the design and conduct of substantively and qualitatively new scientific studies using advanced statistical tools.[95] In other

[93] Substantive consultation and authorization of meta-analysis publication description: Michał Skrzypek, PhD, Hab. Associate Professor at the Medical University of Silesia, Head of Department of Biostatistics, School of Public Health in Bytom, Medical University of Silesia.

[94] The concept was formulated by Gene V. Glass in 1976 and later popularised in 1978 by Robert Rosenthal. However, simple methods of this type have been described before, such as Ronald Fisher's combined probability test, https://pl.wikipedia.org/wiki/Gene_V._Glass; https://pl.wikipedia.org/wiki/Metaanalysis, accessed: 2.08.2018; R. Rosenthal, "Combining Results of Independent Studies," *Psychological Bulletin* 85, no. 1 (1978): 185–193, http://dx.doi.org/10.1037/0033-2909.85.1.185.

[95] Cf. "Most often, a meta-analysis takes the form of a systematic review of the literature in a certain area, enriched with an analysis (usually statistical) of previously obtained results, inference and a summary. Meta-analysis is considered to be an independent and fully-fledged type of scientific *research* (*integrative research* or *literature-based discovery*). It identifies what conclusions can be drawn from the totality of publications on a given topic, providing more accurate and broader knowledge than analysing individual studies,

words, a prior synthesis by teams of researchers from different scientific centres of the results of their research in the same field (or deriving from other primary sources) published in reputable scientific journals becomes the basis for further scientific research showing the characteristics of novelty,[96] namely the basis for designing a scientific experiment the object of which is to perform a collective, independent, creative and significant analysis of the research results from the research work of other groups of scientists. This analysis is carried out by means of advanced statistical tools (statistical inference), functioning within an operational scheme programmed by the operator (requiring the design of an analytical procedure and/or statistical analysis). Often the design of such scheme requires the creation of new statistical-analytical tools in the form of hitherto unknown mathematical-statistical algorithms.

As a result, the procedure takes the following course. Out of the experimental data made available by several or more research teams from different centres, covering the results of survey or laboratory studies of the same kind (identical in subject matter), a database is formed, which, as a result of this procedure, offers a broader statistical group than the analyses known (published) so far. Then, in the act of scientific creativity, a meta-analyst analyses these data (this database), using the method of generalising information from a broader statistical group, in order to discover substantively and qualitatively new knowledge on the given subject, which is the subject of their inquiry (by comparing and visualising the analysed research results and drawing substantively and qualitatively new scientific conclusions, according

https://pl.wikipedia.org/wiki/Metaanaliza, accessed: 2.08.2018. For more on *meta-analysis*, see S. Greenland, K. O'Rourke, "Meta-Analysis," in *Modern Epidemiology*, 3rd ed., ed. K. J. Rothman, S. Greenland, and T. L. Lash (Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2008); E. Walker, A. V. Hernandez, and M. W. Kattan, "Meta-analysis: Its Strengths and Limitations," *Cleveland Clinic Journal of Medicine* 75, no. 6 (2008): 431–439.

[96] Cf. M. W. Lipsey and D. B. Wilson, *Applied Social Research Methods Series*, vol. 49, *Practical Meta-analysis* (Thousand Oaks, CA: Sage Publications, Inc. 2001). For a publication dedicated to systematising procedures in the preparation of meta-analysis, see: B. Hutton, G. Salanti, D. M. Caldwell, A. Chaimani, C. H. Schmid, and C. Cameron et al., The PRISMA Extension Statement for Reporting of Systematic Reviews Incorporating Network Meta-analyses of Health Care Interventions: Checklist and Explanations, *Annals of Internal Medicine* 162, no. 11 (2015): 777–784, https://doi.org/10.7326/M14-2385.

to the state of knowledge, by means of an operational scheme designed by him/her in advance).[97]

The scientific value and significant contribution to the development of science (in the sense of expanding the legitimate state of knowledge on a specific topic) of articles within the framework of so-called meta-analysis is not controversial today,[98] and papers of this kind are presented in thematic publication threads within promotion proceedings for the award of scientific degrees or titles.[99] Recognition of the status and importance of this type of scholarly work for the advancement of science is demonstrated by the creation of the Cochrane Systematic Databases [hereafter: CDSR].[100] These databases are a leading source of systematic reviews of healthcare. Access to these databases, in addition to the various publicly available access options under national licences or subscriptions, is free of charge for researchers in low- and middle-income countries. In addition, CDSR includes Cochrane Reviews (systematic reviews) and protocols for Cochrane Reviews, as well as editorials and occasional supplements. The aim of the editors of Cochrane Reviews is to stimulate discussion and ideas regarding the consideration of synthetic scientific studies (i.e., meta-analyses) to enable appropriate clinical care and health policy decisions to be made by both national governments and clinicians in the course of ongoing medical procedures. In this regard, the editor-in-chief of Cochrane Reviews may commission

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[97] M. Borenstein, L. V. Hedges, J. P. T. Higgins, and H. R. Rothstein, *Introduction to Meta-Analysis* (John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom 2009).

[98] D. F. Stroup, J. A. Berlin, S. C. Morton et al., "Meta-analysis of Observational Studies in Epidemiology: A Proposal for Reporting," *JAMA* 283, no. 15 (2000): 2008–2012, https://doi.org/10.1001/jama.283.15.2008.

[99] For example, the following scientific work will be used: B. Sarecka-Hujar, I. Kopyta, M. Skrzypek, J. Sordyl, "Association Between the 20210G>A Prothrombin Gene Polymorphism and Arterial Ischemic Stroke in Children and Young Adults Two Meta-analyses of 3586 Cases and 6440 Control Subjects in Total," *Pediatric Neurology* 69 (2017): 93–101, which will be assessed in the postdoctoral proceedings of its first author. It should be clarified that the scientific problem addressed in this work was the 20210>A gene polymorphism, which is associated with an increased risk of ischaemic stroke in children and adolescents. The pooled analysis (i.e., meta-analysis) of the source studies mentioned above confirmed that, among both children andadolescents, the polymorphism of the aforementioned gene is associated with an increased risk of stroke (by 83% and 69%, respectively) compared with the control group.

[100] https://www.cochranelibrary.com/cdsr/about-cdsr.

specific review publications on a specific topic or accept proposals from scientific teams in this regard.

By original scientific work, we will therefore understand original works that, at the cognitive level, present new, in the sense of previously unknown (unpublished), scientific data and research results which in their content can communicate to the public both scientific findings incrementing knowledge and breakthroughs (scientific discoveries).

When considering the subject matter and nature of scientific works, it should be noted that the feature distinguishing them from other works is their specific structure.[101] Indeed, it is customary for such a work to consist of: (1) a theoretical introduction (referring to the state of knowledge in Science on the issue under consideration) with an indication of the purpose of one's own research; (2) a description of materials, research methods and techniques and, increasingly often, data on the theoretical computational methods used (the latter boils down to supporting and lending credence to the obtained experimental results with theoretical calculations[102]); (3) presentation of research results and their preliminary analysis; (4) discussion; (5) bibliography. Consequently, a scientific publication in experimental, technical or natural sciences customarily has more than one author. The order of the list of authors of a scientific work and the attribution of the status of author of a scientific work may have different justifications and, importantly, are not necessarily supported by copyright law.[103] The order of the list of authors of a scientific work should not be created by reference to the alphabetical order or the degrees or title held. What should be decisive here is the actual contribution to the research results published in the

[101] Consultation: Prof. Adam Proń, Ph.D., Department of Chemistry and Polymer Technology, Faculty of Chemistry, Warsaw University of Technology.

[102] E.g., in the modelling of equations of state (theoretical part of scientific research) and their experimental verification: M. Chorążewski, E. B. Postnikov, B. Jasiok, Y. V. Nedyalkov, and J. Jacquemin, "A Fluctuation Equation of State for Prediction of High-Pressure Densities of Ionic Liquids," *Scientific Reports* 7 (2017): 5563, https://doi.org/10.1038/s41598-017-06225-9; E. B. Postnikov and M. Chorążewski, "Transition in Fluctuation Behaviour of Normal Liquids under High Pressures," *Physica A: Statistical Mechanics and its Applications* 449 (2016): 275–280; B. Jasiok, E. B. Postnikov, and M. Chorążewski, "The Prediction of High-pressure Densities of Different Fuels Using Fluctuation Theory-based Tait-like Equation of State," *Fuel* 219 (2018): 176–181.

[103] So J. S. Knypl, "Autorstwo pracy naukowej" [Authorship of a Scientific Work], *Nauka Polska* no. 5–6 (1984): 146

scientific paper. The attribution of authorship of collective works will be affected by the customs of a particular community of scientists in a given area of knowledge. As a rule, the originator of a research project is the manager or leader of the research team, who is usually not involved in the experimental work, but more in overseeing the correctness of its progress and the analyses of the research results obtained. As both creator of the scientific idea and overseer of its verification in the course of the research, they are given the status of lead co-author of the paper as the first author or the last or correspondent author (so-called star author). Furthermore, the co-authors of the paper should be all those who made the paper assume a certain form and content. In this respect, a distinction is made in the literature between "scientific" authors and authors who are, as it were, "technical."[104] The role of the latter in the research is not to put forward a scientific thesis, design the experiment or discuss the results achieved, but to carry out important laboratory work. In practice, their contribution to research was designated in Anglo-Saxon countries by assigning them the position of "technical author," with the following formula appearing next to the name of such an author: with the technical assistance of X and Y. However, the degree of complexity of measurement techniques used nowadays in scientific research, as well as the processes of interpretation of research results, make it difficult to unequivocally state that the experimenter's contribution to a research project is of a purely technical nature. The researcher's actions of taking measurements with specialised, often unique apparatus, of analysing and drawing conclusions from the results obtained, in reliance on specialised knowledge and competence, and of using creative invention in the process of both designing and analysing the results of the experiment, mean that the term "technical author" should be reserved exclusively to automated measurements made with commercially available scientific apparatus.

Against the background of the considerations cited above, it is unacceptable, firstly, not to recognise the authorship of a person who has made a significant contribution to a scientific work and, secondly, to recognise the authorship of a scientific work by a person who does not have any contribution to it. Obtaining the status of author of a work in the analysed situations would be

[104] Z. Jaczewski, "W sprawie autorstwa pracy naukowej" [On the Authorship of a Scientific Work], *Nauka Polska* 6 (1985): 216.

a manifestation of scientific dishonesty, expressed in the phenomenon of the so-called ghostwriting and guest authorship.[105] The former is the case when a scientist has made a significant contribution to scientific research and to the creation of a publication, however, their contribution has not been disclosed by indicating them as the author or placing appropriate acknowledgements informing about their role in the creation of the publication.[106] Guest authorship (honorary authorship) is a situation in which the contribution of a particular person to the scientific research was either scarce or did not take place at all, yet, they are indicated as author or co-author of the publication. In this regard, it has been noted in practice that the personal data of eminent scientists who did not participate in the research and were not even acquainted with the manuscript of the publication were added to the list of co-authors of scientific papers without their knowledge or consent. The reason for such procedure is that the presence of eminent scientists among the co-authors of a paper facilitates its publication in a prestigious scientific journal. In response to such incidents, and in order to reduce the possibility of their occurrence, editors of foreign scientific journals have introduced the obligation to provide, in addition to the co-authors' affiliation data, their official (affiliated with the scientific institution) email addresses. Nowadays, after an article is sent to the publisher by the corresponding author, each co-author of the text receives an email from the editorial office stating that an article has been received with their name as co-author and, if they did not participate in the research or were not involved in the editing of the article, they should notify the editorial office and the corresponding author. If the scientist named as co-author of the paper does not dispute their participation in the research and/or the creation of the article, then theu do not have to respond in any way to the email received from the editorial office. On the other hand, if the opposite is the case, they are obliged to take appropriate steps.[107] It seems that the phenomenon of guest authorship

[105] A. Dance, "Authorship—Who's on First?", *Nature* 489 (September 27, 2012): 591.

[106] *A ghostwriter* is also a person who, for remuneration or other benefits, anonymously prepares an important part or even an entire scientific article for a third party.

[107] Consultation: Prof. Adam Proń, Ph.D., Department of Chemistry and Polymer Technology, Faculty of Chemistry, Warsaw University of Technology, editor of the journal Synthetic Metals, published by Elsevier Publishing House.

(honorary authorship) can materialise in practice by increasing the number of authors of a paper, which, however, is not substantively justified by the subject, scope and complexity of individual creative contributions making up the content of the publication. This happens in a context where the assessment of the reliability of authorship attribution concerns a scientific work with a broad research spectrum or even an interdisciplinary one, requiring cooperation of scientists with different scientific specialisation, having different research experience and using different scientific and research tools. Guided by the scientific specialisation and research experience of the individual authors of a paper, a discerning reviewer may have no difficulty in determining for which creative contributions to a given publication they were responsible. In other words, despite the fact that the subject of contribution of the individual co-authors to the research results announced in the publication is not identified, it is possible to plausibly demonstrate, in the manner indicated above, which of the authors is responsible for a particular creative contribution to that work. If the aforementioned analysis leads to a conclusion that the number of authors of a particularly "non-creative" scientific issue for the work is significant, it may be questionable whether the indicated number of authors is substantively and factually justified by their participation in the research. Another problem is that the use of such practice to increase the number of publications of a given scientist works globally to their detriment by diluting the subject matter and significance of their scientific output.

For the reasons mentioned above, it seems that in order to try and eliminate the phenomenon of guest authorship (honorary authorship), the binding standard should be strict indication of the subject and the extent of each co-author's contribution to the research results published in a paper.[108] This rule should be binding especially in the context of interdisciplinary, multi-authored works in the area of experimental sciences, natural sciences, technical sciences or in the field of medicine and health care. The sanctioning of the indicated rule may also contribute

[108] It should be noted that an analogous rule is sanctioned in the Code of the National Science Centre, relating to the reliability of scientific research and efforts to obtain funds for research. Namely, Paragraph 1.4 provides that: "It is good practice to label contributions to a work in the form of acknowledgements or editorial information with an indication of who contributed to the work in its final form and how."

to the consolidation of the standards of reliable attribution of authorship of scientific works and, in the future, exclude the problem of proving the subject and nature of involvement in a research, published in the form of multi-authored scientific works, constituting a thread included among other scientific achievements in promotion proceedings for the award of degrees or titles.[109]

In summary, integrity and adherence to ethical principles in the conduct of scientific research, as well as in the publication of its results, is one of the most important foundations of scientific progress. Unfortunately, cases of scientific dishonesty and even falsification of research results continue to be uncovered in the scientific community, damaging the integrity of science and public faith in the value of scientists' findings. It is necessary to promote the ethics of research activities, and to disseminate the standards for reliable attribution of scientific authorship. The widespread sanctioning of such obligations among editors of periodicals and the promotion of an appropriate attitude, especially among young students of science, should be regarded as a manifestation not only of good manners, but also of social responsibility or implementation of the citizen's right to public information on how public funds are spent on scientific research.

1.4. Freedom of Science and the Paradigm of Scientific Authorship. Conclusions

Under the provisions of the Polish Constitution, human freedom in the sphere of conducting scientific research and publishing its results covers not only the right to undertake scientific work free of state interference, but also guarantees of intellectual property rights of the creators of science. The legal basis for the protection of their copyrights in intangible goods originating as fruits of their research activities is derived from Article 73 in conjunction with Article 64(1) and (2) and Article 32 of the Constitution of the Republic of Poland. The grant of this protection is independent of

[109] The Polish Code of Ethics, in this matter, lays down the following principle: "A co-authored publication intended as a basis for the application for an academic degree or title should contain a separate, self-authored section or be edited in such a manner as to allow the evaluation of the precisely identified contribution of each co-author to the publication" (subsec. 3.3.5).

whether the result of the research work is fixed as a work within the meaning of copyright law. Systemic interpretation of the indicated provisions of the Constitution unveils the constitutional standard for protecting intellectual property rights of authors of science, which also implies their relevant privileges making up the content of the subjective right deriving from and guaranteed by the freedom of science. Enforcement of the subjective right understood in this way can be sought by an individual directly before the courts. Under Article 8(2) of the Constitution of the Republic of Poland, the provisions of the Constitution apply directly, unless the Constitution provides otherwise. While guaranteeing the freedom of science (Article 73) and the protection of the intellectual property of its author resulting from scientific creativity (Article 64(1) and (2)), the legislator did not stipulate that they are realised as specified in statutory law. Protection of one's rights to scientific creativity may be sought by the author under the directly applicable provisions of the Constitution of the Republic of Poland, with concurrent application of appropriate statutory provisions sanctioning particular categories of objects of intellectual property, including in the sphere of scientific creativity of the individual.

However, the freedom we are interested in cannot be treated as a category free from any interference. Like any other subjective right, it may be subject to limitations sanctioned by the legislator under the provision of the Article 31(3) of the Polish Constitution. The freedom to undertake research activities may be restricted by the legislator in order to protect: state security or public order, the environment, public health and morals, as well as the freedoms and rights of other persons, however, the legislator may not deprive an individual of the essence of this freedom. At the same time, the limits to the exercise of this subjective right may be set not only vertically (in the relationship between the individual and the state), but also horizontally (in the relationship between subjects of constitutional freedoms and rights). According to the constitutional principle of freedom (Article 31(2) of the Constitution of the Republic of Poland), the limit of my freedoms and rights are the rights and freedoms of other people. Accordingly, the cited norm defines, in broader terms, the principles of exercise of constitutional freedoms and rights by the individual, including the freedom of science, sanctioning the obligation to respect the rights and freedoms of other people. The sphere of legally protected freedoms and rights of other persons corresponding to the freedom of research and publication of its results is determined—as shown in this study—not only by generally applicable law, but also by codes of ethics for scientists, which, by virtue of statutory authorisation to issue such acts and the provision of Article 31(3) of the Constitution of the Republic of Poland, obtained the status of regulations generally applicable to researchers conducting scientific activity in Poland. Thus, the law and ethical principles determine the paradigm of scientific authorship and the right to be an author of a collective scientific work.

Part II

Anna Chorążewska, Adam Proń

Law and Ethics in Scientific Work

Taken together, these two propositions, that law is local knowledge not placeless principle and that it is constructive of social life not reflective, or anyway not just reflective, of it, lead on to a rather unorthodox view of what the comparative study of it should consist in: cultural translation. […] law is rejoined to the other great cultural formations of human life-morals, art, technology, science, religion, the division of labor, history (categories themselves no more unitary, or definite, or universal than law is)—without either disappearing into them or becoming a kind of servant adjunct of their constructive power.

Clifford Geertz, *Local Knowledge. Further Essays in Interpretive Anthropology* (New York: Basic Books Inc., 1983), 218–219.

Chapter I

Scientific Authorship

1. Introduction to the Issue

In Poland, major institutions making up the state scientific and research infrastructure include universities, the Polish Academy of Sciences and research institutes. Their primary task is to carry out scientific activities, which, according to Article 4 of *The Law on Higher Education and Science*, includes scientific research, development work and artistic creation.[1] Scientific research is an activity that includes: basic research and applied research. Basic research understood as empirical or theoretical works aimed primarily at gaining new knowledge about the foundations of phenomena and observable facts without focusing on any direct commercial application. Applied research is understood as works aimed at acquiring new knowledge and skills, focused on developing new products, processes or services or introducing significant improvements in them. Development works are an activity involving the acquisition, combining, shaping and use of existing knowledge and skills, including those relating to IT tools or software, for production planning and the design and creation of altered, improved or new products, processes or services, excluding activities involving routine

[1] Act of 20 July 2018—*The Law on Higher Education and Science*, consolidated text: Journal of Laws 2023 item 742, as amended, hereinafter: LHES or *Law on Higher Education and Science*; Act of 30.04.2010 on the Polish Academy of Sciences, consolidated text: Journal of Laws 2020, item 1796; Act of 30.04.2010 on Research Institutes, i.e., Journal of Laws 2022 item 498.

or periodic changes thereto, even if such changes constitute improvements.

One of the primary responsibilities of the staff of these scientific research institutions is, of course, to carry out scientific activities. In order to explaining what such activity consists of requires answering the following questions: What is Science today? What activities are inherent in scientific work? What is a scientific "product" and under what conditions is it produced? In seeking answers to such questions, it is important to note that in the 21st century we are witnessing almost revolutionary changes in all areas of human activity, especially in scientific activity. Science and the ways in which it is practised, as well as the scientific method, significantly differ from what we know not only from the 19th century, but also from the 20th century. The reasons for these changes are the state of knowledge, technological progress resulting, among other things, in significant developments in research methods and techniques, and the changing needs of the socio-economic environment of scientific and research institutions. Researchers today have at their disposal sophisticated equipment for research of both a theoretical and experimental nature, as well as efficient techniques for analysing scientific data. The advancement of scientific knowledge and the increasingly complex questions posed to Science affect both the subject matter of scientific research and the structure of scientific teams. Scientific questions are problem-oriented and increasingly specialised. Modern science studies and describes material objects or phenomena with the aim of classifying them appropriately and of increasing knowledge (basic research) to then attempt to develop mechanisms or technologies (applied research) leading to the practical application or even industrial implementation of scientific discoveries. Solving such complex problems requires interdisciplinary research by multi-person teams consisting of specialists from different areas of knowledge. The spectacular and, at the same time, revolutionary progress of communication technologies, favours the creation of such teams, also with an international profile. Thanks to the development of the Internet, researchers working in different scientific institutions, often located in distant countries, can effectively and quickly share ideas, research theses and hypotheses, and scientific data when conducting joint scientific projects. The ability to share data and scientific findings quickly affects not only the members of a particular research team but, indeed, the entire scientific community.

Researchers can share their scientific results via *pre-prints* in open access repositories before detailed peer review (the combination of *peer* and *review* is intended to indicate a particular scrutiny of the article evaluation process, "peer" meaning "to look at something (someone) in research"). Exchange of scientific information has also been facilitated by the creation of scientific journals with an *open access* policy in the last two decades.

The development of the Internet has led to a fundamental change in the practical and economic realities of distributing scientific knowledge and cultural heritage. The Internet has offered the scientific community an opportunity to create a global and interactive space for archiving the state of human knowledge, including cultural heritage, and a guarantee of worldwide access. The Internet has thus become a medium for knowledge distribution. Taking advantage of these opportunities, on 4 September 2018, a group of national research funding organisations, with the support of the European Commission and the European Research Council (ERC), announced the launch of cOAlition S, an initiative to make full and immediate Open Access to research publications a reality.[2] The initiative was born from the cooperation between the Heads of the participating Research Funding Organisations, Marc Schiltz, the President of Science Europe, and Robert-Jan Smits, previously the Open Access Envoy of the European Commission. It also drew on significant input from the Scientific Council of the ERC. It is built around Plan S, which consists of one target and 10 principles. cOAlition S signals the commitment to implement the necessary measures to fulfil its main principle:

> With effect from 2021, all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo.[3]

cOAlition S is directly connected with The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities,

[2] What is cOAlition S?, https://www.coalition-s.org/about/.

[3] "Introduction" to Part I: The Plan S Principles, https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/.

published in English on 22 October 2003. It is one of the milestones of the Open Access movement.[4]

The Plan S is based on the following principles:[5]

"1. Authors or their institutions retain copyright to their publications. All publications must be published under an open license, preferably the Creative Commons Attribution license (CC BY), in order to fulfil the requirements defined by the Berlin Declaration;

2. The Funders will develop robust criteria and requirements for the services that high-quality Open Access journals, Open Access platforms, and Open Access repositories must provide;

3. In cases where high-quality Open Access journals or platforms do not yet exist, the Funders will, in a coordinated way, provide incentives to establish and support them when appropriate; support will also be provided for Open Access infrastructures where necessary;

4. Where applicable, Open Access publication fees are covered by the Funders or research institutions, not by individual researchers; it is acknowledged that all researchers should be able to publish their work Open Access;

5. The Funders support the diversity of business models for Open Access journals and platforms. When Open Access publication fees are applied, they must be commensurate with the publication services delivered and the structure of such fees must be transparent to inform the market and facilitate the potential standardisation and capping of payments of fees;

6. The Funders encourage governments, universities, research organisations, libraries, academies, and learned societies to align their strategies, policies, and practices, notably to ensure transparency;

7. The above principles shall apply to all types of scholarly publications, but it is understood that the timeline to achieve Open Access for monographs and book chapters will be longer and requires a separate and due process;

8. The Funders do not support the 'hybrid' model of publishing. However, as a transitional pathway towards full Open Access within a clearly defined timeframe, and only as part of

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[4] https://openaccess.mpg.de/Berlin-Declaration.

[5] Part I: The Plan S Principles, https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/.

transformative arrangements, Funders may contribute to financially supporting such arrangements;

9. The Funders will monitor compliance and sanction non-compliant beneficiaries/grantees;

10. The Funders commit that when assessing research outputs during funding decisions they will value the intrinsic merit of the work and not consider the publication channel, its impact factor (or other journal metrics), or the publisher."

The agreement for Open Science describes the guidelines for implementing Plan S[6] in realising the main aim to ensure full and immediate Open Access to peer-reviewed scholarly publications from research funded by public and private grants. There are three routes for being compliant with Plan S:

1. Authors publish in an Open Access journal or on an Open Access platform (Open Access publishing venues—journals or platforms);
2. Authors publish in a subscription journal and make either the final published version (Version of Record (VoR)) or the Author's Accepted Manuscript (AAM) openly available in a repository (Subscription venues—repository route);
3. Authors publish Open Access in a subscription journal under a transformative arrangement (Transition of subscription venues—transformative arrangements).

For any chosen route to compliance, the publication must be openly available immediately with a Creative Commons Attribution license (CC BY) unless an exception has been agreed by the funder. These rules mean for Funders:

1. cOAlition S funders will financially support publication fees.
2. cOAlition S funders will not financially support 'hybrid' Open Access publication fees in subscription venues.
3. cOAlition S funders can contribute financially to Open Access publishing under transformative arrangements.

Such a publishing policy naturally contributes to the establishment of scientific collaborations with researchers from other research centres who are active in a similar research area or who deal with the same phenomena or issues but from a different

[6] Part II: Guidance on the Implementation of Plan S, https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/.

scientific perspective. Research is no longer conducted by a lone researcher but in teams. What is more, single-discipline research groups of a few people from a given institution have increasingly begun to develop into large, also internationally oriented interdisciplinary research teams. Thus, there is a perceptible shift away from strictly single-discipline and narrowly specialised science to interdisciplinary science and even to research carried out by large research teams from various research centres all over the world that cover different, seemingly distant scientific fields (interdisciplinary science).

An analysis by the American historian of science Mott T. Greene of the number of authors of scientific *papers* (both *regular papers* and *letters* to the editor) published in *Nature*, the most prestigious journal in the field of science, supports the above conclusions. Although each issue of this journal contains almost the same number of published papers, from 1950 to 2007, the average number of authors per article quadrupled and is still growing.[7] The author of the analysis found that apart from publications in mathematics individual research and article writing in the sciences today is almost non-existent. Moreover, even if scientists wanted to make such an effort, the scientific institutions employing them and funding their research would probably not allow it. After all, the value of scientific work should be, on the one hand, the accumulation of new knowledge and, on the other, an indication of its benefits. From the late 17th century until around 1920, both of these values could be achieved by a single researcher. The realities of the 20th century have shown that this is no longer possible. This peculiar symmetry was disturbed in the 1920s and then periodically reduced in the 1950s, while it was abandoned altogether in the 1980s. At that time, multidisciplinary research became commonplace and, given the challenges posed to science, essential. A way of announcing the authorship of research results obtained as part of such research is to publish an article in a scientific periodical. In this context, Greene notes that, in the reality of 2007, most scientific journals, when marking the attribution of authorship of a scientific paper, did not require indicating what part of the scientific work was done by the individual authors of the scientific article. This deprived both journal editors and their readers of access to full information about who, and to

[7] M. T. Greene, "The Demise of the Lone Author," *Nature* 450, no. 7173 (2007): 1165.

what extent, conducted the research announced in the scientific publication, or which author(s) drafted the manuscript. Greene therefore poses the question: does it no longer matter today who edited the manuscript of a scientific article?[8]

The 21st century is also a time of increased interest in scientific achievements on the part of research institutions' partners in their socio-economic environment. This is because the increment of knowledge and scientific progress directly affects the economic growth of countries. The opportunity perceived by scientists to implement new scientific knowledge in the economy and services to society leads to cooperation between scientific institutions and industry and other entities benefiting from scientific developments. The rapid distribution of information contributes to the creation of a platform for cooperation between scientists and the socio-economic environment of research institutions. In this way, science has become a cause and also a driver of economic growth for countries.[9]

This obvious link between knowledge growth and economic growth has an influence on the increased resources spent by countries and the European Union on research. More generous funding for science has allowed a significant increase in the number of teams carrying out research activities in numerous research centres around the world. As a consequence, the number of published scientific articles and the number of authors of individual papers has been gradually and significantly increasing. This, in turn, results in teams and research centres from all over the world competing with each other for the palm of primacy in scientific discoveries, on the one hand, and strong publication pressure on the other. Naturally, these two factors have led to a gradual increase in the number of scientific periodicals available to researchers. These phenomena not only have a positive side (increased resources for information exchange) but also

[8] Greene, "The Demise," 1165.

[9] L. Bornmann, R. Haunschild, and R. Mutz, "Growth Rates of Modern Science: A Latent Piecewise Growth Curve Approach to Model Publication Numbers from Established and New Literature Databases," *Humanities and Social Sciences Communications* 8, no. 224 (2021), https://doi.org/10.1057/s41599-021-00903-w. In this study, the authors additionally analyse scientific growth in two broad fields (Physical and Technical Sciences as well as Life Sciences) and the relationship between scientific and economic growth in the UK. The comparison between the two fields revealed only slight differences. The comparison of the British economic and scientific growth rates showed that the economic growth rate is slightly lower than the scientific growth rate.

a negative side. Publication pressure affects the meticulousness of the research process, often with adverse consequences to the proper choice of research methodology and the documentation of the research process and the results obtained.[10] As a consequence, it has become problematic to verify the reproducibility of the obtained and published research results and the scientific findings made on their basis.[11] A lowering of standards for the reliability of the review process of articles submitted to scientific periodicals and, consequently, a decline in the quality of published papers is also noticeable.[12] Furthermore, the phenomenon of *predatory journals* and *predatory conferences* has emerged.[13]

Predatory journals are considered to be those that do not follow ethical publishing standards. Their unethical publishing model involves sham review process and then publishing of all submitted and paid-for papers without first implementing a proper editorial process. These publishers exploit the idea of

[10] L. Teytelman, "No More Excuses for Non-reproducible Methods," *Nature* 560, no. 411 (August 22, 2018), https://doi.org/10.1038/d41586-018-06008-w; M. Baker, "Five Keys to Writing a Reproducible Lab Protocol," *Nature* 597 (September 6, 2021), https://doi.org/10.1038/d41586-021-02428-3; D. Lakens, "Is My Study Useless? Why Researchers Need Methodological Review Boards," *Nature* 613, no. 9 (January 3, 2023), https://doi.org/10.1038/d41586-022-04504-8.

[11] Retraction Watch, *Nobel winner retracts paper from Science*, https://retractionwatch.com/2020/01/02/nobel-winner-retracts-paper-from-science/?fbclid=IwAR3Hl6xg0Canp7ub4RCJR3OZxeqPOLsQ1Hz0hzJjgL23blJWnXU-TkpGn3E (accessed January 7, 2023). Explanation: "After publication of the Report 'Site-selective enzymatic C-H amidation for synthesis of diverse lactams'" (I. Cho, Z.-J. Jia, F. H. Arnold, *Science* 364, no. 575 (2019), efforts to reproduce the work showed that the enzymes do not catalyze the reactions with the activities and selectivities claimed. Careful examination of the first author's lab notebook then revealed missing contemporaneous entries and raw data for key experiments. The authors are therefore retracting the paper."

[12] Retraction Watch, "Exclusive: Elsevier retracting 500 papers for shoddy peer review," https://retractionwatch.com/2022/10/28/exclusive-elsevier-retracting-500-papers-for-shoddy-peer-review/#comment-2146593 (accessed on 7 January 2023). W. T. A. Harrison, J. Simpson, and M. Weilc, Editorial, *Acta Crystallographica Section E Structure Reports Online* (2010): E66, e1-e1, https://doi.org/10.1107/S1600536809051757; D. S. Chawla, "Russian Journals Retract More Than 800 Papers after 'Bombshell' Investigation," *Science* [News] (January 8, 2020), https://doi.org/10.1126/science.aba8099.

[13] Charles University Open Access Support Centre, *Predatory Publishing: Predatory Journals and Publishers & Predatory Conferences*, https://openscience.cuni.cz/OSCIEN-27.html (accessed January 7, 2023); Z. Drozdowicz, "Drapieżniki w życiu akademickim" [Predators in Academic Life], *Forum Akademickie* 2 (2023): 44–46.

open access only to derive revenue from the fees charged to authors.[14] Predatory conferences or predatory scientific seminars are meetings of researchers that are supposed to give the impression of reliable scientific conferences, but in reality are not. In the narratives of their participants, such events appear as a series of presentations by randomly selected scientists, uninterested in the research of other conference participants. The basic role of the conference, that is, the exchange of scientific experience between participants working in thematically close areas of science, is lost in this case and its didactic value is also nil.

Participation in a predatory conference involves high conference fees for participants. Additional profits of the organisers derive from charging for the publication of conference presentations and papers in post-conference materials or for providing the opportunity to publish a paper as scientific article in a scientific periodical that applies unethical reviewing standards. The initiators of this practice take advantage of the need of scientists to demonstrate environmental activity in their academic CVs.[15] Often, to mislead scientists, the organisers of predatory conferences, when naming such events, use names confusingly similar to the existing reputable conferences.[16] This phenomenon has become so rampant that it is not uncommon for research-active academics to receive several offers a day to give *invited talks* or even *plenary lectures* at such conferences. Unfortunately, there are also some researchers who effectively use the phenomenon of predatory journals and predatory conferences to develop their scientific output.[17]

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[14] P. Sorokowski, E. Kulczycki, A. Sorokowska, and K. Pisanski, "Comment: Predatory Journals Recruit Fake Editors," *Nature* 543 (March 23, 2017), https://doi.org/10.1038/543481a; T. E. Stone and R. C. Rossiter, "Predatory Publishing: Take Care That You Are Not Caught in the Open Access Net," *Nursing & Health Sciences* 17, no. 3 (2015): 277–279, https://doi.org/10.1111/nhs.12215.

[15] M. Chartier, "The Alarming Rise of Predatory Conferences," *Eos* (September 15, 2022), https://doi.org/10.1029/2022EO220449; J. Beall and R. Levine, "OMICS Goes from 'Predatory Publishing' to 'Predatory Meetings,' *scholarlyoa* (May 31, 2019), https://scholarlyoa.com/omics-goes-from-predatory-publishing-to-predatory-meetings/, accessed January 7, 2023.

[16] J. Zepernick and Ch. "Musick, How to Avoid Predatory Conferences," *Think SCIENCE*, https://thinkscience.co.jp/en/articles/avoiding-predatory-conferences, accessed January 7, 2023.

[17] R. J. Mackenzie, "Inside a ‚Fake' Conference: A Journey Into Predatory Science," *Technology Networks* (July 11, 2019), https://www.technologynetworks.com/tn/articles/inside-a-fake-conference-a-journey-into-predatory-science-321619 (accessed January 7, 2023); J. McCrostie, "'Predatory Conferences' Stalk Japan's

In addition, there is a perceived crisis in the peer review system for accepting papers for print. The history of detailed peer reviewing is long, dating back to the 17th century and the *referee systems* that emerged at that time.[18] Model solutions for appointing reviewers were provided to the British by the then century-old practice of the French Academy of Sciences in Paris, which produced reports evaluating inventions and discoveries in the service of the king.[19] Scientists appointed to the Academy were paid by the state as a reward for their outstanding scientific achievements, and politicians seemed to appreciate their opinions. In 1831, a Cambridge University Professor William Whewell concluded that it was worth following the path of French academics. He succeeded in persuading the Royal Society, a society advocating the advancement of science similar in nature to the French Academy, of the need to commission public reports on submitted manuscripts of scientific papers. The occasion for the introduction of this practice was the Society's launch of a new journal entitled *Proceedings of the Royal Society*. The proposal to transform the Royal Society into a corps of expert referees in the same fashion as the French Academy was met with enthusiasm. However, the adaptation of the French report-writing practice proved more complicated than Whewell had anticipated. It is worth emphasising that Whewell's aim in setting up the referee system was not to prevent bad papers from being printed, nor did he propose a new mechanism for communicating publishing decisions. The referees were intended to increase the public perception of science, to give scientific endeavour a unified identity across England, and to contribute to increased state funding and public recognition of science. Initially, Whewell's vision was accepted. Whewell's first positive report on the work of the astronomer George Airy, "On an Inequality of Long Period in the Motions of the Earth and Venus," was publicly read at the Society on 29 March 1832 and printed in the *Proceedings*. At the same time, a critical report on the same work by John

Groves of Academia," *The Japan Times* (May 11, 2016), https://www.japantimes.co.jp/community/2016/05/11/issues/predatory-conferences-stalk-japans-groves-academia/, accessed January 7, 2023.

[18] Based entirely on: A. Csiszar, "Peer Review: Troubled from the Start," *Nature* 532 (April 21, 2016): 306–308, https://doi.org/10.1038/532306a.

[19] 1699 The French Royal Academy of Sciences was given the power by Louis XIV to make reports and approve books for publication and bypass royal censorship.

William Lubbock, a mathematically gifted astronomer, was not chosen to be made public. Finally, Airy's full article appeared in *Philosophical Transactions*. The assumptions for the functioning of the review system began to change significantly, and almost as soon as the first report was published. After a few years, the reports became classified. The last issue of the *Proceedings*, which contained a report, appeared in mid-1833. No negative reports were ever published. From 1833, the reports became private and anonymous. Whewell himself also changed his opinion on the role of reviewers. In a letter of 1836, he attributed to them the role of defenders of the Society's reputation, working behind the scenes to prevent the publication of papers that he did not believe to be significant scientific discoveries. Nevertheless, the reviewer system soon showed its shortcomings. Namely, in 1892, a paper was published that had been rejected by a Royal Society reviewer in 1845. This paper presented the kinetic theory of gases more than ten years before James Clerk Maxwell's famous work. In this context, Alex Csiszar[20] asks the question if peer-review systems are, in fact, fundamentally flawed.

At the turn of the twentieth century, editors and reviewers were seen as responsible for the integrity of the scientific literature itself.[21] The referee-reviewer became a gatekeeper obliged to look after the Science. As this idea grew in popularity, it began to be recognised that the system might be intrinsically flawed and hinder creative science. In 1903, the Geological Society of London carried out a study into the operation of peer review procedures. Opinions were divided about their value, many comments were made about the unfairness and inefficiency of the system, and the term reviewer (referee) was met with such disfavour that the term was almost banned from all the Society's activities. Despite the shortcomings identified, referee procedures survived and, in time, were widely adopted by scientific periodicals, including American ones. Eventually, the idea that every official scientific journal should introduce a formal peer-review system began to spread after the Second World War. Since 1973, an external reviewer's opinion on a paper has become a requirement for publication in *Nature*.[22] In the 1960s, reviewers became a symbol of objective judgement and

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20 A. Csiszar, "Peer Review: Troubled from the Start," *Nature* 532 (April 21, 2016), https://doi.org/10.1038/532306a 306–308.

21 Csiszar, "Peer Review: Troubled from the Start," 306–308.

22 M. Baldwin, *Making Nature: The History of a Scientific Journal* (Chicago: University of Chicago Press, 2015).

consensus in *Science*, and requirements for detailed peer review of submitted papers were universally introduced.

The concept of "detailed reviews" (peer review) was borrowed from the procedures used by government agencies in deciding who should receive financial support for scientific and medical research.[23] By popularising the system of detailed peer review, the scientific community worked to cement the perception of their role in society, while securing massive government funding to conduct research activities. Peer review thus emerged as a response to political demands for scientists to be publicly accountable for the published research output. Today, the system has come under the spotlight. The psychology of bias, the problem of objectivity and the possibility of assessing the reliability and relevance of these procedures are rightly discussed. In 1991, an e-mail/FTP server was launched at xxx.lanl.gov. This became a tool for the free sharing of non-peer-reviewed versions of physics articles (*preprints*). It was later moved to the web at arXiv.org, becoming a reference for discussions about the end of peer-reviewed journals.[24]

Preprint servers, or servers containing original, not yet peer-reviewed versions of articles (*preprints*), are a rapidly growing forum for the exchange of scientific ideas. Author(s) archive the original versions of their papers by posting them on an open access website and make them available to the scientific community for review and comment prior to or in parallel with their peer review evaluation process. Typically, these original versions of articles do not formally undergo any detailed peer review process on the site where they are posted. The use of servers collecting manuscripts that have not yet been peer-reviewed is becoming more common in many fields, and more and more journals are willing to accept papers posted on these servers for publication. Some journals have even integrated their article submission platforms, allowing manuscripts posted on arXiv and bioRxiv to be submitted directly to journal websites.[25] *Preprints*, according to the now widely promoted open access policy, are gradually becoming more and more important.[26] The scientific community

[23] Csiszar, "Peer Review: Troubled from the Start," 306–308.

[24] Baldwin, *Making Nature*.

[25] For examples of journals allowing for direct preprint posting during the journal submission process, see: http://www.biologists.com/cob-news/#biorxiv.

[26] Examples of online pre-print servers: Physics: https://arxiv.org/; Biology: https://www.biorxiv.org/; Chemistry: https://chemrxiv.org/; Earth Sciences:

openly discusses its role in the process of sharing research results and scientific findings. Recognising the importance of such a form of scientific discussion, the National Institutes of Health (NIH) has formulated recommendations for the requirements that such publicly available non-peer-reviewed manuscripts of scientific papers, as well as research results not yet in the form of a final report or article (Interim Research Products), should meet.[27] The National Institutes of Health encourages researchers to publish their results in this form, especially in case of research funded by NIH.

The phenomenon under scrutiny has proven so important in the research landscape[28] that even a *not-for-profit* organisation called *Crossref* has been established to improve the exchange of scientific ideas.[29] This organisation has been prominently involved in the development of the Principles of Open Scholarly Infrastructure (POSI).[30] Crossref aims to facilitate the search for citation, linking, evaluation and reuse of research results. The phenomenon of open access publishing of not yet peer-reviewed papers has also been recognised by the Council of Science Editors (CSE) and the Committee on Publication Ethics (COPE). CSE is seen by the scientific community as an authoritative source of information on current and emerging issues subject to international exchange of scientific information. CSE has

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https://eartharxiv.org/; Earth and Space Sciences: https://essopenarchive.org/; Engineering: https://engrxiv.org/; Medicine and Health Sciences: https://yoda.yale.edu/medrxiv; Social Sciences: https://www.ssrn.com/en/ and https://socopen.org/; Arts & Humanities, Behavioural Sciences, Chemistry, Earth Sciences, Engineering, Life Sciences, Materials Sciences, Mathematics & Computer Science, Medicine & Pharmacology, Physical Sciences, Social Sciences: https://www.preprints.org/.

[27] https://grants.nih.gov/grants/guide/notice-files/not-od-17-050.html.

[28] D. Crotty, "Preprints and Citations: Should Non-Peer Reviewed Material Be Included in Article References?", *The Scholarly Kitchen* (March 14, 2018), https://scholarlykitchen.sspnet.org/2018/03/14/preprints-citations-non-peer-reviewed-material-included-article-references/; S. I. Hunter, I. Kleshchevich, and B. Rosenblumsep, "Guest Post—What's Wrong with Preprint Citations?," *The Scholarly Kitchen* (September 18, 2020) https://scholarlykitchen.sspnet.org/2020/09/18/guest-post-whats-wrong-with-preprint-citations/; J. Kaiser, "Are Preprints the Future of Biology? A Survival Guide for Scientists," *Science* [News] (September 29, 2017), https://www.science.org/content/article/are-preprints-future-biology-survival-guide-scientists.

[29] https://www.crossref.org/.

[30] "Introduction to posted content" (includes preprints): https://www.crossref.org/documentation/research-nexus/posted-content-includes-preprints/.

issued a document entitled "White Paper on Promoting Integrity in Scientific Journal Publications" in which it has made recommendations[31] for:

1. Journal policy for preprint servers:

> Editors have a responsibility to present clear guidelines to authors regarding their policy on preprint servers, including what content can be shared on preprint servers before, during, and after the review process. While journals may be willing to consider content previously posted on preprint servers, journals often require authors to disclose this information at the time of submission. Any such requirements should be clearly stated in the journal's information for authors and information about the preprint server should be collected according to the journal's policy. In addition, it is the authors' (and not the journal editors') responsibility to ensure that preprints are amended to point readers to subsequent versions of the work, including the published article. Authors should not post in the preprint archive the published article nor interim versions that are produced during the peer-review process that incorporate revisions based on journal feedback.

2. Citing a preprint:

> Journal Citations should clearly indicate that a reference is a preprint. The AMA and the ICMJE both recommend including the word 'preprint' in the citation information. The citation should include the link to the preprint and DOI (digital object identifier) if the preprint archive issues DOIs.[32]

The Committee on Publication Ethics (COPE) is a not-for-profit organisation formed by journal editors, publishers, universities and research institutes, organisations and individuals involved in the ethics of publishing activities. COPE's mission is to identify best practices in scholarly publishing ethics and to help editors and publishers achieve this goal. In its recommendations on posted non-peer-reviewed manuscripts (*preprints*), COPE notes:

[31] http://cseditors.wpenginepowered.com/wp-content/uploads/CSE-White-Paper_Feb2022_webPDF.pdf, pp. 18–19.

[32] Compare this to the recommendations of the International Committee of Medical Journal Editors: Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals. Updated May 2023, pp. 9–10, https://www.icmje.org/icmje-recommendations.pdf.

> Preprints offer a wide range of benefits to authors, researchers, publishers, and the public. There are challenges and concerns to address around the verification and integrity of sound science in research published as preprints. Journal editors and publishers should be mindful of developing policies around preprints, and consider incorporating them into their instructions for authors and submission processes.[33]

Recognising the benefits of publishing scientific data in the form of non-peer-reviewed manuscripts (*preprints*), COPE has therefore developed detailed rules for the use of this platform for the exchange of ideas in science.[34]

Parallel to this debate, there is still a multi-faceted discussion in the scientific community about the importance of detailed peer reviews for *Science*. A part of the scientific community believes that detailed peer review is one of the pillars of research quality, as well as public confidence in scientific achievements. However, reviewers often do not receive recognition for their work. Sometimes their reviews, both positive and negative, are not taken into account by journal editors, despite the fact that they contain fully substantive arguments. In this way, much of their valuable time is thus wasted. The question must therefore be asked: should reviews not be made public before publication? Should reviewers remain anonymous? Publons, a company backed by New Zealand investors, has started to encourage researchers to post their review stories online. This company also rewards the best reviewers with prizes such as credits on Amazon Web Services.[35] Another problem with the evaluation system is the proper selection of reviewers. Most journal editors go to great lengths every day to convince busy scientists to review for free papers submitted to the journal. This circumstance has exposed another weakness of peer review. The possibility of the author suggesting reviewers for a paper was introduced. This opened up an avalanche of unreliable reviews. Some researchers exploited loopholes in peer review systems to make sure that they could review their own work, or formed a circle of 'friends' reviewing and citing each other's work. Cases of fake reviews and the need to retract many papers involved publishing giants such as

[33] https://publicationethics.org/node/38176.

[34] https://publicationethics.org/sites/default/files/u7140/COPE_Preprints_Mar18.pdf; https://publicationethics.org/case/preprint-plagiarism.

[35] R. V. Noorden, "The Scientists Who Get Credit for Peer Review," *Nature* (October 9, 2014), https://doi.org/10.1038/nature.2014.16102.

Elsevier, Springer, Taylor & Francis, SAGE and Wiley. As a result of the above, editorial practices have changed. Editors are now forced to verify the authenticity of the declared reviewers, and to rule out proposed reviewers when the author provides Gmail, Yahoo or other free email addresses as contact details, rather than email addresses at the reviewers' academic institution.[36]

Another weakness of the peer review system is the possibility of rejecting a paper without review, simply because, at first glance, the editor is of the opinion the article does not fit the profile of the journal.[37] Breakthrough papers are also repeatedly rejected. The research conducted by Kyle Siler and her team[38] into the effectiveness of the peer-review process, while showing certain shortcomings, nevertheless demonstrated its unquestionable usefulness. The publication fate of more than 1,000 papers submitted ten years ago to medical journals of very high reputation, that is, *Annals of Internal Medicine*, *British Medical Journal* and *The Lancet*, was examined. Using the citation rate of the papers as their importance indicator, the team showed that the review processes in these journals resulted in the rejection of papers that were subsequently published in other journals that had little resonance in the scientific community, while publications accepted for publication were highly popular. The detailed statistics were as follows: (i) out of the 1,008 manuscripts submitted, only 62 were published in one of the three aforementioned journals; (ii) out of the rejected papers, 757 were eventually published in other, less prestigious journals; (iii) out of the remaining 189 manuscripts, some were published after a radical change and the rest were not found in the population of published papers. The cited study also showed that as many as 772 manuscripts were rejected without review, and among these there were 12 of the 15 most cited papers in the study population. Against this backdrop, Kyle Siler's team posed the question: Are editors afraid to publish ground-breaking, unconventional research results? The Kyle

[36] C. Ferguson, A. Marcus, and I. Oransky, "Publishing: The peer-review scam," *Nature* 515 (November 26, 2014): 480–482, https://doi.org/10.1038/515480a.

[37] This is pointed out by Fiona Godlee, editor-in-chief of the British Medical Journal, who gave the example of an article presenting excellent biotechnology research that may be rejected simply because it does not fall within the scope of the journal's clinical interests.

[38] K. Siler, K. Leeb, and L. Beroc, "Measuring the Effectiveness of Scientific Gatekeeping," *PNAS* 112, no. 2 (2015): 360–365, https://doi.org/10.1073/pnas.1418218112.

Siler team's research also showed that the number of citations cannot be considered an unambiguous measure of the quality of a paper, as it turned out that the most cited scientific papers in the world are rarely about ground-breaking discoveries, but rather present research of interest to a large number of scientists. This circumstance discourages research in unconventional areas of science and in those areas of science that are of interest to smaller populations of researchers. Commenting on this, Daniele Fanelli, an evolutionary biologist at the University of Montreal, who deals with publication policy, including the problem of publishing negative results, points out that one alternative approach would be to assess the quality of published papers by conducting a new round of peer review and perhaps even checking if the research has been successfully replicated and, in the case of medical science, transferred to a clinical setting. This, however, would involve additional and significant work and resources. The problem has also been commented on by Lamont, a sociologist from Harvard University, in his book entitled *How Professors Think* and devoted to the assessment by academics of the quality of papers published by other researchers. Upon reading his reflections, one might be tempted to conclude that the review process is like democracy—it has many flaws, but, so far, nothing better has been invented.[39]

Much has also been written about the lack of a proper scientific review culture and the inefficiency of the current review system in Poland.[40] It is pointed out that reviews are unreliable, the review process takes too long and the reviewer is not paid for their work. Repairing the system would require identification of the existing threats and flaws affecting the review system in place and proposals on how to remove them so as to produce a significant increase in the value of reviews. In the literature, Piotr Siuda identifies three fundamental pathologies of the review system: falsification of the review process, quasi-predatory practices and poor quality of reviews. The falsification of reviews involves an attempt to get the author to review their own work. In such cases, the author identifies an existing academic as a candidate reviewer, while providing false contact details. An unreliable review process may also be initiated by editors themselves,

[39] M. Peplow, "Peer Review—Reviewed," *Nature* (December 22, 2014), https://doi.org/10.1038/nature.2014.16629.

[40] P. Siuda, "Recenzenckie patologie" [Reviewer Pathologies], *Forum Akademickie* 2 (2023): 40–43.

by treating prestigious names more leniently in the process or by referring colleagues' work to less demanding reviewers. A significant pathology are quasi-predatory practices in review processes, which involve setting abnormally short deadlines for the submission of reviews in combination with rewards, such as giving the reviewer a reduction in the fee for publishing a paper in the journal. Such practices occur in journals of the MDPI publishing group, some of which have recently been included in the list of predatory journals.[41] The reviews submitted in the review process are also often biased, cursory, do not show a thorough analysis of scientific findings, and are sometimes downright unreliable. Piotr Siuda, calling by name the above-mentioned ills of the reviewing process, proposes to change the rules of the system to make it more demanding for both authors and reviewers. He proposes to introduce the rule of *triple-blind review* instead of *double-blind review*. Furthermore, he advocates moving away from the principle of publishing all results obtained so as to raise the requirements for papers to be accepted for publication. The cited author points out that the reviewing system calls for development and establishment of good practices, including the principle of remunerating reviewers for their work.

Upon reading Piotr Siuda's article, some reflections arise. Some of the identified pathologies occurring in the review process can be easily eliminated. Among these is the forgery involving the author's proposing as reviewers of their paper eminent, real-life specialists, for whom the author set up an e-mail address without their knowledge. In such a case, the supposed correspondence between the editor and the reviewer becomes, in fact, correspondence between the editor and the author impersonating the reviewer, and the author writes the review of the article themselves. This is a naive scam with no chance of success in decently edited journals. Firstly, an experienced editor only uses official, business email addresses in correspondence with reviewers. Secondly, a professional editor never asks for a review scientists suggested by authors.

While in cases of scientific fraud it is easy to put remedies in place, with the current publishing policy we should not expect the quality of reviews to improve but rather to deteriorate. This

[41] "List of all MDPI predatory journals in: MDPI Predatory Publishing" (February 22, 2023), https://predatoryreports.org/news/f/list-of-all-mdpi-predatory-publications?fbclid=IwAR1x55P2XmzShjL2p5hAbgeJsDxLiUJCXyOkr4751zfiyRtbMo_F885fklw.

is due to the rapidly increasing number of scientific journals and, consequently, the number of publications, with an inadequate increase in the number of academics,[42] which makes it increasingly difficult to find a competent reviewer agreeing to accept an article for evaluation. Between 1996 and 2021, 59 million scientific articles registered in bibliographic databases such as Web of Science and Scopus were published. In 2021 alone, the number of published papers approached 4 million. At the same time, the average number of authors per publication has steadily increased over the past 100 years, reaching a figure of at least seven in the chemical sciences in recent years. However, it is important to realise that the number of potential reviewers is much lower than the number of co-authors of articles. This is due to the fact that, in publications describing experimental research, the authors are predominantly MSc and PhD students, who do not yet have sufficient experience and general knowledge to cope with writing such a review. Requests for reviews come not only from luminaries of world science, but also from researchers with mediocre or even minor scientific achievements. Many scientists take a very selfish approach to the review process. By submitting a large number of manuscripts to scientific journals, they refuse the requests for reviews sent by journal editors. With the rapidly increasing number of manuscripts received and a de facto shrinking population of competent reviewers, the day-to-day work of journal editors is becoming increasingly difficult. Expanding the number of editors, sometimes even absurdly as, for example, in the case of the journals published by the *Multidisciplinary Digital Publishing Institute* (MDPI),[43] will not lead to an improvement in the quality of the review process, but rather to its deterioration. This is because the majority of this multitude of editors have only negligible or even no competence at all in editing scientific articles. The lack of proper editorial oversight means that the

[42] Based on the data from Statistical Yearbook of the Republic of Poland (Warsaw 2022), 434–435, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-rzeczypospolitej-polskiej-2022,2,22.htm, it follows that the title of professor in Poland was awarded to: 459 persons in 2010, 665–2015, 889–2020, 870–2021, while the habilitated doctor degree was awarded to 950 persons in 2010, 1643 in 2015, 2046 in 2020, 819 in 2021, and the doctoral degree was awarded to 4815 persons in 2020, 5956 in 2015, 4451 in 2020, 5261 in 2021, not all of whom remained active researchers.

[43] An example of this is the *International Journal of Molecular Science*, published by the MDPI publishing house, which has around 2,500 editors.

number of factual and editorial errors in articles submitted to MDPI journals is much higher than in publications published by more reputable publishing houses. Moreover, it is possible to find articles in MDPI journals whose publication constitutes an insult to logic and scientific knowledge. In the light of the above, the scientific status of the journal editor and their experience seem to be crucial for maintaining the level of the journal. They should be well acquainted with the community of researchers working in the field of science to which the journal they are editing is devoted. They should also be a sufficiently well-known and respected so that competent reviewers would feel uncomfortable refusing to write a review for them. In view of the small, as opposed to the needs, population of competent reviewers, maintaining a high level of scientific publications is only possible in such journals where the number of published papers does not increase exponentially, and it is even better when this number stabilises. In this context, an example worth following is the prestigious *Journal of the American Chemical Society* released by the American Chemical Society (ACS), which has published a similar number of papers per year over the last decade, ranging from 2,450 to 2,650.

Numerous scientific publicists propose modifications to the review process in such a way as to make it more objective and offer a better barrier against unworthy manuscripts. In the classic publication evaluation system, only the reviewers are anonymous to the authors. In a proposed modification, the reviewers would be anonymous to the authors and the authors to the reviewers (*double-blind review*). In yet another modification (*triple-blind review*), authors would remain anonymous not only to the reviewers but also to the editor. By complicating the review procedure, such modifications will not only fail to improve the quality of reviews, but will even seriously hamper the reviewers' work. The unprecedented increase in the number of journals and the number of articles published per year (in the case of the latter, almost 100-fold in China, almost 10-fold in Poland and more than 3-fold in France over the last 33 years) means that competent reviews can be less and less hoped for, and no modifications to the review procedure can change that. The world of scientific publishing will become more and more heterogeneous, with a stable, small number of prestigious journals and a growing share of periodicals publishing a large number of scientifically weak and inadequately edited articles, or even papers that have already been published (the phenomenon of self-plagiarism) or that infringe on the copyrights of other publishers and scientists (plagiarism of papers by other researchers published in other journals). It should also be added that even the most prestigious journals are increasingly failing to follow good practices, as far as the robustness of the editing process is concerned. This can easily be noticed by senior scientists who started publishing their articles in the 1970s or 1980s. The meticulousness of the technical editors shown at that time is unmatched by modern editors, even though those editors from the past did not have all the modern IT tools at their disposal.

2. Scientific Method

> The scientist is not a person who gives the right answers, he's one who asks the right questions.
> Claude Levi-Strauss, French philosopher
> https://www.theguardian.com/science/2014/jan/28/asking-right-question

Today, therefore, it is reasonable to ask whether published scientific data have in fact been properly assessed and verified in the review process. This has given rise to the need for tools to verify the validity of the research process or the already published research findings. Today, critical analysis of scientific data and findings is more important than ever before.

The world of scientific research is also heavily influenced by the phenomenon of *data-driven science* (an element of the broader contemporary concept of big data), which consists, roughly speaking, of the computer-assisted making of new discoveries through in-depth analysis of an existing body of scientific data. This issue was highlighted by the editors of the prestigious scientific journal *Nature* [Methods]. Namely, in an editorial entitled "Defining the Scientific Method,"[44] they pointed out that the development of omics sciences[45] and research based on the analysis

[44] Editorial, "Defining the Scientific Method," *Nature* [Methods] 6, no. 237 (April 1, 2009), https://doi.org/10.1038/nmeth0409-237.

[45] Omics sciences mean disciplines that aim to elucidate the biological and chemical principles of organismal functioning using modern chemical methods (e.g., spectroscopic and spectrometric methods) and molecular biology methods (e.g., PCR—polymerase chain reaction). The name of a given "omics"

of experimental (survey or laboratory) data opens up new opportunities for discovering knowledge on the one hand, but, on the other hand, is a cause of confusion in terms of establishing what scientific research should consist of, or even how to define science. After all, the research tools used in the medical, health or biological sciences are increasingly based on methods of collecting huge amounts of experimental data so that they can then be subjected to creative analysis, which is not pre-determined (profiled) by an appropriate scientific hypothesis (thesis) already at the time of data collection. The question posed at this stage is whether this circumstance changes the nature of scientific research and redefines science and the methods of doing it.

The scientific methodology applicable before the era of big data was based on the establishment of a scientific hypothesis deduced from the observations made, followed by the meticulous design and execution of experiments or calculations, and, finally, the confirmation and possible refinement or rejection of the hypothesis established. This methodology, popularised by Bacon, Descartes and Pierce, has contributed to the considerable success of science. Nevertheless, contemporary philosophers, such as Paul Feyerabend, argue that the classical scientific methodology, which boils down to making a hypothesis and verifying it, is not the only way to conduct scientific research. An example of a different approach was provided by *The Human Genome Project*, which many saw as a break with the view that proper biological research must be based on hypotheses, that is, classical scientific methodology. Despite the criticism, the project was carried out; it provided much of the information needed to understand human biology.

Today, methodological developments allow the collection of as much "omic" data as possible on various biological processes. Hence, with the help of mathematical and statistical analyses, the application of which can be a reference to a methodology based on the classical hypothesis and its verification, it is now possible to make extremely useful predictions (about genes and their functions or protein structure and function, for example). Referring to this phenomenon, the editor-in-chief of *Wired*, Chris Anderson, pointed out that modern biology is too complex to make hypoth-

discipline is derived from a given set of test substances, e.g. proteomics refers to the research related to the characterisation of the proteome (complete functional information on the proteomic composition of a sample), https://kamiljurowski.wordpress.com/praca-naukowa/nauki-omiczne/.

eses and create models, as the classical scientific method is dead as compared to the subject area. In this context, he called for the traditional scientific method to be replaced by methods based on the correlation analysis of huge amounts of data (big data), using new technological tools. Commenting on this position, Sean Carroll, a physicist at the California Institute of Technology, who is also involved in the philosophy of science, argued in *Edge* that hypotheses are not useful tools in a potentially outdated vision of science. In this context, hypothesis-making should be preceded by data collection, as model-based quantitative analyses require rich dynamic data collected under specific conditions and stimuli. Indeed, the quality and conditions of sampling are fundamental for conducting further mathematical and statistical analyses in a legitimate way on previously collected vast amounts of survey-laboratory data.[46]

Performing such correlational analyses on large data sets can provide answers to many questions posed by science, though of course not all. Indeed, "omics" data can provide information on the size and composition of biological entities, and thus define the boundaries of a scientific problem. The function thus defined can then be investigated by biologists using a classical hypothesis-driven experiment. Nevertheless, today's state of knowledge on the effectiveness of scientific methodology, which consists in collecting experimental data under specific (identical) conditions, analysing them mathematically and statistically and verifying them by means of a classical hypothesis-based experiment and its verification, should produce the intended results. However, it is very likely that combining these scientific techniques into a single method offers a better chance of success and reliable scientific results.[47]

In researching the nature and pace of development of modern science, another important phenomenon is discernible. Namely, it has become apparent that there has been a drastic reduction in the number of publications describing discoveries that are groundbreaking for science as compared to those that provide new data in areas that are already known. The former can be called "breakthrough science," the latter "incremental science." The authors of

[46] Reflections based entirely on: Editorial, "Defining the Scientific Method," *Nature* [Methods] 6, no. 237 (April 1, 2009).

[47] Reflections based entirely on: Editorial, "Defining the Scientific Method," *Nature* [Methods] 6, no. 237 (April 1, 2009).

a study published in *Nature*[48] analysed millions of manuscripts and patents from 1976 to 2010 and, in addition, compared manuscripts from the 1950s and the 2000s in terms of the most frequent verbs describing the subject of scientific findings. They found that papers from the 2000s less often used words such as: "produce" or "establish," while the predominant vocabulary included verbs such as: "improve" or "enhance." These analyses lead to the conclusion that new research primarily produces incremental knowledge of what is known and identified, while the number of reports on breakthroughs has decreased in relative terms. The analysis of patents showed the same trend. The results of the discussed studies further indicate that breakthrough research results announced in articles are less frequently cited, while papers publishing incremental research results are widely cited. Thus, the percentage of such publications or inventions that give a new direction to a particular scientific field decreases significantly.

Commenting on this phenomenon, Dashun Wang, a sociologist at Northwestern University, points out that incremental science is not necessarily bad, and argues that, for example, the first direct observation of gravitational waves was both revolutionary and a product of incremental science. John Walsh, on the other hand, a scientist at the Georgia Institute of Technology, preoccupied with science policy analysis, emphasises that the ideal would be a mix of breakthrough and incremental research in the right proportion, because in a world where we are concerned about the reliability of the published research results, it would perhaps be better if the announced discoveries were repeatedly verified. It is difficult to pinpoint direct causes for the discussed phenomenon of dominance of incremental science, nevertheless, the authors of the study attempt to seek an explanation. In their opinion, a partial answer involves the trends in the size and functioning of scientific teams and institutions. There are many more of them today than in the 1940s, which has created a more competitive environment and exerted pressure to publish and to apply for patents. This, in turn, has translated into the motivation of scientists to work. It became common for large research teams to set their sights on conducting research in areas covered by current scientific trends rather than in niche areas with no

[48] M. Park, E. Leahey, and R. J. Funk, "Papers and Patents Are Becoming Less Disruptive over Time," *Nature* 613 (January 4, 2023): 138–144, https://doi.org/10.1038/s41586-022-05543-x.

predictable chance of spectacular results. This trend has directly translated into large teams being more likely to produce incremental science rather than breakthrough science.[49]

As regards the diagnosed phenomenon in the Polish context, one can point to yet another factor besides such obvious ones as competition of scientific teams or publication pressure. It seems that in Poland such additional factor are the legal conditions for the career advancement of scientists. Apart from obtaining a doctoral degree, the career path of a Polish scientist is conditioned by two further stages of scientific promotion, namely obtaining a habilitated doctor degree and then the title of professor. In order to obtain the highest scientific status relatively quickly and without controversy, it is safer to choose the path of incremental science, which nevertheless adds something to the state of knowledge, than to take the risk of research in unknown, new areas, although potentially leading to breakthrough results. Reliable incremental research guarantees a fast publication path and obtainment of results fully accepted by the environment as a basis for promotion. In contrast, focus on breakthrough research often makes researchers who have chosen this model of operation struggle to publish their significant scientific findings after years of hard work. An instructive example are the numerous cases of Nobel laureates whose Nobel Prize-winning work has been rejected by editors of recognised journals.[50]

In the context of this discussion, three issues arise that must be considered:

1. Who is a scientific author (Science Creator) today?
2. When does a research contribution entitle to co-authorship of a scientific publication?
3. According to what principles should the attribution of authorship of scientific works proceed?
4. How should the authorship of a scientific achievement documented by a series of thematically related multi-authored scientific articles be demonstrated in a promotion procedure for the award of a degree or title?

This book will attempt to provide answers to such questions.

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[49] M. Kozlov, "'Disruptive' Science Has Declined—And No One Knows Why," *Nature* [News] (January 4, 2023), https://doi.org/10.1038/d41586-022-04577-5.

[50] F. Macdonald, "8 Scientific Papers That Were Rejected Before Going on to Win a Nobel Prize," *HUMANS* (August 19, 2016), https://www.sciencealert.com/these-8-papers-were-rejected-before-going-on-to-win-the-nobel-prize, accessed 7 January 2023.

3. Scientific Author—Who Is the Creator of Science?

> A quotation from Piotr Leonidowicz Kapitza (Nobel Prize in Physics with Arno Penzias and Robert W. Wilson, 1978):
>
> When Moseley came to Manchester he at once accomplished some minor research work and then eventually he came to Rutherford and told him of three different topics he would like to investigate. One of these researches was the classical work which had made Moseley's name so well known—the dependence of the wavelengths of Roentgen rays on the position of atoms in the periodical system. Rutherford at once advised Moseley to choose this work for his investigation. The future showed that Rutherford made the right choice, but he always pointed out that the idea of the experiment belonged to Moseley. Rutherford was very particular to give credit for the exact authorship of any idea. He always did this in his lectures as well as in his published works. If anybody in the laboratory forgot to mention the author of the idea Rutherford always corrected him.
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> P. L. Kapitza, "Recollections of Lord Rutherford." *Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences* 297 (1966): 123–137. The full text available via https://doi.org/10.1098/rspa.1966.0198

As we already know from the first part of this study, in no legal regime of intellectual property law, regardless of the level of jurisdiction (international, regional or national), can a legal definition of an author (creator), let alone a creator of science, be found. On the other hand, the definitions of author and right to authorship developed in legal science relate these concepts to the result of human creative activity. Based on copyright regulations, it may be assumed that an "author" or "creator" is a person who, by their own—strictly creative and intellectual—efforts, makes changes in the world. The result of these efforts is supposed to be an individualised and unique work, in which the author's mark is clearly imprinted. In doing so, copyright law protects only the form of expression. Only the final form of the work is therefore relevant. Consequently, in a legal sense, the author is not the creator/author of a discovery, idea, procedure or method. Authors of ideas, discoveries or theories can only obtain legal protection indirectly when they express their concepts and theories in words, mathematical formulae or drawings and then release them as a work in the sense of copyright law. Thus, an obvious dissonance between copyright and scientific authorship becomes apparent, for in science, scientific ideas, theses and discoveries are most important. Unfortunately, a research contribution does not always demonstrate the ability to be expressed as a work within the meaning of copyright law. For these reasons, the issue of scientific authorship has to be thoroughly analysed.

Research conducted at the intersection of intellectual property studies and science and technology leads to the conclusion that, as in the case of intellectual property law, scientific authorship shows a relation to something that has been fixed in a medium (article, book, poster). Therefore, journals and scientists can legally protect scientific publications from misappropriation or reproduction of published articles without their consent. However, this is where the analogy ends. In the cited studies,[51] it was recalled that a work according to copyright law, and thus a non-scientific work, reflects the personal creativity and original expression of its creator. Therefore, copyright protects the form of expression. Adopting the same reasoning to a scientific work is unacceptable. Indeed, such a qualification would disqualify the scientific author as a researcher, as it would place the results of their scientific activity in the domain of artefacts and fiction rather than truth. The object of research work is to establish true facts about the phenomena and objects under study or the relationships between them. In view of this, the most important thing about scientific authorship is not the form of expression, but the substance of the scientific findings made. In addition, scientific authorship cannot lead to the acquisition of "ownership" of a scientific achievement. Indeed, the practical dimension of scientific authorship boils down to the acquisition by a researcher or a team of researchers in the scientific community of recognition of the authorship of making an objective finding about the essence of the investigated thing or phenomenon, as well as the truthfulness (authoritativeness) of a statement about the nature of the investigated issue. For these reasons, scientists cannot copyright the content of their

[51] M. Biagioli, "Aporias of Scientific Authorship: Credit and Responsibility in Contemporary Biomedicine," in *The Science Studies Reader,* ed. M. Biagioli (New York: Routledge, 1999), 12–29, M. Biagioli, "Rights or Rewards? Changing Frameworks of Scientific Authorship," in *Scientific Authorship: Credit and Intellectual Property in Science*, ed. M. Biagioli and P. Galison (New York: Routledge, 2003), 253–261.

statements about phenomena or things because they form part of the natural world, which is a "fact," and facts (like the landscape depicted in a painting) cannot be copyrighted. They always belong to the public domain and cannot be owned by anyone like an artefact expressed in a non-scientific work.

It is worth adding at this point that until scientific discoveries (breakthrough science) or scientific findings (incremental science) are presented in a scientific paper and published and subsequently verified by the international scientific community, they do not count as such and do not benefit the scientist who discovered or established them. It is only by gaining recognition that the discovery or finding becomes scientific and the researcher is granted the status of creator of science.

A good illustration for these considerations is the case of the Fermi-Dirac dispute over the acknowledgement of authorship of a scientific formula describing the properties of a system of indistinguishable, non-interacting fermions, called the Fermi-Dirac statistics. Before discussing this case in detail, it should be recalled that, under the provision of Article 1 of the Polish act on Copyright and Related Rights, copyright protection covers "work" understood as "each individual creative work, embodied in any form, regardless of its value, designation, or medium of expression." A work is the subject matter of copyright from the moment it is fixed, even if it is unfinished, and an author is entitled to protection regardless of their compliance with any formal requirements]. Copyright protection arises in relation to an "embodied work," that is, once it has achieved "any form, however impermanent, yet stable enough for the features and content of the work to have an artistic effect,"[52] and this regardless of whether any formalities have been complied with. Consequently, the lack of publication of the manuscript of a scientific work is not an obstacle to obtaining copyright protection, since "fixing the work" according to the Polish Supreme Court may take "the form of an unrecorded work" and "may be embodied only by appropriate conduct of the performer." However, a condition for establishing the work is that it must be expressed in words, mathematical symbols, graphic signs as a literary, journalistic, scientific, cartographic or computer program work. Among other things, the above requirements for the protection are fulfilled by

[52] Judgment of the Supreme Court of 25.04.1973, I CR 91/73, OSNCP 1974, no. 3, item 50.

a researcher presenting a scientific concept in the form of a lecture at a scientific conference. However, copyright only protects the medium of expression. Thus, discoveries, ideas, procedures, methods and principles of operation and mathematical concepts are not protected. From the point of view of copyright law, we cannot speak of the "author of an idea," the "author of a discovery" or the "author of a scientific theory." When an author expresses the content of a discovery, an idea, a procedure, a method or principle of operation or a mathematical concept by means of words, a drawing or mathematical symbols and thus fixes even as an unfinished "product," for example, an unfinished manuscript of a scientific publication put in a "sock drawer," or presents it orally at a conference, it gains copyright protection. This does not mean, however, that he will be attributed the status of creator of, for example, a scientific theory, as the first author of the Fermi-Dirac statistics method found out. Namely, after Wolfgang Pauli announced the exclusion principle in 1925, a method of particle statistics based on the theory of a monoatomic perfect gas was developed subject to Pauli's prohibition, that is, an equation describing the distribution of particles and energy states, taking into account the relationship to the Bose-Einstein statistics. The authorship of this mathematical concept, called the Fermi-Dirac method of statistics, is attributed to Fermi and Dirac, and the authorship of the scientific theory to Fermi, even though the first scientific work describing the above was the work of another scientist, Pascual Jordan.

How did this happen?[53] Following Pauli's announcement of the exclusion principle in December 1925, Pascual Jordan produced a manuscript of a publication in which he presented the above-described quantum statistics, and handed it to Max Born, going to lectures at MIT, to read and evaluate during the ship's journey to the United States. Born unfortunately forgot about the manuscript. He only remembered it after six months had passed, realising at the time that he had deprived Jordan of the priority of this discovery, since by that time it had already been presented to the scientific world by Fermi and Dirac. Nonetheless, the priority palm of this discovery was ultimately awarded to Fermi, since, as it later turned out, Dirac was unknowingly inspired by Fermi's work.

It should be highlighted that, upon the completion of the manuscript, Pascual Jordan "fixed the work" by expressing in

[53] D. N. Schwartz, *The Last Man Who Knew Everything. The Life and Times of Enrico Fermi, Father of the Nuclear Age* (New York: Basic Books, 2017), 87–89.

words this scientific discovery and obtained copyright protection, however, only as regards the manner of expression (that is, as regards the form of description) but not as regards the authorship of the discovery, because this is not subject to copyright protection as establishing the truth about a phenomenon that has always belonged to the public domain.

History has recognised Fermi and Dirac as the discoverers, since they were the first to publish works presenting the discovery. Namely, in the case of Fermi, biographers date the scientific discovery (the birth of a scientific idea: the quantisation of a one-atom perfect gas) to September 1925, however, the first fixation of the work in non-permanent, "unrecorded" form took place on 7 February 1926 when Fermi presented the theory orally during a lecture to his colleagues at the Institute of Physics of the University of Florence. In doing so, he obtained copyright protection. Then, six weeks after this presentation, he published an article in a periodical issued by the Accademia dei Lincei dedicated to this discovery, fixing the "work" in a recorded form.[54] Nonetheless, the palm of priority in the attribution of this discovery to Fermi was accorded as a result of the third fixation of the work. Namely, on 24 March 1926, he submitted to the *Zeitschrift für Physik* an extended German-language version of the article announcing the results of this scientific achievement, entitled "Zur Quantelung des idealen einatomigen Gases."[55] It is worth mentioning that the common language of science at the time was German, not English.

Paul Dirac, on the other hand, submitted a paper on the same subject, "On the Theory of Quantum Mechanics," to the journal *Proceedings of the Royal Society of London* on 26 August 1926. The paper was published on 1 October 1926.[56] Based on the theory of the perfect gas, Dirac developed a different mathematical method for solving the same scientific problem, reaching the same analytical conclusions as Fermi. Dirac's approach, however, was broader, as it also included particles nowadays known as "bosons," which do not obey the Pauli exclusion principle but behave according to Bose-Einstein statistics. In this publication, Dirac neither quoted Fermi's work nor cited it in the bibliography.

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54 E. Fermi, "Sulla quantizzazione del gas perfetto monoatomico," *Rendiconti Accademia Lincei* 3 (1926): 145–149.

55 E. Fermi, "Zur Quantelung des idealen einatomigen Gases," *Zeitschrift für Physik* 36 (1926): 902–912, https://doi.org/10.1007/BF01400221.

56 P. Dirac, "On the theory of quantum mechanics," *Proceedings of the Royal Society of London* 112, no. 762, Series A (1926), https://doi.org/10.1098/rspa.1926.0133.

When Fermi read Dirac's article, he annoyedly wrote him a letter insisting on the priority of coming up with the scientific idea: "In your interesting paper 'On the Theory of Quantum Mechanics' […] you have put forward a theory of the Ideal Gas based on Pauli's exclusion Principle. Now a theory on the ideal gas that is practically [sic] identical to yours was published by me at the beginning of 1926. […] Since I suppose you have not seen my paper, I beg to attract your attention to it."[57]

In response to this letter, Dirac explained: "When I looked through Fermi's paper, I remembered that I had seen it previously, but I had completely forgotten it. I am afraid it is a failing of mine that my memory is not very good and something is likely to slip out of my mind completely, if at the time I do not see its importance. At the time I read Fermi's paper, I did not see how it could be important for any of the basic problems of quantum theory; it was so much a detached piece of work. It had completely slipped out of my mind, and when I wrote up my work on the antisymmetric wave functions, I had no recollection of it at all."[58]

Against the background of this story, the question arises as to how copyright law assesses the relationship between Dirac's work and Fermi's work describing in different words and languages the same discovery. This question is resolved by Article 2 of the Polish Copyright Act, under which: Paragraph (1) "A work deriving from another person's work, such as in particular translation, transformation or adaptation of an original work, is the subject matter of copyright, notwithstanding the right in the original work." Under Paragraph (4) of the same provision, "[a] derivative work is not a work inspired by another person's work." A development of another person's work, or a derivative work, is a new, independent subject matter of copyright that is "dependent" on the original work. In a dependent work, a certain amount of "creative interference" with another work is apparent, as it is created by taking elements of creative nature and incorporating them into a new work (the dependent work). An inspired work is an independent and self-contained work that is inspired by another work, but without taking creative elements from another work. This means that one has used someone else's idea, which has inspired one's own independent and original

[57] Schwartz, *The Last Man Who Knew Everything.*
[58] Schwartz, *The Last Man Who Knew Everything.*

work with a completely different form of expression in words or mathematical symbols, as in the case of Dirac's work, which was undoubtedly—unconsciously—inspired by Fermi's work but expressed in a completely different way (it took on a different form/form).

Another interesting example of a discrepancy between authorship according to intellectual property law and the recognition of authorship of a scientific discovery by the international scientific community is the story of the discovery of nuclear fission.[59] In 1944, the Nobel Prize in Chemistry was awarded to the German radiochemist Otto Hahn for his discovery of this phenomenon. From 1934 onwards, in a Berlin laboratory, scientists Lise Meitner, Otto Hahn and Fritz Strassmann conducted research into the production of new chemical elements with large atomic masses (so-called transuranic elements) as a consequence of the bombardment of metal targets with neutrons. This research continued with Lise Meitner until March 1938, when she had to emigrate to Sweden due to the persecution of Jews in Germany at the time. After Meitner's departure, Hahn and Strassmann continued this work together. In 1938, they succeeded in carrying out an experiment which resulted in the detection of barium, an element much lighter than uranium (relative atomic masses: uranium 238.0289, barium 137.328), in the products of bombarding uranium with slow neutrons—instead of the expected transuranic element. In December 1938, both scientists published the results of this experiment in *Naturwissenschaften*, but were unable to explain precisely the nature of the observed phenomenon.[60]

[59] N.-T. H. Kim-Ngan, "Niedoceniony przez Komitet Nagrody Nobla udział austriackiej uczonej Lise Meitner w odkryciu rozszczepienia jądra atomowego" [The Nobel Prize Committee's Underestimation of Austrian Scientist Lise Meitner's Contribution to the Discovery of Nuclear Fission], *Postępy Techniki Jądrowej* 1 (2007): 15–23.

[60] O. Hahn and F. Strassmann, "Uber den Nachweis und das Verhalten der bei der Bestrahlung des Urans mittels Neutronem enstehenden Erdalkalimetalle" [Concerning the Existence of Alkaline Earth Metals Resulting from Neutron Irradiation of Uranium), *Naturwissenschaften* 27 (1939): 11–15 (sent 22 December 1938, published 6 January 1939), https://www.chemteam.info/Chem-History/Hahn-fission-1939a/Hahn-fission-1939a.html; O. Hahn and F. Strassmann, "Nachweis der Entstehung aktiver Bariumisotope aus Uranium und Thorium durch Neutronenbestrahlung; Nachweis weiterer aktiver Bruchstucke bei der Uranspaltung (Verification of the Creation of Radioactive Barium Isotopes from Uranium and Thorium by Neutrons Irradiation; Identification of Additional Radioactive Fragments from Uranium Fission)," *Naturwissenschaften* 27 (1939): 89–95 (posted 28 January, published 10 February 1939).

Admittedly, they identified barium as a product of the fission of uranium and thorium, but they misinterpreted the phenomenon itself without understanding its essence. Hahn informed Lise Meitner, who was in exile, about the experiment by letter. During the Christmas holidays, Meithner and her nephew Otto Frisch correctly interpreted the experimental results described by Hahn and subsequently gave the scientific community the first physical interpretation of the uranium nuclear fission phenomenon, together with the predicted value of the energy released (approx. 200 MeV)[61] (radioactive decay of a nucleus, involving the splitting of the nucleus into two or more parts which are comparable in size), in papers published at the beginning of 1939. Meitner also carried out the relevant mathematical calculations, confirming that the fission of uranium nuclei should produce barium nuclei. The authorship of a scientific work properly describing the results of Hahn and Strassmann's experiment as nuclear fission did not translate into recognition of the scientific authorship of this discovery by the scientific community. For the discovery of heavy nucleus fission, the Nobel Prize was awarded to Otto Hahn. The Austrian scientist Lise Meitner had to wait for the scientific world to recognise her contribution to the discovery of nuclear fission. Today, her enormous contribution to the development of Science is unquestionable,[62] and an element with an atomic number of 109 and a mass number of 279 is named in her honour (meitnerium).

The issue of scientific authorship and its inextricable link to the need to take responsibility for the integrity of published research results is worth considering from the perspective of detected scientific frauds. The issue of distribution of responsibility becomes particularly relevant for the undertaking of team research work on interdisciplinary scientific projects involving specialists from

[61] L. Meitner and O. R. Frisch, "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction," *Nature* 143 (1939): 239–240 (sent on 16 January, published on 11 February 1939); O. R. Frisch, "Physical Evidence for the Division of Heavy Nuclei under Neutron Bombardment," *Nature* 143 (1939): 276 (experiments of 13 January, sent on 16 January, published on 18 February 1939); L. Meitner and O. R. Frisch, "Products of the Fission of the Uranium Nucleus," *Nature* 143 (1939): 471–472 (sent on 6 March, published on 18 March 1939); L. Meitner and O. R. Frisch, "New Products of the Fission of the Thorium Nucleus," *Nature* 143 (1939): 637 (sent on 26 March, published on 15 April 1939).

[62] T. Pospieszny, *Zapomniany geniusz. Lise Meitner—pierwsza dama fizyki jądrowej* [Forgotten Genius. Lise Meitner—The First Lady of Nuclear Physics] (Warszawa: Novae Res, 2016).

different areas of knowledge. Obviously, a thorough analysis of academic literature allows to detect errors in publications resulting from carelessness in conducting experiments or misinterpretation of the data obtained. From time to time, however, scandals involving the falsification of research results erupt. One of such situations was the affair involving the German physicist Jan Hendrik Schön. At the beginning of the 21st century, while working at the US Bell Laboratories, he published a series of articles in the most prestigious journals, such as *Nature* and *Science*, which simply electrified the solid state physics community, for example, in one of his papers he described the operation of a single-molecule field-effect transistor. For several years he was one of the most popular physicists in the world, a serious candidate for the Nobel Prize. A scandal erupted in the early 2000s when it was proven that he had falsified research results in many of his papers. The investigation was launched by Lucent Technologies, which carried out research programmes in Bell's laboratories. The members of the investigating committee were not allowed to see the experiment notes because, as it turned out, Schön did not keep them. There were no records, registers, reports or any evidence whatsoever in paper or electronic form of the research work described in the articles. As a consequence of these findings, Schön's co-authored articles were retracted, he was stripped of his prestigious awards and the University of Constance revoked his doctoral degree.[63]

It is worth considering the problem of accountability for published research results precisely based on the example of the "Schön affair." Of course, it was Schön, in particular, who suffered the consequences. However, when the unreliable publication scam and scientific fraud was discovered, there was no shortage of opinions that it could not have reached such a scale had it not been for the acquiescence, or at least intellectual laziness, of many of those who worked with Schön or reviewed his work. The odium, therefore, falls in part on the entire scientific community, which in one way or another, contributed to the worldwide publicity of the achievements that soon turned out to be frauds. The scientist who perpetrated it suffered all possible penalties. What is important, however, is whether the responsi-

[63] This story was described by journalist Eugenie Samuel Reich in her book *Plastic Fantastic: How the Biggest Fraud in Physics Shook the Scientific World*, published in 2009.

bility for these scientific frauds was borne by the collaborators of the fraudster, especially Christian Kloc and Bertram Batlogg, who co-authored most of the challenged and retracted articles. The first of the two, Krystian Kloc, a graduate of the Faculty of Chemistry at the Silesian University of Technology, emigrated to Germany after his studies and a short period of work in Poland. He was an outstanding specialist in obtaining single crystals of organic compounds, and these were the single crystals grown by this scholar that were used by Schön in his research. The ethics committee investigating Schön's scientific fraud case rightly exonerated him. It was established that he had only provided Schön, in the best possible faith, with samples for testing and had no reason to believe that the measurements made on them were falsified. Bertram Baltogg, on the other hand, was the head of the research group in which Schön worked. By the time the scandal broke out, he was no longer an employee of Bell Laboratories as he had won a competition for a professorship at ETH Zurich, Switzerland's most prestigious polytechnic. For similar reasons to those of Kloc, the committee exonerated him. In fact, this finding of the ethics committee can be questioned. Batlogg was incredibly proud of the results obtained by Schön. It should be noted that instead of duly coordinating and supervising the research work in his group as its head, he travelled the world and gave lectures promoting Schön''s achievements. He tolerated Schön's behaviour, which was inappropriate from the point of view of research work as Schön did not allow anyone to participate in the experiments he conducted, experiments which, as it later turned out, were not conducted at all. It seems, therefore, that Batlogg should nevertheless have suffered some consequences for his negligence in leading the team and supervising the research carried out by the researchers subordinate to him.

When considering questions of responsibility for collaboratively published research results, certain general rules can be adopted. Firstly, it must be established that all authors are undoubtedly responsible for the editorial and linguistic level of the publication. Secondly, it should be pointed out that responsibility for the published research results cannot be enforced on those authors who had no influence on the execution of the research and no competence to interpret it. This is a common case in interdisciplinary research. The only way to reduce the likelihood of unintentional errors, as well as to avoid potential scientific fraud in such research, is for all researchers involved in the execution of the project to work together as closely as possible. Hence, the role of leaders of collaborative research groups is very important. They should organise—either directly or by means of remote communication—frequent internal seminars attended by all project members. Familiarisation of project participants with the research techniques used should also be recommended, considering its educational value. It is unacceptable if the performer of the research refuses to allow other team members to participate in the activities, as happened in the Schön affair.

The *cases* cited and the above considerations show that the principles of attribution of scientific authorship, as well as the attribution of authorship of scientific articles, must be governed by different rules than those generally established under intellectual property law. Indeed, a creator of science is literally a non-author according to the definition adopted in intellectual property law. This issue has become particularly important after the discovery of numerous cases of scientific fraud and misconduct in research procedures. The world of science and scientists has decided that scientific authorship and the attribution of credit for scientific discoveries or findings is inextricably linked to the personal responsibility of the researcher for the integrity and reliability of the research process. The scientist receives credit, but must also take epistemological (and perhaps legal) responsibility for the veracity of the claims they publish.

For these reasons, determining the rules for attributing scientific authorship in relation to the rights of the creator of a research result (the author of the scientific product) and the authorship of the scientific achievement in proceedings for the award of a degree or title becomes an important issue.

4. Contribution to Research versus Authorship and Attribution of Scientific Works

4.1. Contribution to Research and the Right to Intellectual Property Protection when Publishing Research Results

One of the primary forms of publishing scientific findings (research results) is the creation and sharing of scientific works with the scientific community. These can take the form of papers delivered at scientific conferences and congresses or posters displayed at these conferences and congresses, as well as published scientific articles. When research results and scientific findings are the result of a team-based scientific project and are to be published in the form of a multi-author work, a dispute may arise over who the scientific author (creator of the Science) is and who has the right to scientific authorship of the published work.

As follows from the above considerations, regulations of national copyright laws, including the Polish Act of 4 February 1994 on Copyright and Related Rights, might not be compatible with the specificity of conducting research and making scientific findings, especially in such an area of knowledge as hard sciences or natural sciences. Such situation is the case when the participation in the research process of a particular team member does not concretise *strictly* in the creation of a part of the manuscript of a scientific publication, that is, a contribution work to a multi-author work being a scientific publication in the understanding of copyright law. The lack of direct and, as it were, intuitive coverage by the regime of attribution of authorship to a work under the Copyright Law Act of all the possible categories of fruits of the research process means that not every research team member's contribution to the research will receive appropriate protection under copyright law. By contrast, in the legal culture of democratic states, the protection of property and the freedom of scientific research are among the universally recognised human rights. In this context, property is understood as an autonomous concept that cannot be exclusively equated with ownership of movable or immovable properties. Property, therefore, also includes intellectual property, in the case of which the object of protection are intangible goods, that is products of the human intellect. The concept of "intellectual property" and, consequently, also intangible goods is defined in Article 2(viii) of the Convention establishing the World Intellectual Property Organisation[64] (hereinafter WIPO Convention) as "rights relating to: Literary, artistic and scientific works; artistic performances, phonograms, radio and television broadcasts; inventions in all fields of human activity; scientific discoveries; industrial designs; trade and service marks, trade names and signs; protection against unfair competition, as well as all other rights

[64] Journal of Laws 1975, No. 9, item 49; done at Stockholm on 14 July 1967 and amended on 28 September 1979.

emanating from intellectual activities in the industrial, scientific, literary and artistic fields." In the context of the quoted provision, it is assumed that intellectual property rights constitute a set of subjective rights of the creator to the product of their intellect, that is, an intangible good. Consequently, as long as the product of human thought, created in a strictly creative act, has an individualised and original nature and exists independently of its author, showing the ability to be perceived by persons other than the creator himself, it is subject to protection under intellectual property law. An intangible good defined in this way may arise in the field of industry, science or art as a result of human creative activity. Therefore, the object of legal protection becomes a guarantee of the creator's rights to the product of their intellect.

It should be added that the requirement to afford adequate protection to creators, regardless of the form that the fruits of their creative activity take, stems from the universal system of human rights protection. The analysis of its regulations provides the legal basis for recognising, as a binding principle, the guarantee of personal and property interests of all creators of intangible goods. Such regulations can be found in the Universal Declaration of Human Rights[65] of 1948. In many places, including Article 1, the Declaration expresses the principle of protection of human dignity, understood also as a subjective right, and under Article 17: "every person, whether alone or in association with others, has the right to own property," "no one shall be arbitrarily deprived of their property." Then, Article 27(2) of the Declaration expressly sanctions the principle of the protection of personal and property interests of creators of intangible property, providing that: "every person has the right to the protection of the moral and material benefits derived from any of their scientific, literary or artistic activities." The invoked subjective right is of a universal nature and has not been limited by an exclusive reference to the author within the meaning of the copyright laws. From the perspective of subjective rights of creators of science, the protection of intangible property, understood in this way, is

[65] Today, there is no doubt that the Declaration constitutes a legally binding instrument. This is because the norms contained therein are considered to be a component of customary international law and their binding force is not questioned. W. Brzozowski, "Uniwersalny system ochrony praw człowieka" [Universal System of Human Rights Protection], in *Prawa człowieka* [Human Rights], ed. W. Brzozowski, A. Krzywoń, and M. Wiącek (Warszawa: Wolters Kluwer Polska, 2019), 107.

not limited in scope to the created scientific works and works (works) contributing to multi-author works, but also extends to any scientific findings made by them, regardless of the form of their fixation or expression, including ideas, theories, hypotheses, concepts and discoveries (truths, facts) of science and methods and principles of operation, which are denied legal protection under Article 1(2)1 of the Polish Copyright Act or Article 23 of the Polish Civil Code. In practice, the analysed protection will refer primarily to the sphere of protecting personal interests, that is, the moral rights of the creator of science, the author of a contribution to the research, to the authorship of a scientific work in which the results of their scientific activity have been used.

It follows from the previous considerations that the sources of such protection should be sought first and foremost in the legally binding codes of ethics for the scientific community, regulating—in addition to national copyright laws—the principles of reliable conduct of scientific research and publication of its results in scientific works.[66] Furthermore, in order to decide whether a particular member of the research team is entitled to co-authorship of a scientific publication, reference should be made not only to the aforementioned statutory and code regulations, but also to the general rules of civil law.

4.2. Grounds for Guaranteeing the Moral (Personal) Interests of the Scientific Author—The Right to Authorship

In seeking to decode the guarantees for the personal (moral) interests of an author of a research contribution (scientific authorship), several important conclusions can be made. From the point of view of civil law, a joint scientific project is initiated when a group of persons, intending to undertake a specific scientific activity, forms a team of collaborators, with an assumption of mutual sharing of the obtained "raw" scientific data or prepared research reports. In this case, we have to do with conclusion of a civil law agreement on the joint conduct of scientific research, the subject, scope and personal composition of which are deter-

[66] For the importance of ethics in scientific research and in the attribution of authorship to academic papers, see R. Z. Morawski, *Etyczne aspekty działalności badawczej w naukach empirycznych* [Ethical Aspects of Research Activities in Empirical Sciences] (Warszawa: Wydawnictwo Uniwersytetu Warszawskiego, 2011).

mined by the common research objective to be achieved by the co-operators.

Considering the specificities of experimental research, another aspect should be noted. The assumptions and scope of research work within a joint scientific project carried out in the field of experimental studies may change, even substantially, in the course of the project. The scope of such research very often cannot be precisely predicted or designed in advance. Often, in the course of research, previously unnoticed research issues arise (the need for a new synthesis or a different measurement), the solution of which requires a new approach and, consequently, inclusion of new member(s) in the scientific team with a different spectrum of research specialisation. A similar situation may also follow from a review of a scientific paper before its acceptance for publication. Namely, the reviewer may condition such acceptance on the performance of additional research, imaginably, falling beyond the competence of the existing research group. In other words, during the course of the research process, the number of the scientific team members co-authoring the future publication (patent) may change over time, that is, increase. As a result, both the number of parties and the content of the joint research agreement may be modified, and this can happen several times.

It should be explained at this point that under the provisions of the Polish Act of 23 April 1964—Civil Code,[67] a civil law contract is concluded when two or more parties reach an agreement about the purpose they intend to achieve, jointly and in agreement, and about their mutual performances. Under the provisions of the Code, the parties entering into an agreement may arrange their legal relationship at their own discretion, provided that its content or purpose does not contradict the nature of the relationship, the law or the principles of social co-existence (Art. 3531). Furthermore, legally effective conclusion of a contract does not, as a rule, require any specific form; contracts may be effective as a result of purely oral arrangements. The Civil Code stipulates that only when the law reserves for a legal act the written, documentary or electronic form on pain of invalidity, an act performed otherwise than in the prescribed form shall be invalid (Article 73 § 1). It is worth adding that for a legally effective oral conclusion of a joint research agreement, it is not necessary for

[67] Journal of Laws 2022, item 1360 as amended.

the parties to be legally aware of it. What is important is that, from the perspective of any other average person their behaviour and actions could be interpreted in this way, as actions aimed at concluding such an agreement.

As regards the joint research agreement, the Civil Code does not define its concept (name), subject matter or scope, and therefore also its form. As a result, such an agreement may be concluded in any form, including oral, based on the principle of freedom of contract, as a so-called unnamed contract. However, in terms of shaping the content of such an agreement, researchers are bound by the regulations of the Civil Code prohibiting contractual contents or purpose contrary to the nature of the relationship, the law or the principles of social co-existence. The latter principles, in the context of scientific activity, have even been codified in a specific way in the form of numerous codes of ethics for researchers. Furthermore, according to the cited statutory provisions, a joint research agreement, like any other legal act, will produce not only the effects expressed therein, but also those arising from the law, principles of social co-existence and established customs (Article 56). The latter have also been codified in a specific way as multiple codes of ethics for researchers.

There is therefore no doubt that the coming to an agreement by a group of researchers to conduct research jointly, upon commencement of its implementation, must qualify as the conclusion of a legally binding contract for the joint conduct of research, even if its content is defined by purely oral or email agreements, or even implied, bearing in mind the specialisation of individual members of the research team.

Consequently, in cases of disputes over the right to co-authorship of a scientific publication, within the framework of civil law rules binding on scientists, as cited above, it becomes necessary to determine the rules of attribution of authorship of scientific works announcing the results of research obtained by a group of persons in the joint execution of a scientific project. In the first place, activities consisting in writing a part or the entire manuscript of a publication should entitle to authorship. Under national copyright legislation, such an action should be qualified as creation of a contribution to a work or creation of a scientific work, respectively, which unquestionably gives rise to authorship (co-authorship) of a scientific work. Thus, title to co-authorship of a scientific work arises from the creation or co-authorship of a scientific publication (work).

Secondly, the title to authorship may follow from the general principles of civil law and legally relevant codes of ethics, regulating the principles of attribution of scientific works in case of collaborative research and publication of its results. Namely, the provisions of the Civil Code and the aforementioned codes of ethics impose an absolute obligation on scientists to comply with the obligations under a joint research agreement, even if concluded verbally, provided that its content or purpose is not contrary to the nature of the relationship, the law or the principles of social co-existence. By way of example, the content and purpose of the arrangement must not contravene the ethical principles of scientific authorship as set out in the codes of ethics for scientists. The research team may not, therefore, define the legal relationship binding upon them at their absolute discretion. It is obliged to respect the provisions of the generally applicable law, the rules of social coexistence and established customs accepted in the relevant scientific community. The latter have been precisely defined in the relevant codes of ethics. Consequently, a contract for the joint conduct of scientific research may constitute a legal basis for becoming a co-author of a scientific publication, provided that, under its provisions, the scientist was obliged to perform a specific research task or research activity, which was then duly performed and used in the scientific work. In other words, the research contribution announced in the scientific publication and the relevant provision of the joint research agreement will be a basis for co-authorship of the scientific publication. Such arrangements are to be regarded as correct irrespective of whether or not a particular research contribution can be viewed as creative. Indeed, the requirement of contractual compliance obliges a team of researchers to recognise the co-authorship of a scientific publication of a researcher whose contribution to the research is deemed to be substantial (because it was used in the scientific publication), even if its nature is non-creative. On the basis of these principles, it would be unacceptable for such a contract to confer the status of co-author of a scientific publication without any contribution, even of a non-creative nature, to the published research (*guest authorship* or *honorary authorship* are therefore unacceptable).[68]

[68] See S. Ngai, J. L. Gold, S. S. Gill, and P. A. Rochon, "Haunted Manuscripts: Ghost Authorship in the Medical Literature," *Accountability in Research* 12, no. 2 (2005): 103–114, https://doi.org/10.1080/08989620590957175; J. S. Ross, K. P. Hill, D. S. Egilman, and H. M. Krumholz, "Guest Authorship and Ghostwriting in

It should be stressed that a researcher whose contribution to the research is of an intellectual nature has two unquestionable titles to the co-authorship of a scientific work. First, by reference to the universal principles of ethics, which require that the status of co-author of a scientific paper be granted to any researcher whose contribution to the research published therein was substantial and creative. Second, the right to co-authorship can be derived by the researcher from the content of the joint research agreement. In addition, if they prepared their contribution to the research in the form of a contribution work to the publication, the legal basis for protecting their authorship is provided by copyright law.

Taking the above into account, it is impossible not to recognise the importance of the principles of reliable conduct of scientific research and publication of its results in scientific works and, consequently, also the binding rules of authorship attribution, as based on the rules contained in the codes of ethics. Unfortunately, the norms and guidelines provided in these codes regarding fair attribution of co-authorship of scientific works are of a general nature. As a result, it is not always possible to derive from them direct commands and prohibitions—without prior interpretation—which will prove decisive for proper attribution of authorship of scientific works realised in different areas of knowledge. In many cases it is even impossible to directly apply them in various fields of science and art (scientific and artistic disciplines).[69]

Publications Related to Rofecoxib. A Case Study of Industry Documents From Rofecoxib Litigation," *JAMA* 299, no. 15 (April 16, 2008), https://doi.org/10.1001/jama.299.15.1800.

[69] The legislator distinguished the following fields of science: the field of humanities [divided into disciplines: archaeology, ethnology and cultural anthropology, philosophy, history, linguistics, literary studies, cultural and religious sciences, art sciences, Polish philology], the field of engineering and technical sciences [divided into disciplines: architecture and urban planning, automation, electronics, electrical engineering and space technology, technical computing and telecommunications, security engineering, biomedical engineering, chemical engineering, civil engineering, geodesy and transport, materials engineering, mechanical engineering, environmental engineering, mining and energy engineering, heritage protection and conservation], the field of medical and health sciences [subdivided into disciplines: medical biology, pharmaceutical sciences, medical sciences, physical culture sciences, health sciences], the field of family sciences [with the discipline of family sciences], the field of agricultural sciences [with the division into the disciplines: forest sciences, agriculture and horticulture, food and nutrition technology, zootechnics and fisheries], the field of social sciences [with a breakdown into

Such a situation may occur especially when a scientific publication is the result of cooperation of a team of researchers with different specialisations and competences, using different types of scientific and research techniques. The heterogeneity of the subject matter, nature, methods and procedures used in scientific research in particular disciplines, and especially in projects of an interdisciplinary nature, means that doubts or disputes may arise with regard to the application of the general principles of attribution of authorship in a specific situation. In order to resolve such doubts, it is first necessary to consider legitimate sources of information about their direction and correct understanding, and thus legally binding interpretation(s). Such sources may, among others, be the recommendations of authoritative bodies of scientists of recognised repute (credibility) and appropriate formal-legal status. An example of such a document is the study entitled "Reliability in Research and Respect for Intellectual Property,"[70] adopted in 2012 by the Team for Good Academic Practice at the Ministry of Science and Higher Education.[71] With regard to the issue of reliable attribution of authorship of scientific work, the document reads, inter alia:

the disciplines: economics and finance, socio-economic geography and spatial management, security sciences, social communication and media sciences, political and administrative sciences, management and quality sciences, legal sciences, sociological sciences, pedagogy, canon law, psychology, international relations], the field of science and natural sciences [with a breakdown into the disciplines: astronomy, biotechnology, computer science, mathematics, biological sciences, chemical sciences, physical sciences, earth and environmental sciences], the field of theological sciences [subdivided into the disciplines: biblical sciences and theological sciences], the field of veterinary sciences [with the discipline of veterinary science], the field of arts [subdivided into the disciplines: film and theatre arts, musical arts and plastic arts and art conservation]. See Regulation of the Minister of Education and Science of 11.10.2022 on the fields of science and scientific disciplines and artistic disciplines (Journal of Laws 2022, item 2202) .

[70] See: "Rzetelność w badaniach naukowych oraz poszanowanie własności intelektualnej" [Integrity in Research and Respect for Intellectual Property] (Warszawa: Ministerstwo Nauki i Szkolnictwa Wyższego, 2012), https://ken.pan.pl/images/Rzetelnosc_broszura_fin_low-skompresowany.pdf (accessed January 7, 2023).

[71] The team consisted of: Prof. Jan Hartman, PhD—Chairman, Prof. Andrzej Adamski, PhD, Prof. Grzegorz Gładyszewski, Rev. Prof. Janusz Mariański, PhD, Prof. Grzegorz Racki, PhD, Prof. Grażyna Skąpska, PhD, Roman Sławeta, PhD, Prof. Wojciech Tomasik, PhD, Aleksandra Wiktorowska, PhD, and Marek Wroński, PhD.

> Scientific activity, like all creative work, is a domain of freedom. The belief in the autonomy of scientific research may sometimes cause creators to approach with absolute discretion the origins of their own works, including the designation of authorship. These issues are regulated by law, and any person responsible for indicating the information on authorship of a work that they submit to a publisher must be mindful of the obligation to comply with the relevant legal provisions on what is meant by authorship. Of these provisions, the most important are Articles 8 and 16 of the Act of 4 February 1994 on Copyright and Related Rights (consolidated text: Journal of Laws 2021, item 1062, as amended). Article 8 of the Act states that the author of a work is its creator. Article 16 of the Act, on the other hand, defines the subject matter of moral rights. They protect the author's connection with the work, which manifests itself, among other things, in the right to mark the work with one's name or pseudonym or to make it available anonymously. In particular, it should be noted that Polish law does not deprive of author's rights anyone who has made even the most modest, but independent and creative, contribution to the creation of a work. Thus, a co-author is anyone who has written even a small part of the work, has made any creative contribution to its conception or arrangement, scientific research the result of which is a given work. On the other hand, someone who performed (even if very important) administrative tasks related to the preparation of a scientific work (for example, as the head of a scientific institution) is not a co-author. Also, a consultant, who shares their knowledge and provides advice in the creation of a scientific work, does not acquire the right of co-authorship on this account.

In summary, in the opinion of the authoritative body cited above, any creative contribution to the research process that directly contributes to a specific scientific work entitles its executor to the status of co-author of the publication. A prerequisite for asserting of such a claim is, of course, the possibility to demonstrate that this contribution to the creation of a scientific publication was independent and significant, that is, of a substantial or substantial and creative nature.

In the case of multi-authored works, resolving the question of whether an author's contribution to a scientific publication was independent and creative or whether, although not creative, it is nevertheless important (significant) is not an easy issue. However, it is not an impossible task. Upon application of the provisions of copyright law, the relevant codes of ethics together with the recommendations of the Good Academic Practice Panel and the regulations of the Civil Code, it is possible to decode the fair rules of authorship attribution applicable in a specific scientific community based on the provisions of law, the rules of social co-existence and the customs established in the given environment. This can be done by answering the question what scientific creativity is in a particular type of scientific discipline. Obviously, the considerable diversity of subject matters, research techniques and methods, and therefore different nature of scientific work and the scientific techniques used, mean that it is impossible to formulate a universal answer to such question. This problem is especially actual in the context of interdisciplinary research carried out by a team. However, a more general assumption can be made that in such areas of knowledge and fields and disciplines of science in which theoretical research is the primary form of investigation, demonstrating a significant or creative contribution to a scientific publication will not cause major problems. Customarily, such contribution will at least involve a possibility of the research team's member to claim the authorship of a scientific concept (thesis or hypothesis) and/or its descriptive development (evidencing a scientific thesis or hypothesis). In practice, this will translate into the possibility to demonstrate authorship of a work within the meaning of copyright law, which will constitute a contributory work to a scientific publication.

The discussed issue will no longer be so easily and unambiguously resolved when the creative contribution to a scientific publication of a given member of a team of scientists does not take the form of a contributory work—a work within the meaning of copyright law. Such situation arises when a scientific work in a given area of knowledge and scientific field involves both theoretical and experimental (experimental) or exclusively experimental research. Proper attribution of authorship of a multi-authored scientific publication in which not all parties to the project (and therefore the completed research process) participated in the writing and editing of the manuscript requires detailed consideration. It will become necessary to resolve this issue in reference to the nature, subject matter, methods and research techniques used in diverse areas of knowledge and scientific fields, taking into account the specificities of the research conducted in interdisciplinary teams of scientists, in order to resolve whether the contribution of a member of the research team was creative or not.

It has become accepted in the scientific community that the results of experimental research used in scientific work can be given different weight considering the nature of the procedures used to obtain them. Namely, the application of such procedures may involve highly specialised research activities, however, of purely technical, routine nature, and therefore repetitive and predictable in the sense that another expert performing the same research would most likely obtain an analogous experimental result. In such cases, during the study, the experimenter is even certain about the effectiveness of the research tool used and accuracy of the result obtained. However, the use of the experimenter's specialised knowledge and high competence, as well as the highly specialised research procedure known to the experimenter in the experimental process, may be accompanied by uncertainty both as to the adequacy of the research method (technique) used (and therefore the possibility of obtaining the desired result of the research process) and accuracy of the obtained result. In other words, in the course of an experiment, it is impossible to predict its final outcome, both in terms of adequacy of the implemented research method (technique) and the research result. There is also no certainty that any researcher conducting the same experiment would obtain the same results. As a result, the person conducting the scientific experiment is required to take a creative approach to the research process and not just routinely use specialised knowledge and competence, for example, in the operation of highly specialised and unique scientific and research apparatus. In the case under consideration, the researcher is expected to make research assumptions (scientific thesis) regarding the applicability of a given research method (technique), and then design the experiment, taking into account the possibility of ongoing correction or even change of the original assumptions in the experiment's conduct, depending on its course.

Consequently, if certain standards are to be established for qualifying the contribution of a research team member as independent and creative and, thus, giving rise to the right of co-authorship of a given scientific work, it becomes necessary to set certain principles of universal nature based on case studies in hard sciences and natural sciences. For these reasons, further considerations will be devoted to a practical analysis of the subject and nature of contributions to scientific research by researchers from different areas of research specialisation within those sciences.

In addition, we will try to answer the question about the value and importance of the contribution of individual members of the research team to the scientific research published in a scientific publication, including the project manager understood as the head of the scientific research team carrying out a specific project. We will also consider the role of a mentor of the research group in the preparation of scientific publications as a part of scientific collaborations initiated, coordinated and supervised by them. In this context, it is important to note that the issue of proper attribution of authorship of a scientific paper does not end with the question of whether or not to recognise a given person's status of co-author of a scientific paper.

4.3. Independent and Substantial Contribution to Research as a Basis for Scientific Authorship

When looking for an answer to the question of who the scientific author is and who has the right to become a co-author of a manuscript of a multi-authored scientific publication, it is necessary to refer to the customs established in the scientific community, which today have been compiled in many codes of ethics for researchers. Consequently, it has become possible to decode the ethical rules for authorship attribution of scientific works without violating the copyright rules. The analysis of these regulations, together with the recommended way of understanding and applying them, allows us to make some general remarks. For this purpose, we can use the criteria for scientific authorship proposed by the International Committee of Medical Journal Editors, ICMJE.[72] According to these principles, a potential author of an article should meet the following criteria:

1. Make substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work;
2. Draft the work or revise it critically for important intellectual content;
3. Give final approval of the version to be published;
4. Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

[72] http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html.

Let us comment on each of the above recommendations.[73]

Ad 1. Make substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work.

The first recommendation conditions the status of co-author of a scientific publication on making by a member of the research team a significant contribution to the conception or design of the work, acquiring scientific data, or analysing or interpreting the results of the published research. In commenting on this recommendation, it should be noted that team research increasingly involves master's students and even undergraduate students. Although there are examples of extraordinary creativity among these youngest adepts of science, their participation in the creation of a research publication is usually limited to obtaining data. In our view, this fully justifies assigning them the role of authors of the publication, despite their lack of significant intellectual contribution. This problem also applies to technical staff. They are generally left out of the list of authors, as it is considered to be their professional responsibility to carry out syntheses or measurements under the direction of academics. Of course, there are exceptions also in this regard, but unfortunately rare.

Ad 2. Draft the work or revise it critically for important intellectual content.

The second recommendation is that the co-author of a scientific publication should, as a minimum, draft the first version of the article or critically revise it, thus creating a significant intellectual contribution to the published content. This indication sanctions the principle that the first version of the article should be written by the leader of the research group. In general, however, this work is done by a doctoral student. In case of interdisciplinary articles, the first version is often a compilation of text fragments written by different members of the research group, as well as by researchers from other groups collaborating

[73] A. Chorążewska, K. Grzybczyk, A. Kertyczak, A. Proń, and J. Zrałek, "Sprawozdanie: Międzynarodowa Konferencja Naukowa nt.: Przyszłość badań naukowych w świetle prawa autorskiego, kodeksów etycznych naukowców oraz kryteriów ocen jakości badań," Katowice, 31 stycznia–1 lutego 2020 [Report: International Scientific Conference on: The Future of Scientific Research in the Light of Copyright Law, Ethical Codes of Scientists and Criteria for Assessing the Quality of Research, Katowice, 31 January–1 February 2020], *Przegląd Prawa Konstytucyjnego* 3, no. 55 (2020): 190–193, https://doi.org/10.15804/ppk.2020.03.10.

with the team coordinating the research. For this reason, many contemporary articles in life sciences and related fields contain passages that are difficult to understand, and often contain many errors both in terms of content and editing.

Ad 3. Give final approval of the version to be published.

The third indication highlights the principle that a text submitted for editorial review should be approved in advance by all members of the research team. This is an extremely important condition. All authors should approve the final version of the article. There are cases, albeit rare, where co-authorship is abandoned due to differences in the interpretation of results between authors. In an extreme situation, this can lead to a publication being blocked.

Ad 4. Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

The fourth principle requires that, when deciding to submit an article for review and, in the co-authors' intention, also for subsequent publication, co-authors of a paper should be aware that, at the same time, they agree to take responsibility for all aspects of the published work, that is, they provide assurance as to the reliability, accuracy or integrity of the published research results. Taking responsibility for the integrity of published results is an important ethical requirement for the authors of publications. Responsibility for unconscious errors, resulting from ignorance, as well as for conscious scientific fraud, resulting from the dishonesty of one of the co-authors, should be borne equally by all authors of an article. However, each situation of a disclosed deliberate scientific fraud by one co-author or part of the co-authors should be dealt with on a case-by-case basis, as often the other co-authors do not have the knowledge and/or technical ability to detect the falsification. Most often, such incidents occur in interdisciplinary research, and the ethics committees examining the irregularities usually postulate to punish only the actual perpetrators of the fraud.

In a similar way, the criteria for authorship have been defined by the Polish Code of Ethics for Researchers.[74] According to the provisions of this Code, the criteria for authorship are met when

[74] This Code of Ethics for Researchers was developed by the Science Ethics Commission (Commission for Research Integrity) and adopted by the General Assembly of the Polish Academy of Sciences on 25 June 2020.

it is based on the fulfilment of at least one of the following conditions: a creative and significant contribution to the research, which means a significant contribution to creating scientific ideas, formulating concepts, and designing research, an unquestionable active involvement in the acquisition of data, in the analysis and interpretation of the findings, as well as a substantive and reliable contribution to preparing and critically drafting the article from the point of view of the applicable scientific criteria (Chapter III, Paragraph 3.3.2.). Protecting the moral (personal) interests of the author of an independent and substantial contribution to the research, the Polish Code of Ethics precisely defines who does not have the right to authorship, and provides guarantees for the recognition in the publication of contributions other than intellectual. The code reads as follows: "Financial support and other types of assistance should be appropriately acknowledged" (Chapter III, Paragraph 3.3.7.), and "[o]btaining funding, providing access to equipment and related training, collecting data, or exercising general administrative supervision of a research group do not give anyone the right to claim co-authorship. The head of a research unit may not be listed automatically as a co-author of articles published by their subordinates" (Chapter III, Paragraph 3.3.3.).

The Polish Code of Ethics also regulates the issue of the order of co-authors, indicating that the order of the names on the list of authors of a multi-authored work, must not be random. "Names of the authors of a publication should be listed in the order that is customary in a given scientific discipline and should be accepted by all co-authors at the initial stage of drafting the publication. Intellectual contributions of other individuals who have a significant impact on the published research should be appropriately acknowledged" (Chapter III, Paragraph 3.3.6.). Polish ethical standards furthermore correlate scientific authorship to the responsibility for the quality and reliability of published research results. Under the cited Polish code of ethics: "[a]ll authors are fully responsible for the content of the publication unless otherwise specified (for example, that they are responsible only for a specific portion of the research in their area of expertise). When the affiliations of authors are listed, it is recommended that the nature of their contribution be specified." (Chapter III, Paragraph 3.3.4.).

A comparative analysis of the ethical regulations adopted at different levels of jurisdiction: international, individual countries, institutions and scientific societies, and associations of publishers, in relation to the expected rules for conducting research and publishing its results,[75] leads to identical conclusions regarding the applicable criteria of scientific authorship and the right to recognise, in a work, research contributions other than intellectual. An examination of the provisions of these codes of ethics allows to reconstruct the common principles, universally recognised by the global scientific community, which, altogether, make up the content of a universal code of ethics for researchers. The universally recognised principles protect, in absolute terms, the moral (personal) interests of the creators of science to their scientific work and intellectual contributions, as well as contributions of other kind to the common research project. Conclusions in this regard are presented in Table 2. They allow us to establish the rules of collective authorship and order of authorship of collaborative research papers by common principles of a universal ethical code for researchers.

Table 2. A universal ethical code for researchers—rules have been reconstructed by the comparative method based on regulating the ethics codes listed in Table 1. List of codes of ethics included in the analysis. Source: own study.

Commonly recognised values	Rights arising from the obligation to protect intellectual property in scientific creation	The method of protection
1. Scientific creation is protected by law	— intellectual property right to scientific creation	— calls for establishing policies and practices that specify the rights of researchers to their research results in the employer's internal law, as well as in specific collaboration agreements or other types of agreements
2. Researchers' right to be independent in their research	— researchers' right to be independent of their upervisor(s) and publish their research independently	— a requirement that employers' internal legal policies, practices and procedures ensure: ✓ Researchers' right to publish their research independently of their supervisor(s); ✓ Researchers' right to be recognised for their original contributions to a scientific project by granting them co-author status, patents, etc., and by citing them as authors of data/creators of research.

[75] Developed on the basis of a comparative analysis of the provisions of codes of ethics for researchers—for the list of the documents considered, see Part I of the study.

3. The right to a joint publication of the research group	— a right of collaborating researchers to co-authorship of a joint paper	— an obligatory rule: a group of researchers working together should publish the results of their research as co-authors in a joint paper.
4. Scientists are obliged to recognise others' original intellectual contributions to science	— a right to protect and recognise by other researchers one's intellectual, scientific creation	— an obligatory rule: co-authors are obliged in a paper to cite related others researchers' works which have influenced the published research.
5. Direct, significant intellectual contribution to research is protected by ethical standards	— researchers' right to establish diverging from copyright law rules of attribution of scientific paper's authorship in ethical standards — a right to establish best practices and habits for recognising original, intellectual and significant contributions made to a scientific project	— obligatory rules: ✓ only "direct, significant intellectual contribution" is a basis of a paper's authorship; ✓ a creator of substantial intellectual contribution should be an author. It should be said that: ✓ honorary or guest authorship of a paper is not acceptable; ✓ participation in research, which consists of: • acquisition of funding, • collection of data, • provision of purely technical services, • provision of equipment, patients, or materials, • writing assistance (drafting or editing the manuscript), • general supervision of the research group or acting as department chairperson who provided only general support, while they may be essential to the work, are not in themselves sufficient contributions to justify authorship. — obligatory rules: ✓ an author of an idea (scientific thesis); ✓ an author of conception or design of the project; ✓ a creator of experimental data; ✓ an executor of the practical (like acquisition and/or processing of data/material) or intellectual work in a scientific project (e.g., analysis and interpretation of data/material);

		✓ an author of the manuscript of a publication (who was writing substantial sections of the paper, e.g., synthesising findings in the literature review or the findings/results section or has been involved in drafting the article or revising it critically for important intellectual content) should be recognising as co-author of a paper, and no person who fulfils the criteria for authorship should be excluded; their authorship is justified. — an obligatory rule: ✓ nobody should be named as an author without approving the final version to be published, and all partners in research collaborations should be properly informed and consulted about submissions for publication of the research results.
6. Researchers' and sponsors' rights to be acknowledged for their credit in research in a paper	— an obligation to thank other scientists and assistants for their help and assistance of another kind than intellectual credit to research — an obligation to thank sponsors for funding research	— obligatory rules: ✓ if one has made other than significant intellectual but substantial contributions, one should be acknowledged in a paper (this might include interviewers, survey management staff, data processors, computer staff, clerical staff, statistical advisers, colleagues who have reviewed the paper, students who have undertaken some sessional work, the supervisor of a research team and someone who has assisted in obtaining funding); ✓ sponsors and funding institutions have also to be acknowledged in a paper.
7. Researchers' right to regulate the order of authorship of collective works and rules of fulfilling the ethical standards of authorships in a collective paper	— an obligation to establish an order of authorship of collective works	— obligatory rules: ✓ the institution is obligated to establish rules for the attribution of authorship of publications for specific areas of knowledge (for each laboratory), but a person who has made the major contribution to the paper and/or taken the lead in writing is entitled to be the first author; ✓ decisions about the order of authors and acknowledgements for support staff and other persons should be made as agreed upon by all research team members, ideally at the start of the project;

		✓ decisions about an order of authors and acknowledgements for support staff and other persons should usually be made by the first author in consultation with other team members; ✓ the order of authorship is: authors' team members who made a significant contribution to analysis or writing (i.e., more than commenting in detail on successive drafts) are entitled to follow the first author immediately; where there is a clear difference in the size of these contributions, this should be reflected in the order of these authors;
	— an obligation to describe in a paper the contributions of each author to the research	✓ team members specify in their manuscript a description of the contributions of each author and how they have assigned the order in which they are listed so that readers can interpret their roles in research correctly.
8. Authorship and responsibility for authenticity and quality of published research is tightly coupled	— an obligation to take responsibility for the quality, authenticity and correctness of the published join research	— obligatory rules: ✓ between authorship and responsibility there is tight coupling, so each co-author of a collective work is accountable for the authenticity and quality of the published research, a defence of minimal participation in work done in one's laboratory is entirely inapplicable when one is a co-author of the disputed work; ✓ a scientific team should indicate the primary researcher who is generally responsible for the quality and authenticity of the published results of the research and for fulfilling the ethical standards of authorship by all persons indicated as authors of the article
9. Procedures applicable in cases of research misconduct	— an obligation to define cases of research misconduct — an obligation to protect the researcher's reputation — an obligation to conduct a research misconduct investigation in an impartial,	— obligatory rules ✓ research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research or in reporting research results; ✓ plagiarism is defined as using other people's work and ideas without giving proper credit to the original source, thus violating the rights of the original author(s) to their intellectual outputs (it is a broad definition that goes beyond the description based on copyright); ✓ a complaint solely intended to harm the alleged ethical violator should not be filed;

	expedient and professional way involving the disciplinary officer and a professional institution, unbiased in ethical matters — the principle of presumption of innocence applies	✓ a complaint should be filed only in proper cases to protect the integrity of the research profession and the public interest; ✓ retaliation of any kind against a person who, acting in good faith, reports or provides information about suspected or alleged misconduct is prohibited; ✓ institutions are obliged to protect the rights of "whistle blowers" during investigations and ensure that their career prospects are not endangered; ✓ complaints about research misconduct are carried out so as to guarantee thorough, competent, objective, fair, and appropriate protection of the confidentiality and reputations of all participants; ✓ anyone accused of research misconduct is presumed innocent until proven otherwise; ✓ if allegations of research misconduct are not confirmed, efforts will be made to restore the reputations of the respondent(s).

Commenting on the principles of a universal code of ethics for scientists, as reconstructed above, it is necessary to address the following two issues:

1. The principles recommended in the universal ethical standards for determining the order of authors of a collective work, i.e., the rules of collective authorship.
2. An analysis of the prerequisites formulated in the universal ethical rules of scientific authorship for the right to become a co-author of a scientific publication (the right to be an author)—this strand is discussed below the table.

Re. 1. Locating the Authors of collaborative work.

It should be recalled that the reconstructed code of ethics recommends the following rules for the order of authors of a multi-author paper:

a) the person taking the lead in preparing and writing the manuscript should be listed as the first author;
b) the order of authors and the inclusion of acknowledgements to individuals and institutions is decided by the first author in consultation with the team;
c) the order of inclusion of names in the list of authors should be decided at the earliest possible stage of the research project;

d) all co-authors should agree to the accepted order of authorship of the collective work;
e) scientific research institutions should adopt internal regulations defining the principles of scientific authorship and co-authorship, either in the form of general rules applicable within the institution or in the form of separate regulations laid down independently for each laboratory, in order to take account of the specificities of the scientific speciality and of the publication of research results; these regulations should protect the rights of authorship and the respective position in the list of authors of the person who contributed most to the scientific project.

The rules regarding the order in the list of authors of scientific publications and the inclusion of acknowledgements to individuals and institutions require comments (items a–d). In practice, as we have already mentioned, it is the leader of the research group who is the last author, even if they had the greatest involvement in coordinating the project and writing the article. The first author is generally the collaborator who has devoted the most time to the research within the project. It is customary for the first author to be a doctoral student, and they are not decisive in determining the number and order of authors. This decision should be made collectively, taking into account as far as possible the wishes of the collaborators involved in the research. The principle that the order on the lists of authors of publications to be produced in the future should be decided at the earliest possible stage of the research project is an unrealistic recommendation. In research work, it is impossible to predict in advance the contribution of the collaborating researchers to the obtaining of those significant results that will later be used in a publication. Research hardly ever follows a set plan and almost always requires modification, sometimes even a fundamental change, of the original assumptions. In practice, the number and order of authors is determined when the manuscript is started, but even then it can be changed.

As regards the recommendation requiring scientific institutions employing authors to define the rules for authorship attribution in their internal regulations, it should be noted that excessive formalisation and setting strict rules for this attribution is unnecessary. Both the number of authors and their order of authorship can be determined without conflict during a joint meeting of all participants of the research to be committed to a paper, in reliance on generally accepted principles of research ethics. Indeed, experience leads to the opposite conclusion. Creating detailed internal rules strictly regulating the question of attribution often generates unnecessary conflicts.

Re. 2. Prerequisites for the right to be a co-author of a collective work according to the universal ethical rules of scientific authorship.

Authorship of a scientific publication should be a consequence of the researcher's independent and substantial participation in obtaining the research results described in the article, as well as in the creation of the article itself. It should also be expressed in the observance of the provisions of the concluded contract (even if only verbal) for the joint conduct of scientific research. However, the attribution of authorship arising from such contract should comply with the applicable legal and ethical standards. In the first place, the authorship status should attach to that member of the research team whose role proved to be predominant in the competent drafting of the scientific article's text, with the appropriate use of the creative contributions by all members of the research team. The editing of the publication, in which the results of the research and its conclusions are discussed, is the final stage of the previously implemented research process. Proper editing of the article and presentation of the theses postulated in its content, as well as the ability to adequately present the research results, including their logical explanation and justification (including the use of appropriate tools for their mathematical or statistical processing), fundamentally affect the reception of the paper by the journal editor and reviewers, as well as readers. This does not mean that the lead author of a manuscript, that is, the researcher who played a predominant role in its creation, automatically obtains the position of first author or so-called corresponding (star) author of the scientific publication. The fact that their function in the research team was to get a grip on the creation of the text of the scientific paper means that the qualification of their contribution to the research paper as independent, creative and significant cannot be questioned. Consequently, two other factors should be decisive when assigning the position of the first author of a research paper—firstly, which researcher made the greatest intellectual contribution to the undertaking and conduct of the research, and secondly, which researcher spent the most time carrying out the research and, then, analysing the research results obtained. All of this adds to the assessment of the value of a work, and may subsequently translate into greater resonance of the work within the scientific community. A finished work, especially once it has been submitted to print and published, becomes the evidence of proper verification of the scientific thesis posed at the outset of the research process. The right to authorship of the team member who predominantly contributed to the text of the manuscript is, of course, directly protected by copyright. Under copyright law, the status of author of the work is also afforded to any member of the research group who has presented the result of their research in the form of a work and, at the same time, made a contribution, within the meaning of copyright law, to the prepared multi-author scientific publication.

If, however, the type of research carried out, due to its experimental nature and method of expression, does not clearly allow protection to be granted under the provisions of the Copyright Law Act, it becomes necessary to point to other, additional legal bases for the protection of the authorship status of a member of the research group whose scientific work undoubtedly contributed to the publication in question. This is particularly the case when a specific product of the human intellect—as in the case of the scientific work of a synthetic chemist, operator of specialised scientific measurement apparatus, statistician or chemometrician—in a given situation is not capable of being expressed directly in the form of contributory work to a scientific publication. This happens when the result of scientific research takes, firstly, the form of pure outcome of experimental research performed using scientific measurement apparatus, and secondly, (as in the case of a synthetic chemist) the form of a chemical compound or material for directional research intended to determine in detail its properties and the possibility of its technological application by an interdisciplinary research team in the area of both basic and applied research, and thirdly, the form of developing a mathematical and/or statistical model or a chemometric strategy, the purpose of which is, for example, to improve chemical information extraction from multidimensional incomplete data and/or induced structure data. Each of the analysed stand-alone contributions to a study published in a scientific publication requires further elaboration and, then, creation of a contributory work in the form of analysis and discussion (drawing conclusions) of that part of the research process. If the elaboration of the research result is carried out by the experimenter themselves (synthesiser, experimenter or mathematician/statistician/chemometrician), the requirement to demonstrate an independent, creative and significant contribution to scientific research, entitling to co-authorship of the work, is fulfilled, and this directly under the Copyright Act, as such process results in the creation of a contributory work for the publication. Doubts—albeit unfounded—may arise when the creator of the research result is not the author of such contributory work.

In case of such publication, protection of the right of co-authorship may be claimed by the author of the research result used therein if the following conditions are cumulatively met: firstly, it can be shown that the product of their intellect constitutes their independent contribution to the scientific research announced in the work (criterion of independence of the contribution); secondly, that the product of their intellect was created as a result of carrying out a number of activities of an individualised and creative nature (criterion of the contribution's creative nature); and thirdly, that the result of the research obtained by them conditioned the possibility of undertaking and carrying out further directional research by other members of the research group, thus, determining the possibility of creating the entire work (criterion of the substantial nature of the contribution).

Therefore, if the contribution to scientific research does not cumulatively meet the three above-mentioned criteria, and, in particular, does not have a creative character, the creator of the research result may derive the status of co-author of the scientific publication only from the research team's joint research agreement. Such a situation may occur when the research result was obtained by using specialised research procedures, however, of a routine, repetitive nature, or by using automated measuring apparatus. If, on the other hand, the contribution to scientific research cumulatively follows all three aforementioned criteria, then undoubtedly the author of the research result has the right to co-authorship of the scientific publication. In the lack of the possibility of recourse to copyright law, the legal basis for the protection should be sought by the said author directly in the provisions of the 1997 Constitution of the Republic of Poland (the provisions of which, by virtue of its Article 8, apply directly, unless the Constitution itself provides otherwise) and in the provisions of the Civil Code. A contribution to research which is in line with the indicated criteria meets, at the same time, the prerequisites under the definition of the term "scientific creativity," as developed in literature, which, as one of personal (moral) interests of a human being, is subject to legal protection under Articles 23 and 24 of the Civil Code. Thus, the cited provisions concretise the constitutional requirement to guarantee intellectual property rights to the author of a research result on equal terms with the author of a scientific work in the understanding of the Copyright Law Act (Article 73 in conjunction with Article 64(1) and (2) and Articles 32 and 33 of the Constitution of the Republic of Poland).

In conclusion, in order to demonstrate the importance and significance of a research result obtained as a result of scientific activity and later used in a scientific publication, a researcher seeking legal protection should invoke, in particular, the provisions of the Code of Ethics for Researchers, which has already been referred to many times. The Code's provisions specify that a person's scientific creativity subject to protection under Article 23 of the Civil Code is an independent, creative and significant contribution to a published research. At the same time, the Code of Ethics clarifies that the said intellectual contribution to the research of an experimental scientist does not have to be reduced to the preparation of the manuscript for publication, that is, it does not have to consist in a significant contribution to the drafting and writing of the article or its critical revision from the point of view of intellectual content. It can be expressed in a significant contribution to the initiation of the scientific idea, creation of the concept and design of the study or a significant contribution to the acquisition of data or the analysis and interpretation of the results obtained. As a result, the use of another researcher's (previously unpublished) scientific data by a team of researchers conducting further research unquestionably gives rise to their right to co-authorship of the paper, when the process of obtaining the data was independent and creative, and the data itself can be considered relevant. The condition of relevance of the research result is fulfilled when the above-mentioned data are used in the work, as this means that the work would be incomplete without them. On the other hand, it is the role of experts from relevant scientific disciplines to assess whether this contribution to the research meets the requirement of the researcher's independent scientific creativity. It must be assumed, however, that the status of independent and creative contribution to a research should always be attributed to those products of the human intellect that are created as a result of a complex, creative (not routine and fully automated) scientific process. This means that the experimenter, in the course of the research process (be it the operator of the scientific and measuring apparatus, or the mathematician, statistician or chemometrician creating a strategy or model for the extraction of data, especially incomplete data or data with an inductive structure), is continuously obliged to properly control the (previously designed) experiment, by properly selecting the individual elements of the implemented procedure or modifying it on an ongoing basis, according to the partial results obtained. Consequently, the experimenter is required to be more than just able to have and demonstrate specialised knowledge and competence. Indeed, it is necessary to be able to demonstrate convincingly that the use of this knowledge, skills and competence did not merely amount to performing routine, always repetitive, purely technical activities.

4.4. Principles of Attributing Authorship of Scientific Works vs. the Order on the List in Multi-authored Works

From the dawn of academic writing until the late 1970s, the rules for attribution of authorship of scientific publications did not present difficulties. Indeed, the overwhelming majority of articles had one or two authors. Articles that did not require painstaking experimental research were usually single-authored, and those that were primarily based on experiment had two or at most three authors—usually a professor plus an assistant and, possibly, a doctoral or master's student. As a result, it must be concluded that, in the 20th century, in many scientific centres a hierarchical arrangement of authors of a scientific publication of German origin applied, that is, the order of names was as follows: first the professor, then the assistant (postdoc), and, finally, the doctoral student or the doctoral student and the master's student. In the case of articles that were the result of collaboration between several scientific institutions, a different, rather transparent ordering system was also in use 40–50 years ago. Co-authors were divided into groups according to their affiliation. The names of all co-authors from the institution initiating and coordinating the research came first in the list of authors, followed by other co-authors from the collaborating institutions.

Such an example is provided by an article published in *Physical Review B*,[76] which was a result of collaboration between experimentalists from the University of Pennsylvania and theorists from the industrial company Xerox. What beautiful times those were when industrial companies hired theorists! In this publication, the authors were grouped precisely by affiliation—first came those from the University of Pennsylvania, then—those from Xerox. The first author was Shahab Etemad, a refugee from Iran, a physics professor in that country, given a hand in his dramatic life situation by his PhD supervisor, Alan Heeger, who hired him as a postdoc until Shahab found a permanent position at Bell Laboratories. Shahab Etamad requested the author of this paper, Adam Proń, to provide doped polyacetylene and doped deuterated polyacetylene. While the preparation of polyacetylene was already standard, at the time, obtaining its deuterated form required the development of an entirely new procedure. Shahab Etemad performed spectroscopic studies for both forms of the polymer (IR, Raman). Difficulties encountered in the quantitative interpretation of the spectra forced him to turn for help to theoretical physicists from Xerox. Heeger's and MacDiarmid's contribution to this work was minor (proofreading of the manuscript), however, the published research was funded from the grants they had obtained. Both at that time and presently, in the United States, it is considered that obtaining a research grant automatically entitles the grant recipient to co-author any article funded from the grant. A similar (institutional) arrangement of authors was also used in an article in *the Journal of Physical Chemistry*,[77] the result of a collaboration between the University of Maryland, Naval Research Laboratory and University of Pennsylvania.

[76] S. Etcmad, A. Pron, A. J. Heeger, and A. G. MacDiarmid (Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19104), E. J. Mele and M. J. Rice (Xerox Webster Research Center, Webster, New York 14580), "Infrared-active Vibrational Modes of Charged Solitons in $(CH)_x$ and $(CD)_x$," *Physical Review* B 23, no. 10 (1981).

[77] G. R. Miller (Department of Chemistry, University of Maryland, College Park, Maryland 20742, and Code 6120, Naval Research Laboratory, Washington, D.C. 20375), H. A. Resing (Code 6120, Naval Research Laboratory, Washington, D.C. 20375), F. L. Vogel, A. Pron, T. C. Wu, and D. Billaud (The Moore School, and the Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19104), "The Identification of PF_6 —Ions in Intercalated Graphites by19 F and31 P NMR Spectroscopy," *The Journal of Physical Chemistry* 84, no. 25 (1980).

Over the last 50 years, many changes have taken place in this area. The hierarchical order of publication authors (professor—assistant professor (postdoc)—doctoral student (MSc), which was widespread in Europe 40–50 years ago, is now in decline. Likewise, the alphabetical order of authors, also used in the past, especially in the physical sciences, is disappearing. From the 1970s onwards, both the number of publications and the average number of authors per publication began to increase rapidly. This process further accelerated after the implementation of universal computerisation and as a result of rapid development of interdisciplinary research. The last decade has seen a large number of articles with several hundred or even several thousand authors, especially in such fields as particle physics or biomedical sciences. According to Clarivate Analytics, in 1981, the highest number of co-authors of a single article was 118. 34 years later, in 2015, the highest number of authors of a single particle physics article reached 5154.[78] The rules of authorship attribution are difficult to understand in this case, at least for scientists not involved in particle physics. Very spectacular and rather worrying is the increase in the number of scientific articles in virtually all fields of science. In the last three decades, the number of research papers published annually has increased: 77 times in China (from 8,000 to 550,000), 8 times in Poland (from 6,000 to 49,000) and less than 3 times in France (from 38,000 to 110,000). At the same time, there is a phenomenon of an excessive number of scientific papers being published by a relatively small number of leaders of very large research groups. There are more than 9,000 scientists worldwide who have published more than one article every five days since the beginning of the 21st century, with an average of more than 73 scientific articles per year.[79] This excessive accumulation of publication "assets" by selected scientists is fostered by the science policies of governments in virtually all countries where research is conducted.

All of this necessitated, as already indicated in the earlier considerations, development of principles defining the criteria

[78] G. Aad et al. (ATLAS Collaboration, CMS Collaboration), "Combined Measurement of the Higgs Boson Mass in pp Collisions at $\sqrt{s}$ = 7 and 8 TeV with the ATLAS and CMS Experiments," *Physical Review Letters* 114, no. 191803 (2015), https://doi.org/10.1103/PhysRevLett.114.191803.

[79] J. P. A. Ioannidis, R. Klavans, and K. W. Boyack, "Thousands of Scientists Publish a Paper Every Five Days," *Nature* 561 (2018): 167–169, https://doi.org/10.1038/d41586-018-06185-8.

for scientific authorship and the right to obtain authorship on a scientific publication. At the same time, it was obvious to the scientific community that the criteria for authorship under copyright law are not useful especially in the area of hard sciences, life sciences, medical or technical sciences. A creative and substantial contribution to the research process does not always demonstrate the ability to be expressed as a work and contribution to a multi-author publication.

The significant change in the conditions for conducting scintific research also affected the second aspect of determining the rules for the attribution of authorship of scientific works. At the turn of the 20th and 21st century, it became particularly important to define precisely not only the criteria for the right to authorship of a scientific work but also the rules for determining the order of names on the author list. Two models competed in this regard. The hierarchical model, taking into account the formal position of the researcher in the research team, whose rules assign a prominent role and position on the author list to the team leader and senior researchers. The second, American model, which is now quite widely used, is based on an anti-hierarchical arrangement, assuming that the first author is the member of the research team who has devoted the most time to the research described in the article, that is, usually the doctoral student, followed by the assistant (postdoc) and, finally, the professor. Neither the first (hierarchical) nor the second (anti-hierarchical) authorship attribution model generally reflects the actual contribution of the co-authors to the published research. Hence, in recent years, there has also been a tendency in authorship attribution to take into account pragmatic considerations, namely so as to obtain the best possible results when it comes to gaining research grants or obtaining scientific promotions. Thus, a doctoral student who has a chance for a prestigious scholarship, for example, START FNP or the Minister's scholarship, becomes the first author, and an employee preparing to submit an application for a postdoctoral degree becomes a corresponding author (the so-called star author). At the same time, the practice concerning the order of authorship attribution began to take shape based on the importance of the individual researcher's contribution to the scientific project. The greater the importance of the contribution to the overall project, the higher place on the author list a particular team member receives. There are also areas of knowledge, such as mathematics, where the places on the author list are still arranged by the alphabetical order of names of the research team members. However, there are also areas of science, such as the aforementioned particle physics, where the attribution of authorship eludes both the above-mentioned models. An in-depth analysis of the practice of ranking the authors of publications leads to the conclusion that in this matter, not even in one scientific discipline within hard sciences or natural sciences, uniform rules or commonly recognised habits have been established. It is therefore only possible to speak of certain desirable patterns, as postulated in this study.[80]

[80] In his commentary on this subject matter, Professor R. Holyst explained that the following rules for undertaking and conducting research projects and for the attribution of authorship of scientific papers prepared in order to publicise the research results obtained apply in the team he leads:

1. The professor, as head of the research group, designs the research and indicates how the desired results can be achieved, then tries to ensure access to the required research apparatus, analyses the results with the student and writes the publications; in the publications, the professor is the last 'author with an asterisk' (correspondent).

2. In a professor's group, there is always one person who is responsible for carrying out the research project; this person carries it out with the help of other members of the team, with the result that in the procedure of attribution of authorship of the scientific work created, they acquire the status of first author of the publication.

3. As a consequence of the arrangements referred to in para. 1 and 2, arrangement of the following positions on the author list of a scientific publication proceeds naturally, taking into account the research contributions of the other members of the research team; at the same time, at this stage of the authorship attribution of a paper, more importance is given to the position of the second author and less to the successive positions.

4. In a professor's research group, the rule is that everyone who has contributed even a smallest amount to the research published in a scientific paper, even technical staff or, as a rule, undergraduates and masters students, acquires the status of co-author; this is because it is assumed that a particular person's participation in the research carried out is equivalent to their creative contribution (with varying intensity, of course, but nevertheless) to the research results announced in the publication.

It should be noted that, in Prof. R. Holyst's existing research team, the principles for the attribution of authorship of scientific works correspond to the legal regime provided in this regard in the German legal system. Namely, § 24 of the German Higher Education Framework Act (Hochschulrahmengesetz) of 26 January 1976, already mentioned in the theoretical part, reads: „when disseminating the results of scientific research, collaborators contributing scientifically or otherwise substantially to the research must be identified as co-authors; if possible, the extent of their contributions must be stated." Formulation of the rules for the attribution of authorship of a scientific work on the basis of the cited standard implies the obligation to identify as co-authors

Bearing in mind the requirements within promotion procedures for the award of a researcher's degree and the evaluation of an individual's research activity, the custom of anti-hierarchical attribution of authorship has also begun to develop in many areas of knowledge, the rules of which are intended to reflect the real impact and value of the researcher's contribution to the research results and scientific findings announced in the paper. In other words, the adopted order of names on the author list of a paper cannot be accidental or reflect the formal and legal status of a member of the research team, but should express their contribution to the scientific achievement presented in the paper and assessed by the scientific community. In such cases, most often the first author is a doctoral or master's student. Indeed, it is increasingly common for both the PhD student and the MSc student to be involved in research leading to publication, as research group leaders often entrust the supervision of MSc students to their more experienced third or fourth year PhD students. In such cases, it is quite common to show some favouritism to the PhD students, who become first authors, and this even if their involvement in the research was somewhat less than that of the MSc students. This is a purely pragmatic approach, as first position on the author list of a publication is particularly valued by the bodies deciding on prestigious awards or scholarships for which doctoral students often compete. In most cases, a good justification for a doctoral student's first position among the authors is their greater intellectual contribution to the interpretation of the results, resulting from their greater scientific experience than that of a master's student. This approach does not generally

of a scientific work all participants in the research process, regardless of the nature of their contribution to the research, namely whether it was of a creative (scientific) or technical nature. The German legislator assumed that any contribution to the research being a prerequisite for obtaining the research results and the possibility of their subsequent publication as a scientific work must be qualified as substantial and, consequently, sufficient to entail the status of co-author of a publication. See: A. Chorążewska, "Samodzielny, istotny i twórczy wkład w badania naukowe jako podstawa prawna do uzyskania statusu autora publikacji naukowej," [Autonomous, Significant and Creative Contribution to Scientific Research as a Legal Basis for Becoming an Author of a Scientific Publication] in *Konstytucyjna wolność badań naukowych a ochrona pracy naukowej. Studium przypadków z nauk ścisłych eksperymentalnych* [The Constitutional Freedom of Research and the Protection of Scholarly Work. A Case Study in Experimental Hard Science], ed. A. Chorążewska and A. Biłgorajski (Katowice: Wydawnictwo Uniwersytetu Śląskiego, 2018), 236–237.

arouse protests from MSc students, who are aware of their lesser expertise and practical knowledge than that of PhD students. However, there are cases, albeit few, where the MSc student working alongside the PhD students surpasses them both in knowledge and in creativity and experimental talents. Then, this person should absolutely be the first author of the article.

Hence, in an anti-hierarchical, orderly list of authors of an article, the first author is usually the PhD student whose time contribution to the research described in the article was the greatest. The last author is the leader of the research group formally coordinating the research. In between, there are several more authors, whose order should reflect the amount of their time and intellectual contribution to the paper. This common-sense principle often requires negotiation between co-authors in order to reach a consensus. It should be added that in determining the further order of authors, two factors are taken into account: (1) the importance of the results obtained by the potential author to the level and originality of the article; (2) the labour intensity of the research used in the article. This is a general framework, however, the order of authors, apart from the first and the last, generally tends to be determined quite subjectively by the research group leader (or leaders in the case of collaboration between two or more groups). However, a rational research group leader should aim to reach a collective consensus on the order of authors before sending the article to the editor. The process of determining the order can be emotive, which is reflected by footnotes that sometimes appear in articles that two co-authors contributed equally to the research described in the publication.

In an "anti-hierarchical" arrangement, the last author, usually the corresponding (star) author, is the group leader coordinating the research. They should design and inspire the research and be actively involved in interpreting the results and editing the manuscript. This is not always the case, especially in the increasingly frequent cases of the formation of huge research groups in which the total number of postdocs and PhD students exceeds 40–50. In such cases, the star author's role is generally limited to approving the final version of the manuscript.

It is worth noting yet another trait of modern science, which is the aftermath of research funding principles. Namely, 40–50 years ago, research groups were much smaller. The size of teams of even the most eminent scientists did not exceed ten people (3–4 postdocs + 4–5 PhD students), and was usually around five people (1–2 postdocs + 2–3 PhD students). Nowadays, the number of huge research teams led by a single leader and often featuring more than 50 people is rapidly increasing in all research-active countries. Maintaining such a large research group requires constantly applying for new research grants, so the leaders of such groups take great care to have a distinguished research record, documented by important publications in which they are the lead authors. For this reason, they are the star authors of all publications originating from their team and it is not uncommon for them to publish 50–60 articles per year, or one article per week. Because of their huge formal research output, they are much more likely to win grants than scientists leading small research groups or scientists who are just starting to build their groups. This proliferation of large research groups at the expense of small ones resembles the so-called Ostwald ripening phenomenon known from colloid chemistry, where large particles grow at the expense of small ones. Some of such large teams are managed in a very authoritarian manner, as this way of leading the group maximises the scientific gain of its leader. It should also be stressed that many of the leaders of the mega-groups hold important positions in the administration of science, which significantly hinders their research activities and even in some cases prevents them. Obviously, their co-authorship of many of the publications prepared by their research groups is unjustifiable, both under legal and ethical criteria. In the United States, and increasingly in other countries, it is widely accepted that the leader of a group that has won a research grant should be the dominant (star) author on any article describing the research funded by that grant.

The authoritarian style of leadership of the research group may have a negative impact on the scientific career of Polish postdocs when they want to continue their research work in Poland, after returning from a long-term internship abroad. Obtaining a habilitated doctor degree on the basis of the body of work accumulated abroad may be difficult in such case, as the body of work lacks articles in which the habilitation candidate would be the first or star author, as well as articles without the co-authorship of the leader of the entire research group. The first author in the "antihierarchical" system is usually the doctoral student that this postdoc dealt with, and the corresponding (star) author is the authoritative head of the research group. Habilitation committees are increasingly confronted with such cases.

In conclusion, the most desirable anti-hierarchical arrangement of the author list of a paper should be the one that reflects the real significance and importance of the researcher's contribution to the completed research project and to the creation of a specific scientific paper. The discussed rules for determining the order in the author lists of publications assign a significant role to the first author, as well as to the so-called corresponding (star) author. In some countries, for example, Russia, Israel or Spain, as well as in some areas of knowledge, great importance is given to the person at the end of the list of authors. Thus, the first author is the one who has done a significant part of the practical research work, while the corresponding or last author on the list is the leader of the scientific team and also the creator of the research concept and the research theses verified in the paper. Sometimes, in certain areas of knowledge and latitudes, the correspondence author is not given such a prominent role. Rather, they are treated as a kind of secretary of the team, who, in addition to participating in the research, also deals with the administration of the project and documents its progress (e.g., in the USA, in quantum chemistry). We refer to this form of anti-hierarchical attribution of authorship as an ordered list of authors.

However, the practice of attributing authorship of scientific works is not uniform. Recognising the heterogeneity, in the French Code of Ethics, the scientific community calls for a regime obligating to define rules for the attribution of authorship of publications within the institution with regard to specific areas of knowledge (for each laboratory). The referenced Code of Ethics reads:

> Authorship agreements depend on the field research and are under the responsibility of the teams. To avoid conflicts, researchers are advised to agree upon authorship and order of authors sufficiently ahead of publication and in a transparent way. This is especially important in the case of collaborative work. This tricky issue should be discussed collectively in research units and signature recommendations included in the laboratory internal regulations. When the publication results from a collaborative research, authors may not always be able to judge whether the results obtained by collaborators from another discipline are well-founded. It is therefore useful to identify the author(s) who will be able to evaluate the results obtained in each field and those who will guarantee the coherence and integrity of the whole

work. This avoids the risk of all authors being accused, should the publication be found fraudulent.[81]

The recommendations of the Code of Ethics cited above are undoubtedly correct, but by postulating excessive formalism in the relationship between collaborating researchers, they are not fully compatible with the practice of scientific collaboration.

Undoubtedly, the order of co-authors of a scientific work based on the principle of an anti-hierarchical list arranged according to the importance of the researcher's contribution to the scientific project is useful for reviewers assessing the scientific achievements of an applicant for a degree or title. It allows to determine whether such an individual is the author of the scientific achievement they have described in their application for professional promotion and documented by submitting a collection of multi-authored scientific articles or collaborative patents.

It should be noted that such principles for the attribution of authorship, based on the importance and significance of the research contribution and other considerations discussed above, have already been resisted in the scientific community. Gretchen L. Kiser, Director of the Office of Research and Development at the University of California, San Francisco, points out that such attribution of authorship and, as a result, of merit, impedes an interdisciplinary approach to solving research problems posed to scientists.[82] In her view, this creates a negative feedback loop that makes it difficult to undertake interdisciplinary research collaborations.

Consequently, if the rules on the order of authors which distinguish first authors, last authors and star authors were removed, it would be possible to break this negative feedback loop and achieve the effect of conducting interdisciplinary innovative research, perhaps even research that represents a scientific breakthrough. As evidence of the effectiveness and also the accuracy of such an approach, Kiser gives the example of an interdisciplinary collaboration between neuroscientist Den Dubal and psychologist Aric Prather. Dubal was researching the molecular mechanisms

[81] Integrity and responsibility in research practices, Guide of CNRS Ethics Committee, pp. 16–17, http://www.cpu.fr/wp-content/uploads/2016/12/integrity-and-responsibility-in-research-practices-a-guide-19.11.16.pdf, accessed January 22, 2023.

[82] G. L. Kiser, "No More First Authors, No More Last Authors," *Nature* 561 (September 25, 2018), https://doi.org/10.1038/10.1038/d41586-018-06779-2.

of longevity and neurodegenerative diseases, while Prather was investigating the effects of stress on health. Their meeting gave rise to a scientific project intended to demonstrate a link between chronic psychological stress and lower longevity hormone levels. They published the results of this collaborative research and continue to work together (A. A. Prather et al. Transl. Psychiatr. 5, e585; 2015). In this project, it is impossible to identify a leader, and thus the lead, dominant author, as the research idea was born in teamwork. Kiser blames the status quo on the existing rules of evaluating research activity in promotion procedures. Namely, even though there are often some mechanisms in place to value a scientist's contribution to the team in such processes, the culture has remained largely unchanged for more than 50 years. There is an ingrained habit of judging a research activity according to place in the list of authors and attributing a significant role only to first and senior authorship, ignoring at the same time the importance of middle authorship. So is the contribution of a fourth-place author, who has combined different disciplines, irrelevant?

Seeking to justify the rejection of a structured list of authors, Kiser points out that many journals allow and even require statements from co-authors of a paper that explain their role in the conduct of the research and the creation of the article. Furthermore, taxonomies and standard dictionaries have been developed to describe the roles of authors. Commenting on these, it is worth adding that some periodicals, especially in the biological sciences, allow not only the identification of the subject of a substantive contribution to research, but also the assessment of its value for obtaining a scientific finding. In the context of valuation of the weight of contributions, it is permissible for all authors of a paper to declare that their contribution to the research leading to the scientific achievement is equal and equivalent (*equal contribution*). This means that, regarding the rules of an ordered list of authors, each author with an equal contribution to the research has the status equivalent to the first author and at the same time the corresponding (star) author. Kiser believes that it is helpful to sanction such changes, for it allows a fuller spectrum of researcher productivity to be captured. At the same time, Kiser calls for a cultural shift in authorship attribution that will lead to recognition and reward of scientists for their research contributions, and open the way to not only interdisciplinary but even transdisciplinary science.

4.5. Mentoring in Science, Ethical Standards in Research and the Role of the Research Team Leader

Against the background of the considerations made, the importance of mentoring in science for the development and consolidation of ethical standards for conducting scientific research and publishing its results becomes apparent. Naturally, this task is related to the tasks posed to the head of a scientific and research team. The preamble to the Polish Act on Higher Education and Science imposes certain obligations on scientists in this respect, providing that every scientist is responsible for the quality and reliability of research and for the education of the young generation.

The origins of the role of the scientific research team leader can be traced to the dawn of modern university education and state higher education.[83] The turn of the 18th and 19th centuries in the mental culture of Europe was characterised by dynamic development of scientific life (advances in scientific research) and the ensuing expansion of access to education and schooling. Europe's intellectual elites contributed to the emergence and spread of modern university education. It was at this time that the so-called Humboldtian university concept, considered classic today, was invented by Wilhelm v. Humboldt, then director of the Department of Religion and Education in the Prussian Ministry of the Interior. The mission of the university in the Humboldtian sense was to advance science and discover the truth. A university professor was first and foremost a learned researcher. The fundamental rule at the time was to combine research with teaching. It was expressed in mentoring students and younger researchers by showing them, in the course of their education, the methods of arriving at the truth. Consequently, the teaching and formation of young people, young generations of researchers, was to take place during a joint search for truth with the professor, in other words, in the course of team research, assuming that the professor would act as a mentor to the research group thus formed. Already at that time it was emphasised that the state authority should not interfere too deeply in the functioning of higher education. According to the Humboldtian idea under consideration,

[83] K. Bartnicka, "Uniwersytety europejskie na przełomie XVIII i XIX wieku" [European Universities at the Turn of the Eighteenth and Nineteenth Centuries], *Kwartalnik Historii Nauki i Techniki* R. 60, no. 1 (2015): 17–54.

the role of the state was to be limited to providing the higher education institution with a legal framework for its activities, while at the same time guaranteeing freedom of research and education and properly funding of the university. In turn, only the cadre of scholars (professors) was to be the authorised body to pass judgements in scientific and teaching matters. These historical conditions of university education have left their mark on today's higher education, the role of universities, and inevitably linked the process of educating young scholars with the conduct of scientific research by the research and teaching staff.

These historical conditions were important for the popularisation in hard and natural sciences of the practice of conducting scientific research in multi-person teams, which, along with technological advances, evolved into multidisciplinary teams. At the beginning of the 20th century, two ways of conducting scientific research became established: alone and in groups. Heike Kamerlingh Onnes, for example, thanks to his momentum in building his laboratory and employing a multitude of technicians and students, achieved significant scientific successes, greater than those of another researcher of the period, James Dewar. This was the case as Onnes won the competition with Dewar to see who would be the first to liquefy helium and descend to ultra-low temperatures, close to absolute zero. The liquefaction of helium opened for him the way to discover the phenomenon of superconductivity and the way to the Nobel Prize. Undoubtedly, therefore, the "big" one can do more. Hence, the American scientific and research programme initiated in 1942 at the behest of President F. D. Roosevelt and leading to the construction and production of the atomic bomb—the Manhattan Engineering District (MED), more widely known as the Manhattan Project, was carried out at several centres, namely Columbia University in New York, the University of Chicago and the University of California, in addition to the Los Alamos National Laboratory, where, under the direction of Robert Oppenheimer, the atomic bomb was developed. Conducted on a grand scale, the Manhattan Project led to the Americans winning the atomic race against Germany during the Second World War.

The relevance and desirability for the development of Science of conducting research in a team format, highlights the role of the research group leader. This is because, by its very nature, in creative and collaborative research work it is extremely important to appreciate the contribution of each member of the research group, and this regardless of their formal and legal status. When leading a research team, it is important to adhere to the principle that the successful conduct of research requires recognition of the contribution of both the group leader, whose task it is to initiate, plan and direct the research processes and supervise the correctness of their progress, and every other member of the research team, including the students taking part in the research. The role of the team leader cannot be overemphasised here, and they should take on the role not so much of a formal team leader as a mentor to their subordinates. In particular, it is the manager's responsibility to develop an appropriate organisational culture based on the consensual cooperation of team members, the principles of which derive from both the applicable law and recognised ethical standards in the scientific community. The mentor of a research team, as a researcher and teacher, should be able to recognise and appreciate, as well as value the research contribution of each member of the scientific team, rewarding those who deserve it with the status of co-author of a scientific publication. The manager should be a teacher first and a researcher second. Consequently, they should ensure that every team member who has contributed to the published research results is awarded co-author status for the scientific publication. At the same time, even a student's contribution to research should not be depreciated, as the recognition of this contribution and acknowledgement may contribute to the acquisition of a new, valuable scientist for Polish science. It is therefore not worth losing this opportunity.[84]

[84] Based on a paper by Prof. Robert Hołyst entitled *The Role of the Leader (Mentor) of a Research Group and the Course of Attribution of Authorship of Scientific Works on the Example of Theoretical and Experimental Science*. Professor R. Holyst is Head of the Department of Physicochemistry of Soft Matter, Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw and Leader of Research Group 10—Soft Condensed Matter at the Academy, and a member of the Science Evaluation Committee for the term 2019–2022. Professor graduated in theoretical physics in 1986 from the University of Warsaw and became titular professor of chemistry in 1998, having previously obtained his habilitation in 1992 and his PhD in 1989. He is co-author of 260 publications, cited 4800 times (h = 37), and three textbooks on thermodynamics (including Springer-Verlag 2012). He has patented 40 inventions and co-founded 3 startups. He has promoted 22 PhDs and accepted more than 30 postdoctoral fellows. Eight of his students are already professors in Poland, the USA and China. He has lectured at Harvard, the Broad Institute of Harvard and MIT, Yale, Princeton, MIT, Oxford, Cambridge, Ecole Normale, the Max Planck Institutes, as well as in China, Japan, Russia, South Korea, Canada, etc. He has worked with Unilever, Samsung and Mitsui Chemicals. He led the re-

4.6. Contribution to Research versus Authorship of an Individual Contribution to Knowledge. Introduction to the Issue

Scientific creativity is fundamentally different from other human creative activities, especially artistic creativity. Scientific creativity is particularly distinguished by the absence of randomness in the activities undertaken, which often accompanies the creation of an artistic work. Scientific activity consists in the researcher consciously posing a research problem and striving to solve it by means of "consciously adopted research methods in order to establish certain rules, regularities of events, to show the essence (nature) of certain phenomena, etc."[85] The fruit of scientific activity and, at the same time, a form of communicating to the scientific community the existence of a scientific achievement is authorial creativity concretised in authorship or co-authorship of a scientific work or inventive creativity expressed in the status of author or co-author of an invention. The two types of human creative activity cited are fundamentally different. "Authorial creativity should bear the characteristic of individuality and originality, while the mere value of the work, its usefulness, is irrelevant. Inventive creativity, due to the requirement of novelty and non-obviousness, emphasises other elements of the creative process, not so much aiming at presentation, but at a practical solution."[86] An inventor is therefore an individual who "has

form of the organisation of science at the Institute of Physical Chemistry of the Polish Academy of Sciences, of which he was director from 2011 to 2015. He conducts research at the interface of statistical physics, material chemistry and cell biology. He discovered the principle governing diffusion inside living cells. A. Chorążewska, K. Grzybczyk, A. Kertyczak, A. Proń, and J. Zrałek, "Sprawozdanie: Międzynarodowa Konferencja Naukowa nt.: Przyszłość badań naukowych w świetle prawa autorskiego, kodeksów etycznych naukowców oraz kryteriów ocen jakości badań, Katowice, 31 stycznia–1 lutego 2020 [Report: International Scientific Conference on: The Future of Scientific Research in the Light of Copyright Law, Ethical Codes of Scientists and Criteria for Assessing the Quality of Research, Katowice, 31 January–1 February 2020], *Przegląd Prawa Konstytucyjnego* 3, no. 55 (2020): 177–206.

[85] S. Jarosz-Żukowska and Ł. Żukowski, "Wolność badań naukowych i nauczania" [Freedom of Scientific Research and Teaching], in *Realizacja i ochrona konstytucyjnych wolności i praw jednostki w polskim porządku prawnym* [Realisation and Protection of Constitutional Freedoms and Rights of the Individual in the Polish Legal Order], ed. M. Jabłoński (Wrocław: E-Wydawnictwo. Prawnicza i Ekonomiczna Biblioteka Cyfrowa, 2014), 715.

[86] P. Kostański, "Prawa osobiste wynalazcy" [Personal Rights of the Inventor], *Transformacje Prawa Prywatnego* 2 (2012): 73.

creatively solved a specific technical problem, producing a solution that has the characteristics of novelty, non-obviousness and is suitable for industrial application. This solution should belong to any field of technology (including agriculture and biotechnology)."[87] Authorship creativity therefore places emphasis on the original form of expression of the work, no matter whether its guiding idea or the idea expressed in it is objectively new and non-obvious. After all, it is possible to create works inspired by someone else's creativity without infringing the copyright of the original creator. In contrast, inventive creativity requires that the author(s) demonstrate an element of novelty and non-obviousness in the effect (product) of that human creative activity. Thus, inventive creativity cannot be reduced to an artefact as opposed to authorial creativity. Nevertheless, as has already been demonstrated in this study on several occasions, scientific creative writing must meet higher requirements than non-scientific authorship. The most important criterion here is the criterion of truth, that is, the truthfulness and reliability of the scientist's findings about the subject of their scientific research. Scientific writing, however, does not have a uniform character; it can assume different forms, and this is without prejudice to the possibility of attributing to it the characteristic of scientificness.

Organised research activities customarily involve a number of people with different statuses in the research team. In a 2015 document by the Organisation for Economic Co-operation and Development (OECD) (Frascati Manual 2015) entitled "Guidelines for Collecting and Reporting Data on Research and Experimental Development,"[88] it is likewise assumed that projects of research and experimental development are carried out by multi-member teams whose members have different status.

In these Guidelines, research and experimental development (R&D) activities are defined as follows: "Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge."[89] The document

[87] Kostański, "Prawa osobiste wynalazcy" [Personal Rights of the Inventor], 61.

[88] Frascati Manual 2015 © OECD 2015, https://www.oecd.org/innovation/frascati-manual-2015-9789264239012-en.htm.

[89] Frascati Manual 2015 © OECD 2015, p. 44.

distinguishes the following categories of research team members carrying out scientific and development projects:

1. Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, instrumentation techniques, software or operational methods.
2. Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, the physical and life sciences, or the social sciences, humanities and the arts. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods and the use of research equipment, normally under the supervision of researchers.
3. Other supporting staff includes skilled and unskilled craftsmen, and administrative, secretarial and clerical staff participating in R&D projects or directly associated with such projects.[90]

The cited OECD document[91] explains in addition to the proposed researcher definition that:

1. The researcher can be part of the unit's internal or its external R&D personnel, but need not be engaged full-time on R&D activities.
2. Tasks implemented by researchers in the framework of specific R&D projects or general R&D activities and thus their contribution to research projects typically include and take the form of:
   (a) conducting research, experiments, tests and analyses;
   (b) developing concepts, theories, models, techniques, instrumentation, software and operational methods;
   (c) gathering, processing, evaluating, analysing, and interpreting research data;
   (d) evaluating the results of investigations and experiments and positing conclusions using different techniques and models;
   (e) applying principles, techniques and processes to develop or improve practical applications;

[90] Frascati Manual 2015 © OECD 2015, pp. 162–165.
[91] Frascati Manual 2015 © OECD 2015, p. 163.

(f) advising on designing, planning and organising the testing, construction, installation and maintenance of structures, machines, systems and their components;
(g) providing advice and support to governments, organisations and businesses on the application of research results;
(h) planning, directing and coordinating the R&D activities of institutions that provide related services to other organisations;
(i) preparing scientific papers and reports.

3. As researchers are also classified:
   (a) managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work whose position in the unit is usually equal or superior to that of persons directly employed as researchers;
   (b) doctoral students engaged in R&D who hold basic university degrees (ISCED level 7) and perform research while working towards their doctoral thesis (ISCED level 8);
   (c) doctoral students whose work and contribution to joint research projects cannot be identified separately, can be included with technicians or researchers, but such practices may cause inconsistencies in the researcher series.

An applicant for a degree or title is required to demonstrate more than scientific authorship understood as the authorship of a contribution to research (to a scientific work) or to the essence of a given technical solution (to an inventive design). Indeed, scientific writing or inventive creativity can take the form of parallel or continual creativity without a qualitatively new and original contribution to the state of knowledge or without a significant contribution to a creative and non-obvious solution to a specific technical problem, that is, to a so-called inventive idea. However, the author of a scientific achievement applying for a scientific degree or title should merit the title of Creator of Science, which is subject to requirements similar to those applicable to inventive creation. A Creator of Science and author of a scientific achievement is a person who has creatively solved a specific scientific problem (scientific writing) or technical problem (inventive creation), proposing a solution having the features of novelty, non-obviousness and suitable for scientific or industrial application, respectively. The author of a scientific achievement should therefore demonstrate a qualitatively new and therefore non-obvious and original contribution to the state of knowledge of a nature at least improving or developing existing scientific concepts, theories, models or techniques, if not generating new scientific knowledge.

In the case of research carried out in hard and natural sciences, which is customarily carried out in teams, it often becomes problematic to determine:

1. What kind of contribution to the research qualifies an author to be a co-author of a scientific publication, excluding the possibility of including only acknowledgements?
2. What kind of contribution to a series of thematically related research publications or collaborative patents entitles one to aspire to the status of author of a scientific achievement in the sense of an individually identifiable contribution to the state of knowledge?

Consideration of these problems requires examination of the following two questions:

1. Rules for demonstrating authorship of a scientific achievement in promotion proceedings based on a series of thematically related articles and collectively obtained patents, taking into account two further issues:
   (a) The impact of the subject matter and scope of the research activity on the assessment of the value of the contribution to the research or invention project;
   (b) The impact of the attribution of authorship (order in which authors are listed) of a scientific work or co-created invention on the assessment of the "prestige of the creator" and recognition in the scientific community that the creator has contributed to the state of the art, as the Creator of Science.
2. Concepts of independent, substantial and creative contributions to scientific research as basis for authorship of a scientific work in different areas of scientific activity based on a case study.

Chapter II

Authorship of a Scientific Achievement and Scientific Work

A quotation from John William Strutt, Lord Rayleigh (Nobel Prize in Physics, 1904):
I may, perhaps, venture to say that in my opinion many who work entirely upon the experimental side of science underrate their obligations to the theorist and the mathematician. Without the critical and co-ordinating labours of the latter we should probably be floundering in a bog of imperfectly formulated and often contradictory opinion.

Address of the President, Lord Rayleigh, O.M., D.C.L., at the Anniversary Meeting on November 30, 1906. *Proceedings of the Royal Society of London. Section A.—Mathematical and Physical Sciences* 79 (1907): 1–12. The full text available via https://www.jstor.org/stable/pdf/92810.pdf

1. Characteristics of Scientific Work as Creative Work

Creative work[92] means organised human activity that can take the form of: scientific work, artistic work, inventive-technical work or other work. This kind of work is fundamentally different

[92] See: J. Pieter, *Praca naukowa* [Scientific Work] (Katowice: Wydawnictwo Śląsk, 1960), 22–23; J. Pieter, *Nauka i wiedza* [Science and Knowledge] (Warszawa: Instytut Wydawniczy "Nasza Księgarnia," 1967), 20–23.

from manufacturing work. In fact, creative activity materialises in inventing or establishing new relations between already known phenomena, things or concepts or their parts, as well as in studying or analysing various phenomena or things with the intention of making a certain discovery (gaining new knowledge of the world or phenomena). The effects of creative work should be concretised in the achievement of new and at the same time valuable and objectively perceptible results. The objective result of creative work is the "work," which may be expressed in the creative act itself (e.g., the work of theatre artists, dancers or speakers), as well as in a material product of human creative activity taking the form of: a scientific work, a painting, a musical work, a novel, a film, an architectural plan, an invention or a well-argued philosophical view or legal opinion. Creative work is therefore practised by scientists, thinkers (philosophers), artists or inventors.

On the other hand, the aim of manufacturing work[93] is to produce various products with known and predetermined properties, which are created using methods and procedures that are already known, especially among specialists, for example, in certain crafts. In many cases, manufacturing work, like creative work, requires ingenuity, special intellectual abilities and appropriate preparation, and its effect becomes a work, the objectively existing result of human activity in the form of a certain object or other product of human endeavour. The boundary between manufacturing and creative work may in some cases prove to be fluid and ambiguous.

In the opinion of a forerunner of scientific literacy,[94] scientific work is a special form of creative work. In particular, it should be distinguished from the process of acquiring traditional knowledge, that is, from the process of learning. The hallmark of scientific work as a specific kind of human creative activity is:

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[93] See: Pieter, *Praca naukowa* [Scientific Work], 22–23; Pieter, *Nauka i wiedza* [Science and Knowledge], 20–23.

[94] See: Józef Pieter (born 19 February 1904 in Ochaby in Cieszyn Silesia, died 3 March 1989)—psychologist, philosopher, pedagogue and precursor of science as a systematic area of knowledge and scientific inquiry; author of such works as *Psychologia jako nauka* [Psychology as a Science] (1947), *Praca naukowa* [Scientific Work] (1960), or *Nauka i wiedza* [Science and Knowledge] (1967); http://www.pieter.com.pl/index.php?link=publikacje.

> I. either reflecting, i.e. learning about hitherto unknown parts of reality or arrangements thereof; this applies to the sciences of phenomena, e.g. astronomy, physics, psychology, history, etc., or
> II. construction of concepts or formulas, based on the scientific reflection of being, and serving in certain forms of social struggle for being; here, the mathematical sciences come into play to some extent, and—quite separately—the normative sciences, including pedagogical sciences, e.g. general didactics, and technical sciences, e.g. machine science.[95]

Reflecting reality, or learning about reality, can be defined as the search for or acquisition of scientific truths in the form of establishing new scientific facts, linking facts into new scientific theories, or (new) criticism of previous scientific achievements. Indirectly, the set of scientific truths also includes claims about methods, that is, legitimate ways of doing scientific work, the application of which can contribute to reflecting reality or to constructing new concepts or formulas. Similarly, the role of theses, hypotheses or scientific problems should be assessed; although they do not express new scientific truths, by being a source of scientific inquiry, they indirectly contribute to the acquisition of new knowledge and scientific progress. On the other hand, it is difficult to draw a distinction and a strict line between science and technology. Modern technology is based on science and requires research activities by rationalisers, inventors or constructors. Invention and design ventures are often strictly scientific in nature and the method of technical-inventive work is no different from that of research and scientific work.[96]

Scientific work is carried out on the basis of and with the aid of certain procedural patterns. It requires routine, which is concretised by the knowledge of the rules of the so-called scientific craftsmanship, valid in a given area of knowledge. Research requires literature review appropriate to the subject of the research, and the selection of research methods and techniques, and then the skilful conduct of research, analysis of the obtained research results with their critical synthesis. Without the knowledge of scientific craftsmanship, that is, the skilful selection and implementation of a number of general and specific sets of scientific activities, it is difficult today to cultivate science

[95] See: Pieter, *Praca naukowa* [Scientific Work], 23.
[96] See: Pieter, *Praca naukowa* [Scientific Work], 24–27. Pieter, *Nauka i wiedza* [Science and Knowledge], 20–23.

and obtain achievements that the scientific community will recognise. Scientific work and manufacturing work therefore share a certain similarity, and that is the necessity of the presence of a routine in their conduct. However, in scientific work—in addition to habitual, routine or even mechanical activities—creative activities are necessary, which will contribute to the acquisition of new knowledge, new truths. Consequently, the importance and significance of scientific work for the state of knowledge and scientific progress will not be evaluated according to the volume (quantity) of scientific data obtained or the quantity, quality or complexity of the routine research activities used. The significance of scientific work should be judged by the quality and quantity of new truths established through the previously applied and correctly chosen scientific method, determined precisely by what we call routine scientific craftsmanship.[97] For as Józef Pieter rightly points out, "[e]rrors and shortcomings of 'scientific craftsmanship' can annihilate the value of a given scientific work, but even perfect 'craftsmanship' without—essential to it—creative input will not by itself contribute at all to the establishment of new truths."[98]

From the perspective of conducting scientific research in the realities of the 21st century, the quoted words of Pieter take on particular significance in the context of the pressure to publish or the principles of evaluation of scientific achievements, scientific disciplines and scientists. These factors result in scientists not allowing themselves to undertake painstaking research in areas that are completely new and unfamiliar to science for fear of failing to meet the requirements of scientific evaluation. The pragmatics of scientific activity and the need to secure funding for research implies that both research group leaders and rank-and-file scientists often consciously refrain from presenting ambitious research projects that do not have an application component, as the likelihood of obtaining funding for such projects is very low, much lower than 40 to 50 years ago when, in countries with the greatest economic and scientific potential, the share of subsidies for research unrelated to any utilitarian purpose was much higher. The current scientific policy implicates that today incremental science, rather than breakthrough, discovery-oriented science, should be considered universally dominant. Of course,

[97] Cf. Pieter, *Praca naukowa* [Scientific Work], 28–30.
[98] Pieter, *Praca naukowa* [Scientific Work], 30.

incremental science cannot be discredited. When the aim of such scientific endeavours is not only the collection of scientific data but also creative, collective analysis of the research results obtained, incremental science leads to significant contributions to the state of knowledge. Nevertheless, a danger of non-creative standardisation of the scientific product exists today. It seems, however, that the requirement for a scientist in promotion proceedings to demonstrate authorship of a scientific achievement that constitutes a qualitatively new, original contribution to the state of knowledge can effectively prevent the dominance of this standardisation.

2. Forms of Work and Scientific Activities

The purpose of scientific work is to announce to the scientific community the research results obtained in the research process in the form of experimental data, systematic databases or solutions to an initial scientific problem or issue in the form of scientific works or patents for inventions. Scientific works are published (fixed) either orally or in written form. Orally in the form of lectures presented at conferences or scientific congresses, and in writing in the form of research reports or graphic and written posters published at conferences and congresses, manuscripts of articles placed in open repositories before the reviewing process is complete (so-called *pre-prints*) or scientific works published in the form of articles and books. The point of scientific writing and announcing the achievements of research work to the scientific community in this way is not only to disseminate knowledge and educate, but, above all, to pave the way for further research and the advancement of knowledge.

Scientific activity, preceding the establishment of a work or the filing of a patent application, may take different forms and demonstrate a different kind of contribution to the development of knowledge and scientific and technological progress. This issue, in the reality of the 1960s and the socialist planned economy, was considered by Pieter, already cited above. He proposed a classification of scientific work common to all creators of science (without taking into account the specificity of doing science in different areas of knowledge).[99] Ahead of his contemporaries, at the outset of those deliberations, the cited Polish precursor of science studies already foresaw a change in the organisation of research work, stating that in the future, research conducted in a narrow area of research specialisation, alone or by scholars organised in a department (unit) functioning at a university, would become less and less important. He predicted that research would be carried out by powerful scientific "cooperatives" or "unions" with numerous staff, substantial research infrastructure and financial resources. With regard to the scientific method, Pieter prophetically concluded that this concept should be considered in two senses: (1) as covering the totality of the research methods of arriving at the truth and the conceptual representation of the known truth and (2) as specifying the ways of obtaining scientific material, also without *a priori* assumptions regarding the research thesis ("working methods").[100] Pieter explained that the scientific method is "the totality of appropriate, leading to the goal, i.e. model ways of performing scientific research, elaborating the research in writing and critical evaluation."[101] He added that in order for the method to fulfil its task, it must be well chosen for the object of research. At the same time, the quoted author pointed out that "[e]very new scientific research is based on the existing state of the scientific method, but at the same time, in a way, it contributes to the development of this method. This means that the progress of science, i.e. progress in arriving at the truth, includes progress in the scientific method."[102] In this way, science becomes a function of the method. Consequently, the better the methods, the better and more spectacular the achievements of science, and, conversely, the worse the method, the worse the achievements of science.

Coming back to the types of scientific work, Pieter proposed a division into: research or scientific research work, conceptual work, methodological work, analytical work, synthetic work, contributory work, problem work, theoretical work and experimental work. In the conditions of the scientific research world of the 21st century, this classification, has not lost its relevance,

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[99] Pieter, *Praca naukowa* [Scientific Work], 32–38. Cf. Pieter, *Nauka i wiedza* [Science and Knowledge], 25–33.

[100] Pieter, *Praca naukowa* [Scientific Work], 38–39.

[101] Pieter, *Praca naukowa* [Scientific Work], 39. Cf. Pieter, *Nauka i wiedza* [Science and Knowledge], 31–32.

[102] Pieter, *Praca naukowa* [Scientific Work], 39.

as the author of the proposed division characterised the specific types as follows[103]:

Research or *scientific research work* is research aimed at discovering facts, at describing and explaining phenomena or demonstrating conceptual relationships based on the state of knowledge, the researcher's own research materials and experience. This type of work serves to bring new truths about the world and make scientific discoveries. From the perspective of the currently used nomenclature, this type of work can be identified with the definition of an original scientific article, that is, one that presents the results of original research of an empirical, theoretical, technical or analytical nature.

Conceptual papers are notional papers of preliminary nature that serve to develop a certain concept (research idea) in order to justify the need to undertake systematic research on a new, only conceptually developed research problem.

Methodological work is on devising, justifying and trying out new methods or on criticising and improving known methods. This type of work is also of mental, or conceptual, nature and takes two forms. The subject of the first is criticism of the value of the methods known and applied in a given area of knowledge, while the second is the construction of new methods or the substantial modification of the existing methods, especially for applications in a narrow research field.

Analytical work is work devoted to establishing and clarifying scientific concepts and deriving from them so-called implications, that is, assertions implicit in them. Intellectual involvement in this type of work may be expressed in a critical analysis of the state of knowledge. It may take the form of either scientific critique or analytical revision of the body of literature in a given subject area, with the aim of demonstrating the need to undertake research in that area on a new issue. Such work may be published as part of a broader polemical discussion. A similar nature should also be attributed to *scientific-review* articles, that is, articles providing a critical analysis and evaluation of scientific publications in a given scientific domain, as well as articles critically evaluating works of literature or art (*critical reviews*).

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[103] See: Pieter, *Praca naukowa* [Scientific Work], 32–38; Pieter, *Nauka i wiedza* [Science and Knowledge], 25–31.

Synthetic papers are papers devoted exclusively to synthesis, that is, to the assembling into a coherent whole much scientific data, many papers or research results; using induction to summarise the state of knowledge in a given research area. The purpose is to seek connections between the published results of detailed research and then to make generalisations. The nature of synthetic work is demonstrated in the preparation of scientific textbooks, as well as in the writing of *review* articles (*review article*), especially those that aim to familiarise readers with a particular field of study (*tutorial reviews*). A *review* article can combine the characteristics inherent in analytical and synthetic papers when its content not only integrates the state of knowledge in a given area, but also analytically and critically interprets the existing results of original scientific research.

Contributing works are voluminously small works, dealing with a specific issue of a partial, task-related nature, which is a starting point for considerations or a contribution to the considerations of some larger scientific problem. At the same time, Józef Chałasińki[104] emphasised that a scientific contribution makes sense when it serves to solve a specific scientific problem. If such function is not fulfilled by a contributory work, it is redundant and irrelevant to the progress of science. This category includes works that are *case studies*, meaning articles that undertake an analysis of a given, usually real-life, case in order to draw conclusions about the causes and consequences of the case studied, to describe the event. This category includes frequently encountered case-studies in the field of medicine.

Problem papers are voluminous works that address concepts or phenomena whose importance is expressed in the fact that their scope covers genuinely new issues, including original and significant research results. These works should therefore open up new lines of research. If the subject matter of such works is limited to identifying new issues or fields of study, they should be classified as conceptual rather than problem-oriented.

Theoretical works—based on the available scientific output of the scientific community and the author's own research results, including experimental results, and using deduction or reduction—aim to establish states or processes in the phenomenon under study, for example, physical or chemical, or to logically refine reasoning and conclusions also in the process of so-called

[104] Pieter, Footnote 9 in *Praca naukowa* [Scientific Work], 257–258.

axiomatisation of scientific concepts. These works often contain notably abstract theoretical (non-experimental) considerations that can lead to the formulation of a scientific theory.

Experimental papers are papers announcing the results of experimental studies or those obtained using various research methods of experimental nature, for example, statistics or chemometrics.

Research results and scientific findings obtained by the implementation of the above-described types of scientific work may be published in the form of invention patent applications or in various forms of academic literature. According to the volume of the scientific work, we can make a distinction between small contributory works, research reports, systematic studies of research results and large works. From the perspective of the degree of originality of the subject matter and the manner of scientific elaboration, we can speak of: compilations, imitative works, original works, highly original works or ground-breaking works. A special type of scientific works are promotion works, that is, doctoral, habilitation and professorial works.[105]

The applicable Polish legislation on the evaluation of quality of scientific activity[106] specifies what form a scientific work may take so as to constitute a scientific achievement subject to the evaluation of quality of scientific activity in a given scientific discipline. Thus, academic writing may assume the form of an academic article or academic monograph. In characterising these categories, the Polish legislator has used both positive and negative definitions. With regard to an academic article (§9), it was assumed that it can take the form of:

(1) a peer-reviewed article published in an academic journal or in a peer-reviewed volume from an international academic conference that: (a) presents a specific scientific issue in an original and creative manner, either problem-based or cross-sectional; (b) is accompanied by footnotes, a bibliography or other scientific apparatus appropriate to the scientific discipline
(2) a review article published in a scientific journal included in the list of journals.

[105] Cf. Pieter, *Naka i wiedza* [Science and Knowledge], 189.

[106] Regulation of the Minister of Science and Higher Education of 22 February 2019 on the evaluation of the quality of scientific activity, i.e., Journal of Laws 2022, item 661.

At the same time, legal provisions stipulate that an academic article subject to evaluation is not: editorial (editorial preface), abstract, extended abstract, letter, errata and editorial note.

The negative aspect of the definition of an academic article requires comments. It appears that the provision stipulating that letters to the editor cannot count as academic papers has not been given sufficient thought and should be reversed. It should be made clear that in the publishing practice of scientific journals, three types of such letters can be distinguished. The first type is that of letters that are not of a scientific nature and usually address various social issues related to the development and administration of science. Such letters do not appear in periodicals devoted to hard sciences and natural sciences, but can be found in journals in social sciences, economics and even engineering, such as *Chemical & Engineering News*, a periodical published by the American Chemical Society. Quite a few such letters also appear in the two most prestigious scientific journals, that is, *Nature* and *Science*. An example of this is Cezary Wójcik's letter entitled "Eastern Europe: Progress Stifled by the Old Guard."[107] The referenced letter to the editor by Wójcik contains a sharp criticism of the hierarchical structure of science in Poland. Of course, such letters to the editor are journalistic, not scientific in nature and should not count as a part of the scientific output. Nevertheless, letters to the editor of a, par excellence, research character constituted and still constitute an important group in the entire population of scientific articles. There used to be more of them in the past, now less, but only because many journals have changed the headings of such pieces from Letter to Editor to Short Communication, or Note. Mentions of many discoveries later honoured with a Nobel Prize appeared in their original version precisely as *Letters to Editor*. Letters of a purely scientific nature accounted for approximately 1% of all scientific publications affiliated to Warsaw scientific institutions published in the last forty years, that is, since 1983 (according to Web of Science). These are, in general, publications by astronomers, solid state physicists and representatives of biomedical sciences. Such letters should count as a part of the scientific output of the author(s). The third type of Letters to Editor are critical polemics with articles published in a particular journal. They generally concern misinterpretation

[107] Cezary Wójcik, "Eastern Europe: Progress Stifled by the Old Guard," *Nature* 427, no. 196 (2004), https://doi.org/10.1038/427196b.

of results, incorrectly chosen methods of calculation, etc. Such letters were more likely to be found among articles published 40–50 years ago than today. The tradition of publishing scientific polemics is unfortunately disappearing. Letters correcting errors in scientific publications should also be included in the scientific output of the author(s) for at least two reasons. Firstly, they play an important role by "clearing" the scientific output of erroneous or at least unreliable results. Secondly, writing a critical polemic requires the author(s) to be very knowledgeable and, in some cases, to perform control experiments in order to unequivocally confirm the error (unreliability) of the research and results criticised in the polemic. An example of such a polemic is the reaction of Adam Proń and his colleagues to the article by Enid K. Sichel's group entitled "Magnetic Phase Transition, Aggregate Formation, and Electrical Conductivity in $FeC1_3$-doped Polyacetylene."[108] The polemic in the form of a letter to the editor entitled "Comments on 'Magnetic Phase Transition, Aggregate Formation, and Electrical Conductivity in $FeCl_3$-doped Polyacetylene'" was published in 1985 in the same journal.[109] The one and a half year period between the publication of the article by Sichel's team and that polemic was mainly due to the need for an experiment made by the group of Proń that unequivocally ruled out the interpretation of the results presented by Sichel and her colleagues. It must be admitted that the beginning of the polemic was quite aggressive (youth!): "The paper of Sichel et al. presents the results and interpretation of Mossbauer spectroscopy studies of $FeC1_3$-doped polyacetylene with which we cannot totally agree. The main points of our disagreement are the following […]." In conclusion, it is recommended to change the wording of the provision categorically disallowing a letter to the editor from the scientific output of an evaluated researcher, and to include such an achievement in the evaluation of research activity in a given discipline. The existing rule is unfair to researchers. Each example of a letter to the editor should be examined individually, as

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108 E. K. Sichel, M. F. Rubner, J. Georger, Jr., G. C. Papaefthymiou, S. Ofer, and R. B. Frankel, "Magnetic Phase Transition, Aggregate Formation, and Electrical Conductivity in $FeCl_3$-doped," *Physical Review B* 28, no. 11 (1983), https://doi.org/10.1103/PhysRevB.28.6589.

109 A. Proń, Z. Kucharski, P. Bernier, I. Kulszewicz, M. Zagorska, J. Suwalski, and D. Billaud, "Comments on 'Magnetic Phase Transition, Aggregate Formation, and Electrical Conductivity in $FeCl_3$-doped Polyacetylene,'" *Physical Review B* 31, no. 7 (1985), https://doi.org/10.1103/PhysRevB.31.4690.

it is not difficult to distinguish between journalistic contents and scientific contents.

In commenting on this regulation, it is worth recalling another example. Namely, the publication of Prof. Ludwik Wertenstein, head of the Radiological Laboratory at Śniadeckich 8 in Warsaw before the Second World War. The team led by this researcher, in April 1934, less than three months after the discovery of artificial radioactivity by the Joliot-Curie couple in Paris, obtained an artificial radioactive isotope of fluorine, having previously bombarded nitrogen with alpha particles. This was done by Marian Danysz and Michał Żyw. Prof. Wertenstein (their mentor) informed the scientific world about this discovery in the pages of the prestigious *Nature* on 14 April 1934 in a paper entitled "An Artificial Radioelement from Nitrogen," published in the section Letters to the Editor.[110] From the perspective of the rules governing the evaluation of research activities in Poland and the assessment of the scientific achievements of its authors, the publication of such an important scientific report in a prestigious periodical would have been worthless. This is because Letters to the Editor are arbitrarily not subject to evaluation. From today's perspective, the authors of such a study would undoubtedly gain recognition from the scientific community, the status of creators of science and scientific authors of the discovery. However, in light of the Polish regulations on academic evaluation, the discovery would not have any significance, as it was not presented in a form subject to evaluation of research activity.

In turn, an academic monograph subject to the evaluation of the quality of research activity is defined (§10) as:

(1) A peer-reviewed book publication that (a) presents a specific scientific issue in an original and creative manner; (b) is accompanied by footnotes, a bibliography or other scientific apparatus appropriate to the discipline.

(2) (a) a peer-reviewed book publication annotated with footnotes, a bibliography or other scientific apparatus appropriate for a given discipline, constituting a translation: (a) into Polish of a work of importance to science or culture, (b) into another modern language of a work, published in Polish, of importance to science or culture; (2) a scientific edition of source texts.

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[110] L. Wertenstein, "An Artificial Radioelement from Nitrogen," *Nature* 133 (1934): 564–565.

In addition, the Law on Higher Education and Science (Article 177 in conjunction with Article 187, Article 219 and Article 227) distinguishes between academic promotion writing, which presents the academic achievements forming the basis for awarding a scholar, respectively, a doctoral degree, a habilitated doctor degree or the academic title. At the initial stage of the academic career, such writing takes the form of a doctoral dissertation. At later stages of the career, it takes the form of scientific achievements which, in the case of an application for the award of the degree of habilitated doctor, should constitute a significant contribution to the development of a specific discipline, and in the case of professorship—an outstanding contribution to the development of a specific field of science or of a discipline or disciplines within a specific field of science. These achievements may consist not only of scientific writing, but also of inventive, design, construction, and technological achievements. The issue of promotion writing will still be discussed in detail in this work, however, at this point it is worth considering an important issue. Namely, the place of publication of promotion work, in the context of the phenomenon of predatory journals discussed earlier. The question arises whether a reviewer in promotion proceedings should pay attention to the place of publication? In effect, should they deprecate papers published in journals identified as predatory or should they pay no attention to such fact and make a fair assessment of the papers? In seeking an answer to the question thus posed, it should be made clear that an honest, upright and reputation-conscious scientist should avoid untrustworthy publishing houses or those suspected of improper practices.[111] Irrespective of the place of publication, however, the scholarly output presented in an application for scientific promotion should be assessed in an expert manner, and the rank of the journals in which the publications composing this output have appeared should not be taken into account. The point is, however, that the probability of encountering articles with little or no originality is much higher in the journals of the MDPI group than in many prestigious journals released by ACS, RSC, Nature Portfolio or Wiley. Similarly, the likelihood to encounter methodological, computational, interpretative or linguistic errors

[111] M. Kosmulski, "MDPI a sprawa polska" [MDPI and the Polish Case], *Forum Akademickie* 5 (2022); A. Proń and H. Szatyłowicz, "Nie marnować publicznych pieniędzy" [Do Not Waste Public Money], *Forum Akademickie* 12 (2022).

or even plagiarism is much higher for articles from MDPI group journals than for publications in publishing houses of better repute. This conclusion is backed by the reviewing experience in the promotion proceedings (habilitation and professorial) of the author of this study, Adam Proń. Although there were, of course, occasions when errors were found in publications in periodicals such as *Angewandte Chemie* or *Journal of Physical Chemistry C* and others, 80% of the errors discovered were in MDPI articles. The MDPI is also seriously deficient by allowing papers to be published that repeat previously printed content. An instructive example can be provided by a certain review article, which turned out to be a compilation of text extracts from research articles, unfortunately carried over in extenso, including the reproduction of errors contained therein. Notwithstanding these remarks, it should be stressed that the presentation in promotion proceedings for evaluation of a body of work consisting almost exclusively of publications printed in journals of questionable reputation and suspected of unreliable publishing practices does not allow its negative evaluation without a prior, thorough expert analysis covering all important aspects of these publications, such as: originality of the concept, research and computational methodology, and interpretation of the research results.

Another significant problem in the assessment of a scientist's academic output is the presence in their publication achievements of works replicating previously published research results, which is referred to as *self-plagiarism*. This is not a legal term, as it has not been formulated by the legislator in any normative act. However, the term is found in many documents setting moral standards when publishing the results of one's own scientific work, and the phenomenon should be assessed from this perspective.[112] As an example, the World Association of Medical Editors, in the document *Publication Ethics Policies for Medical Journals*,[113] points out that self-plagiarism cannot be explicitly assessed as a form of scientific misconduct and certainly compared to plagiarism, as one cannot be a plagiarist of one's own work; one cannot steal from oneself (an oxymoron). The quoted recommendations explain:

[112] Cf. J. Banasiuk and J. Sieńczyło-Chlabicz, "Pojęcie i istota zjawiska autoplagiatu w twórczości naukowej" [The concept and essence of the phenomenon of self-plagiarism in scientific creation], *Państwo i Prawo* 3 (2012): 6–19.

[113] https://wame.org/recommendations-on-publication-ethics-policies-for-medical-journals.

> Plagiarism is the use of others' published and unpublished ideas or words (or other intellectual property) without attribution or permission, and presenting them as new and original rather than derived from an existing source. The intent and effect of plagiarism is to mislead the reader as to the contributions of the plagiarizer. This applies whether the ideas or words are taken from abstracts, research grant applications, Institutional Review Board applications, or unpublished or published manuscripts in any publication format (print or electronic). Plagiarism is scientific misconduct [...]. Self-plagiarism refers to the practice of an author using portions of their previous writings on the same topic in another of their publications, without specifically citing it formally in quotes. This practice is widespread and sometimes unintentional, as there are only so many ways to say the same thing on many occasions, particularly when writing the Methods section of an article. Although this usually violates the copyright that has been assigned to the publisher, there is no consensus as to whether this is a form of scientific misconduct, or how many of one's own words one can use before it is truly "plagiarism." Probably for this reason self-plagiarism is not regarded in the same light as plagiarism of the ideas and words of other individuals. If journals have developed a policy on this matter, it should be clearly stated for authors.[114]

The phenomenon of self-plagiarism, as undesirable when publishing research results, was probably first identified in the 1960s. This was first done in 1960 by Samuel Goudsmit, editor of *Physical Review Letters*, and then by Dr Franz J. Ingelfinger, editor of *The New England Journal of Medicine*, who announced that texts already circulated in the pages of another periodical would not be accepted for publication in their journals. In honour of the editor of *The New England Journal of Medicine*, such publication policy was referred to in 1969 as the Ingelfinger Rule.[115]

This issue should be considered in the context of researchers popularising their own scientific achievements and striving to develop previously stated theses or scientific concepts in subsequent publications, and also taking into account the current widespread pressure to publish. Making a publication effort to popularise one's own scientific output in several works cannot be

[114] *Section: Plagiarism,* https://wame.org/recommendations-on-publication-ethics-policies-for-medical-journals.

[115] A. S. Relman, "The Ingelfinger Rule," *The New England Journal of Medicine* 305 (1981): 824–826, https://doi.org/10.1056/NEJM198110013051408.

arbitrarily qualified as a reprehensible phenomenon and a breach of ethical principles. Scientists have a natural tendency to present their research results to the widest possible audience in order, on the one hand, to gain recognition among specialists and, on the other, obviously, to increase their own scientific output. The concept of self-plagiarism can be identified with the following phenomena:

(1) reuse of one's own work in a later work;
(2) republishing an already distributed own work;
(3) recopying, taking over parts of one's own work into a new piece.

Analysing this phenomenon, Miguel Roig[116] made a classification of self-plagiarism. Based on the criterion of the extent of reuse of one's own text and the way in which research results are repeatedly published, he distinguished the following three types of self-plagiarism:

(1) redundant publication, the most common form of which is duplicate publication;
(2) reuse of excerpts from one's own work (text reuse);
(3) fragmentation of a publication (segmented publication, salami, piecemeal, fragmented publication, partitioning of a study into several manuscripts).

In assessing these practices, Roig concluded that it is unethical to adopt all or a part of one's own previously distributed works into later works without indicating one's own authorship. Consequently, if one correctly cites the source and indicates one's own authorship of the adopted work or part of it, this is an instance of legitimate use of one's own scholarly work and not unethical self-plagiarism. A document authoritative on the matter within the United States, "Avoiding Plagiarism, Self-plagiarism, and Other Questionable Writing Practices: A Guide to Ethical Writing,"[117] reads: "self-plagiarism is not considered research misconduct in accordance to 42 CFR 93."[118]

[116] M. Roig, "Plagiarism and Self-plagiarism: What Every Author Should Know," *Biochemia Medica* 20, no. 3 (2010): 295–300, https://doi.org/10.11613/BM.2010.037.

[117] This guide was written by Miguel Roig, PhD, from St. Johns University with funding from ORI. This module was originally created in 2003 and revised in 2006 and 2015; https://ori.hhs.gov/avoiding-plagiarism-self-plagiarism-and-other-questionable-writing-practices-guide-ethical-writing.

[118] The Code of Federal Regulations (CFR) is the codification of the general and permanent rules published in the Federal Register by the departments

Thus, we may qualify as an example of academic fraud the act of a researcher consciously recycling their own scientific work into subsequently published works when this serves to fraudulently augment the scientific output by misrepresenting its comprehensiveness and, at the same time, gives rise to an impression of publishing the work for the first time. To impute an academic with unethical self-plagiarism, the following conditions are met. There must be a conscious (i) use of one's own work in whole or in part in a subsequent scholarly work without mentioning one's own authorship and original place of publication; and (ii) misleading of the publisher and readers into believing that the published work is original and individual and is being published for the first time, with a view to creating an impression of enlargement of one's own scholarly output, which in fact does not occur. It must therefore be accepted that a researcher may use their own scientific output in subsequent research work. However, in such cases, they should update the previously disseminated scientific claims accordingly. It should be emphasised that the fear of being accused of self-plagiarism must not lead to a slowdown or limitation of the exchange of relevant scientific information (scientific data) or have a negative impact on one's career by inhibiting the publication in high-scoring journals of research results referring to the researcher's published output.

The issue of republishing the same scientific work in its entirety or in its essential parts has been regulated in detail in the Polish Code of Ethics for Researchers, which formulates the rules for presenting such works in the researcher's output. Namely, this type of studies, related to each other in terms of content in substantial parts and to a substantial extent, especially studies transferring previously published content in extenso to new works, should be included in the author's list of achievements as one item. At the same time, the Code accepts that artificially enlarging the publication output by repeatedly documenting, under different titles, the same scientific achievement is a reprehensible action. In commenting on this recommendation of the Code of Ethics, attention should be drawn to the tendency, apparent in the scientific literature, to publish two or more very similar articles, which in fact should appear as a single work. This problem

and agencies of the Federal Government. It is divided into 50 titles representing broad areas subject to federal regulation. https://www.ecfr.gov/current/title-42/chapter-I/subchapter-H/part-93/subpart-A/section-93.103#.

is, unfortunately, steadily increasing, as the editor of a journal, reviewer of habilitation and professorial applications and reader of scientific literature, the author of the study, Adam Proń, can clearly witness. It is noticeable that often the authors of such papers edit them in such a clever way that anti-plagiarism software does not detect the textual borrowings. Another contemporary problem is the so-called salamisation of research results, that is, the publication in several articles of research results that should be found in one paper. Figuratively, this issue can be explained using the example of a publication on the development of a new organic light-emitting diode. Such an article should consist of the following parts: (i) synthesis of a new electroluminophore; (ii) investigation into its redox properties by electrochemical methods; (iii) investigation into its spectroscopic and photophysical properties, including characterisation of thermally activated delayed fluorescence; (iv) performance of quantum chemical calculations to support the interpretation of electrochemical and spectroscopic results; (v) determination of the crystal structure of monocrystals and thin films deposited on a substrate; (vi) determination of the mobility of charge carriers (holes and electrons) in thin films; (vii) fabrication of a prototype diode and determination of its characteristics. A research designed and carried out in this way allows to publish its results in a single comprehensive article in journals such as *Chemistry of Materials* (ACS) or the *Journal of Materials Chemistry C* (RSC). However, a scientist wishing to increase their publication output may publish the same results in five separate journals: (i) synthesis + stationary spectroscopy + part of DFT calculations in *The Journal of Organic Chemistry* (ACS) or less ambitiously in *Tetrahedron* (*Elsevier*); (ii) electrochemistry, spectroelectrochemistry + another part of DFT calculations in *Electrochimica Acta* (*Elsevier*); (iii) photophysics + another part of DF studies in *Journal of Physical Chemistry C* (ACS) or *Physical Chemistry Chemical Physics* (RSC); (iv) crystallographic studies of monocrystals in *Acta Crystallographica*; (v) thin film structure studies + electrical transport studies + diode design + diode characterisation in *Organic Electronics* (Elsevier). In extreme cases, by selecting journals with unreliable publishing practices but included in reference government publication lists, such publication policy might allow a resourceful scientist to produce up to eight different papers that, in an automated procedure of evaluation, will translate into a high parametric contribution to a scientific discipline. Nonetheless, such an unreliable publication practice, detracting from the value and impact of the scientific achievement on the state of knowledge and scientific progress, will not escape the eye of a skilful reviewer in the promotion procedure, bearing in mind the individualised and expert nature of the assessment of a scientist's achievements in a promotion procedure.

When reflecting on academic writing, it is also worth referring to the social role of science. Józef Pieter distinguishes two social purposes of science and academic writing. Firstly, academic writing is to serve the scientific community to communicate knowledge (research results and scientific findings made) to audiences capable of understanding and benefiting from it, that is, other scientists and partners in the socio-economic environment of research institutions. In this way, it is intended to contribute to scientific and technological progress. The second objective of academic writing, on the other hand, is to disseminate knowledge to the public. The realisation of this objective requires a skilful adaptation of the presentation of fruits of scientific work to the level of perception of a scientific text by a non-specialist reader. The type of writing in question requires a combination of fully scientific level of transmitting knowledge with teaching skills.[119]

The consequence of distinguishing these two fundamental social objectives of science and its achievements is the adoption of a classification of scientific writing according to the circle of addressees. It can take the form of professional writing, intended for specialists, or didactic-scientific writing aimed at disseminating scientific knowledge among non-specialists.[120] The former should be strictly scientific, that is, created in the forms, style and content appropriate to the conceptual apparatus and scientific method in a given area of knowledge, and then made available to a wider audience according to the principles of evaluating scientific achievements applicable in a given field of science, for example, monographs, thematic collective works or scientific articles in scientific periodicals or peer-reviewed post-conference materials. In reference to the second type of academic writing, Pieter pointed to the inadequacy of using the presently common terms "popularising" or "popular science" writing. Advocating the adequacy of the term didactic-scientific writing, Pieter stressed that its essence is expressed not so much in making scientific

[119] Pieter, *Nauka i wiedza* [Science and Knowledge], 187–188.
[120] Pieter, *Nauka i wiedza* [Science and Knowledge], 189–190.

knowledge available to the people (*populus*), but in applying to its dissemination didactic principles (teaching principles) tailored to the level of perception of particular recipient groups. For these reasons, academic writing that disseminates scientific knowledge in the circles of interested but non-professional readers has a heterogeneous form, from strictly specialised to very elementary, almost devoid of professional idiom. Such writing can therefore take the form of school textbooks, academic textbooks, but also forms addressed to a wide range of so-called educated lay readers. Indeed, realisation of the social purpose of science requires dissemination of scientific knowledge within a wide framework of general education in society. As Pieter emphasised: "Science is an instrument of social life. This instrument becomes all the more valuable the more the whole society—not just a handful of specialists—is interested in it and—consequently—the better the conditions for improving it."[121]

Scientific work as a process of acquiring knowledge, truths about the world around us and the analysed phenomena, should be based on appropriately selected, both general and specific methodology and rely on scientific accuracy when conducting research. On the other hand, when publishing the results of research, due to the social dimension of scientific writing, the most important principles are those defining the way in which thoughts are formulated, focusing on consistent logic in speech and the correctness of grammar and writing style. The importance of the close correlation between methodological correctness of the research process and the logical flow of argument and grammatical and literary correctness of a scientific text is perfectly reflected in the following words of Pieter: methodologically poor research will not be improved by a good linguistic approach, however, the best research can be obscured and spoiled by poor writing from the point of view of logic, grammar and style.[122]

In this connection, Józef Pieter looked at the principles of correct scientific writing, explaining that such writing should confirm with the following requirements: (a) scientific accuracy and precision, (b) sufficient justification of scientific claims, (c) economy of words, (d) clarity of argumentation, and (e) style of scientific writing.[123]

[121] Pieter, *Nauka i wiedza* [Science and Knowledge], 188.
[122] Pieter, *Nauka i wiedza* [Science and Knowledge], 189–192.
[123] Pieter, *Nauka i wiedza* [Science and Knowledge], 192–201.

The principle of accuracy and precision of scientific writing[124] means its adaptation to the precepts of logic. It therefore requires avoiding ambiguous and vague concepts and contradictory statements, as well as prolixity. The language used should be strict, precise, and the concepts defined unambiguously. The principle of adequate (sufficient) justification of scientific claims[125] is a manifestation of one of the basic rules of logical thinking, namely the principle of sufficient reason. Fulfilment of this requirement is possible in so-called axiomatic scientific theories, that is, in mathematics or other hard sciences and natural sciences. This does not mean that the principle of sufficient reason is only applicable to these sciences. It is a universal principle that also applies to social sciences or humanities. In order to meet the requirements under this principle, it is necessary that the author of the paper first cites the major, non-evidential assumptions on which their work is based, referring to the state of knowledge and the body of literature. The author should then adequately distance themselves from or express doubts about claims they have been unable to substantiate or have substantiated insufficiently, using phrases such as: "it seems," "it is possible," "it is quite likely," "it looks like it," "it seems" or "it could be." The principle of economy of words, or economy of thought,[126] is expressed by Ockham's maxim that concepts should not be multiplied beyond necessity. It is expressed in the postulate of introducing into the text as many words and sentences as it is necessary for methodological and logical reasons and in view of the cognition of the addressee for whom the work is being prepared. Hence, repetitions, summaries, emphasis or additions are permissible in didactic works, which will not be justified in works addressed to professional readers (scientific community). The principle of clarity of argumentation in scientific writing[127] is usually expressed in the accessibility of the style and, on top of that, in the adoption of language allowing a professional reader, in particular, to reproduce the researcher's train of thought. What is important here is the use of appropriate words, linguistic phrases and syntactic forms that ensure comprehensibility of the sentence structure, the contents contained therein, the reasoning and the formulation of statements. The principle of preserving the style

[124] Pieter, *Nauka i wiedza* [Science and Knowledge], 192–194.
[125] Pieter, *Nauka i wiedza* [Science and Knowledge], 194–195.
[126] Pieter, *Nauka i wiedza* [Science and Knowledge], 196.
[127] Pieter, *Nauka i wiedza* [Science and Knowledge], 197.

of academic writing[128] is expressed in the choice of appropriate vocabulary, linguistic phrases and the way in which tasks are arranged, and then the entire flow of statements. A good style of scientific writing should harmoniously combine the features of factuality, clarity and accessibility of a scientific text from the point of view of the capacity to understand its content by the intended addressee. The style of a didactic-scientific text should therefore differ from that of a strictly scientific text intended for a narrow range of specialists.

3. Authorship of a Scientific Achievement in Promotion Proceedings

> A quotation from Arthur H. Compton (Nobel Prize in Physics, 1927):
> Science's prime concern is with the understanding of the world and of man. A scientist is a person with a curiosity for reliable knowledge.
>
> Compton A.H. Science and Man's Unfolding View of Himself. *Sooner Magazine* 25 (1953): 28–33. The full text is available via https://journals.shareok.org/soonermagazine/article/download/8261/8260

3.1. Introductory Remarks

Undertaking and conducting research activities is expressed in scientific authorship. Such authorship precedes the conduct of scientific research and the publication of academic works, which may be either guided or independent in nature. Guided academic works are those in which the scientific problem and method are defined by a specialist in a particular area of knowledge, usually a mature researcher, and then implemented by an adept scientist. They are a kind of training in the scientific method or research ancillary to core research, or may combine both these forms. The category of guided works includes laboratory exercises, proseminar assignments, seminar papers, but also bachelor's or master's theses. However, the authors of dissertations, when

128 Pieter, *Nauka i wiedza* [Science and Knowledge], 198–201.

conducting the research preceding their preparation, can display a considerable degree of independence and creative activity. Hence, many contemporary theses undoubtedly balance between guided and independent work. Under copyright regulations, of course, the author of the work in which the thesis is expressed is the graduate student. Materially, however, such a work, or, more precisely, the research process used to collect the scientific data necessary to fix the work, has two authors: the academic teacher who directs the research activity and the student who performs it. The teacher conducting research work is responsible for the conduct of the research and the reliability of the results obtained. By supervising the student's research activity, the teacher contributes significantly to the results of the research and therefore has the right to use them when publishing the results of the studies, which are also included in the student's diploma thesis. It is, of course, unacceptable for a teacher to use their student's work without clearly indicating what elements of their article are based on the creative effort relating to the research announced in the form of a thesis. It is a good practice that the co-ownership of their results, following from joint research, published earlier or simultaneously in the thesis, should result in the student being granted the status of co-author of the scientific articles published by their teacher.[129] Undoubtedly, diploma theses do not constitute independent scientific works that can be the basis for promotion proceedings for the award of a degree or title. Such a requirement should be met by scientific achievements presented in the form of a doctoral dissertation, a habilitation thesis or a professorial dissertation in promotion proceedings.

A fully independent research paper should meet the following two conditions:

(1) it should be conceived either entirely or predominantly on the author's own initiative and based on the author's ingenuity, and then the research activity should be carried out with their considerable participation; it should be added that the author's own conception of the work should be discernible in the justification of the research problem, in the construction of the scientific method and in the conduct of the research and elaboration of its results;
(2) the scientific achievement documented in such a work, at least in some of its relevant parts, should demonstrate not

[129] Cf. Pieter, *Praca naukowa* [Scientific Work], 236 and 252.

only sufficient proficiency in the scientific method appropriate to the scientific discipline but, above all, a degree of novelty (originality) in relation to the state of the art; in other words, the achievement should be at least to some extent creative.

Fulfilment of both of these prerequisites by attaining the necessary level of independent scientific work demonstrating the necessary degree of creative contribution to the state of knowledge is subject to expert assessment during the promotion procedure. Ascertainment that these prerequisites have been fulfilled is to some extent arbitrary and makes an expression of certain good reviewing practice.[130] Scientific creativity can take different forms and show a different contribution value to the state of knowledge. Particularly in promotion proceedings, the principles for assessing the importance and significance of a scientific achievement, in terms of the state of knowledge and scientific progress, are of great importance. To evaluate something means to make a judgement about it on the basis of certain principles, and, thus, evaluation boils down to making statements about the degree of compliance with certain values or the degree of fulfilment of these values in someone's action or work. These value judgements should be formulated after establishing the objectively existing facts concerning the action or work in question. The term evaluation, therefore, refers to special activities that require the exercise of a certain creative effort in carrying out a critical analysis of the assessed action, which are then fixed in a product, the review assessing the value of the work. An expert review should be reliable, factual and highly rational, and, as such, also fully objective. It should be based on a thorough knowledge of the type of facts in question and confrontation of the facts against value principles. Strict criteria, that is, evaluation measures, are necessary for rational review of academic papers. Most often, scientific criticism and the subsequent evaluation of the importance of the work's contribution to the state of knowledge are carried out according to the following criteria: originality, methodological value, logical value, social value, the magnitude of the creative effort and size of the work itself, but also the linguistic correctness of the study and the precision and accessibility of the writing style.[131]

[130] Cf. Pieter, *Praca naukowa* [Scientific Work], 235.

[131] Cf. Pieter, *Praca naukowa* [Scientific Work], 214–217; Pieter, *Nauka i wiedza*

Since the primary purpose of science is to learn new truths, which take the form of increments of knowledge or scientific discovery, the criterion of originality, that is, the novelty of the work under evaluation or its essential creative components, plays a key role in scientific criticism. The word "originality" is derived from the Latin word *orgio*, meaning "beginning." Etymologically, originality of a work means the initiation of something, the novelty of something. The criterion of originality of a scientific work therefore requires a judgement to be made about the degree of the work's relative novelty in many respects or in a certain respect, however, this does not relate to novelty *per se*, in isolation, but in juxtaposition with a degree of originality of problems, hypotheses, methods and results. To accurately assess scientific papers for their originality is an extremely difficult task; in the case of major scientific discoveries, such as original hypotheses, problems or methods, it can often only be done effectively from a certain historical distance. In order to attempt an accurate assessment of the level of originality of a work, two conditions must be met. Firstly, it is necessary to have a thorough professional background in a given specialisation, taking into account the necessary interdisciplinary state of knowledge, especially in related disciplines, in which the reviewed scientific achievement is located. Therefore, knowledge of the history of scientific progress in a given type of research is required, which allows to grasp the relations of the assessed work to the state of knowledge, especially the independence of the statements made in the work. It is also necessary to have a good knowledge of the current publication status in the assessed area in which the contribution to the state of knowledge is made, the latest problems, methods and scientific findings and discoveries. Secondly, appropriate discipline must be maintained when evaluating another person's work. Absolute objectivity is required, but also a certain magnanimity and sympathy allowing to give an honest review of someone else's achievements, without succumbing to subjective judgements.[132]

Methodological evaluation of a scientific work is undoubtedly easier than the above. It requires scientific criticism of the manner in which the precepts of the scientific method, appropriate

[Science and Knowledge], 280–284.

132 Cf. Pieter, *Praca naukowa* [Scientific Work], 217 and 221; Pieter, *Nauka i wiedza* [Science and Knowledge], 284–287.

to a given scientific discipline and research area, are applied in the research and in the writing of the work. The reviewer assesses the degree of compliance with the accepted and observed rules of formulating a scientific problem, using literature of the subject, justifying assumptions, theses or research hypotheses, of the selection or construction of the applied research methods and techniques, the skilful and actual conduct of research and the manner of processing the obtained research results, including drawing the conclusions at the end of the scientific efforts.[133]

Logical evaluation of a scientific paper is a two-stage process with two aspects: the negative and the positive. First, the presence or absence of errors in thinking (logical) in the work is assessed. This involves the assessment whether there are errors in the definition of terms, in the use of terms and in the flow of reasoning. It is therefore an assessment of clarity, accuracy and precision of the style of scientific writing, including the sufficiency of justification of the scientific claims (findings). The positive side of logical evaluation of a scientific work is expressed in the review of the degree of insight represented by the work's author. In this context, two basic mental operations are taken into account: analysis and synthesis. The reviewer should measure how thoroughly the author of the scientific achievement has analysed a given issue or how accurately he managed to combine various components of the work into a whole, making a valuable contribution to science. When assessing the degree of insightfulness of the work, the focus should be on the positive values of the work and not on its shortcomings. A significant feature of the work and its added value to the state of knowledge, stimulating scientific and technological progress, may, in fact, be subtle analysis or skilful synthesis of the detailed research results obtained and the existing state of knowledge.[134]

The assessment of social value is a consequence of the relationship between science and the socio-economic environment of scientific and research institutions and universities. Reviewing the value of a work through this prism requires an assessment of its social value, that is, an assessment of whether it is valuable to the society, the economy or culture. Assessing a work according to its social validity should not be equated with assessing its di-

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[133] Cf. Pieter, *Praca naukowa* [Scientific Work], 221–222; Pieter, *Nauka i wiedza* [Science and Knowledge], 287–290.

[134] Cf. Pieter, *Praca naukowa* [Scientific Work], 222–224; Pieter, *Nauka i wiedza* [Science and Knowledge], 291.

rect utility (utilitarianism). A work, in order to be of value to the socio-economic environment, does not have to show a capacity for direct implementation. It can even be a work of an abstract nature, however, offering a starting point for other research work that can lead to social or economic or cultural transformations. For example, Niels Bohr's theoretical work on the structure of the atom had just such an effect.[135]

The issue of originality of scientific achievements, and, in particular, the fulfilment of this requirement by doctoral theses in the realities of the 21st century, is often addressed in current scientific research. The concept of originality is not a uniformly understood concept with a universal definition. From a definitional point of view, it is identified throughout the scientific world as an original and therefore qualitatively new contribution to the state of knowledge in a given field. Originality, understood in this way, is nowadays interpreted in the context of two further concepts: creativity and innovation. These relationships should be looked at more closely.[136]

In explaining the requirement for originality of a scientific achievement, the literature points out that this premise is met both when new knowledge has been generated as a result of the scientific work and when the existing knowledge can be applied to gain a new understanding. Originality can be evident in the design of the research, the synthesis of knowledge, the implications or presentation of the research,[137] in the application of new methods, new questions or new ideas in the research, but also in the application of existing methods to new data with the effect of incrementally adding to the knowledge base.[138] The originality of a scientific paper can therefore be expressed in a number of ways, and the type of originality that is recognised and valued in a paper largely depends on the established evaluating traditions in the discipline. An analysis of the existing field-specific

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[135] Cf. Pieter, *Praca naukowa* [Scientific Work], 224–225; Pieter, *Nauka i wiedza* [Science and Knowledge], 290–291.

[136] A. Baptista, L. Frick, K. Holley, M. Remmik, J. Tesch, and G. Âkerlind, "The Doctorate as an Original Contribution to Knowledge: Considering Relationships between Originality, Creativity, and Innovation," *Frontline Learning Research* 3, no. 3 (2015): 55–67, https://doi.org/10.14786/flr.v3i3.147.

[137] J. Wellington, *Making Supervision Work for You: A Student's Guide* (London: SAGE Publications Ltd., 2010 (online: 2012), https://doi.org/10.4135/9781446251614.

[138] B. E. Lovitts, "Being a Good Course-taker Is Not Enough: A Theoretical Perspective on the Transition to Independent Research," *Studies in Higher Education* 30, no. 2 (2005): 137–154, https://doi.org/10.1080/03075070500043093.

diversities[139] has demonstrated that originality in the sciences, technology, engineering and mathematics can be expressed in publishability itself, whereas in the arts, humanities and social sciences it relates to intellectual originality.[140] Significant original contributions to research can be manifest in filling small gaps in already saturated research areas, as novel interpretations or applications of known ideas. A researcher can achieve this in a number of ways. For example, by creating a synthesis, providing one original technique or testing the existing knowledge in an original way. While a dissertation must be innovative, this does not necessarily mean revolutionising the existing scientific discourse. There is also value in simply adding new perspectives to the state of knowledge. The requirement to make a small but significant contribution to knowledge in a dissertation can therefore be regarded as a certain standard against which the scientific value and fulfilment of the originality requirement by a dissertation is measured.[141]

Pat Thomson, professor at the University of Nottingham working on education issues, comes to similar conclusions when considering the criterion of originality of a research paper. He points out that even when no qualitatively new original research is presented in a doctoral thesis, doctoral students always produce some of their own interpretations and categorisations.[142] These are a natural consequence of the way the research questions are posed, the methods used, as well as the analytical-synthetic approaches in the course of argumentation. The originality of a work is therefore expressed and is already inherent in the original way of thinking adopted, in its unique authenticity resulting from the author's individual and creative imprint in the work. The originality and authenticity of the work should provide the reader with an interesting and different perspective on the phenomenon under study. It is sufficient if the doctoral

[139] G. Clarke and I. Lunt, "The Concept of 'Originality' in the Ph.D.: How Is It interpreted by Examiners?", *Assessment & Evaluation in Higher Education* 39, no. 7 (2014): 803–820, https://doi.org/10.1080/02602938.2013.870970.

[140] A. Baptista, L. Frick, K. Holley, M. Remmik, J. Tesch, and G. Âkerlind, "The Doctorate as an Original Contribution to Knowledge."

[141] H. Cray, "How to Make an Original Contribution to Knowledge" (August 6, 2014), https://www.universityaffairs.ca/career-advice/career-advice-article/how-to-make-an-original-contribution-to-knowledge/.

[142] P. Thomson, "What Is an 'Original Contribution'?", blog (May 11, 2015), https://patthomson.net/2015/05/11/what-is-an-original-contribution/.

student offers some insightful analysis, some alternative ideas, brings in new literature or methods and/or presents a convincing problematisation. In summary, to ensure the originality of a work, it is sufficient if the author expresses in it an original way of thinking, an original grasp of the topic of the study, prompting the reader to take a second look and think about the issue or phenomenon at hand. In this way, the premise of original contribution to knowledge can be fulfilled.

As already mentioned, in the realities of the 21st century, the originality of a scientific achievement has been linked to its two further characteristics—creativity and innovation. In Poland, this has found expression in the emergence, alongside traditional forms of dissertation, of the category of implementation doctorate. Creativity is expressed in the production of not only new, innovative knowledge, but also knowledge that is relevant and applicable in a socio-cultural-economic context. Doctoral education should foster the creativity of the doctoral student, thus educating them to be a responsible and independent scholar, able to take on intellectual challenges and ready for research independence. Considerations on the requirement for creativity and originality in research work do not, however, lead to depreciation of research results that are neither creative nor original or innovative. Such an example is provided by cumulative research or replication research in the field of hard sciences or natural sciences. They are often valuable and important contributions to the state of knowledge because of their merit or usefulness. For example, replication of a research is an important aspect of knowledge development because it increases the credibility of research results and, therefore, confidence in the results.[143]

Research activity is increasingly seen as a contribution to innovation in the development of the global economy as the principle of building knowledge-based economies spreads in many countries. This is also how the role of universities and research activities is seen by the European University Association (EUA), which represents more than 850 universities and national rector conferences from 49 European countries. The EUA plays a key role in the Bologna process and influences EU policy on higher education, research and innovation. The EUA ensures that the independent voice of European universities is heard, while also

[143] Baptista, Frick, Holley, Remmik, Tesch, and Âkerlind, "The Doctorate as an Original Contribution to Knowledge."

ensuring its participation in creating the directions for development of scholars' research activities. The EUA made this clear by adopting the Lisbon Declaration in 2007. This document analyses the role and possible contribution of European universities of all kinds in achieving the common goal, that is ensuring the socio-economic development of countries and societies through research and innovation.[144] The Declaration points to the links between university research and innovation, emphasising that: "universities are capable of promoting cultural, social and technological innovation and meeting the challenges of the 21st century arising from technological and social innovation, solving problems as they arise and ensuring economic success." According to Lisbon Declaration, doctoral education should encourage the spread of a risk-taking culture. A doctoral student should know that conducting research, the results of which will make an original contribution to knowledge, requires a certain amount of risk in the choice of topic and approach, due to the novelty aspect inherent in originality. Doctoral students must therefore have the courage and confidence to take the risk of making mistakes, to enlarge and rediscover knowledge and to conduct critical research. Doctoral programmes should therefore foster an institutional environment that is open to creativity and the creation of new knowledge and innovation.

Innovation is the same as practical application of a novel idea; it therefore encompasses the process of turning an invention into a practical application and is most often associated with industrial exploitation. A prelude to innovation is always a creative endeavour leading to a scientific or technological achievement that is not only novel but also useful. Innovation therefore requires a focus on creativity in thought and action. The integration of the innovation requirement into doctoral education has two aspects. On the one hand, the fact that the research results obtained by the doctoral student should take into account their applicability for use in the socio-economic environment and, on the other hand, the usefulness of the learning outcomes obtained in the course of doctoral studies to the needs of the industry, in particular for the industrial implementation of scientific and technological innovations. In summary, creativity and innovativeness of scientific achievements also includes the feature of their originality

[144] European Universities Association. (2007). *Lisbon Declaration—Europe's Universities beyond 2010: Diversity with a Common Purpose*. Brussels: EUA.

in the form of novelty or new research. It is possible to have the feature of originality without creativity or innovation, but not vice versa.[145]

3.2. The Degrees and the Title Awarded in the Polish System of Higher Education and Science

The scientific status of researchers in the Polish system of higher education and science, regulated by the *Law on Higher Education and Science* (hereinafter also: LHES), is based on the academic degrees of doctor and habilitated doctor and the title of professor. A scientific degree shall be granted in a given field of science and scientific discipline, with the proviso that a doctoral degree may also be conferred in a field of science. The title of professor shall be conferred in a given field, field and discipline or disciplines (Art. 177 LHES.). Under the analysed provisions, award of the degree or title may be sought by a researcher who, broadly speaking, has a scientific, teaching and organisational output benefitting a higher education institution, as required for a given level of scientific promotion. In assessing the merits of an application for academic promotion, obviously, the greatest weight is given to scientific output. This output may consist of monographs and scientific publications, patents for inventions, protection rights for utility models or exclusive rights to plant varieties, as well as other scientific activity consisting in active participation in national and international scientific conferences (presentation of papers, posters and reports) and academic internships at academic institutions other than the home institution. Among this catalogue of activities, the most important is, of course, demonstration by the applicant for the degree or title of authorship of a scientific achievement constituting an independent contribution to the state of knowledge in a given scientific discipline or, more broadly, field of science. This authorship can be evidenced in promotion proceedings by the following:

(1) (independent) authorship of a scientific monograph,
(2) (independent) authorship of an editorially distinguished part of a collective work (multi-author monograph),

[145] Baptista, Frick, Holley, Remmik, Tesch, and Âkerlind, "The Doctorate as an Original Contribution to Knowledge."

(3) authorship of one series (collection) of published and thematically related articles (and possibly patents for inventions), in which—in the case of creation of this body of works in the form of multi-author articles or multi-author patents—it is possible to identify the subject the investigation and development of which constitutes an individual (independent) contribution to the state of knowledge of the person applying for the degree or title,
(4) original design, construction, technological or artistic achievement.

In Poland, fulfilment of this requirement is assessed differently at each stage of the three-tier academic career. Different requirements are also used when assessing the premise of independence in the creation of the evaluated scientific achievement. These issues will be the subject of further detailed analysis, however, certain preliminary points must be made at this place. Notably, habilitation and professorial achievements should differ in weight. The former should be significant, the latter outstanding. The achievement presented in a doctoral thesis, on the other hand, should represent only, or perhaps as much as, an original (new) contribution to knowledge. Each of these three types of achievement at the academic career levels should be obtained independently, but here again there is a certain gradation in the degree of this independence. While habilitation and professorial achievements are prepared without formal involvement of a promoter, the same cannot be said about a doctoral thesis. The "independent achievement" expected of an applicant for a doctoral degree should be the result of the doctoral student's own scientific and research work and an expression of proficiency in mastering the scientific method. This requires that the doctoral dissertation contain new scientific findings or incrementally contribute to the state of the art. The doctoral student's independence is expressed in the originality of their scientific findings, but does not imply independence of scientific or teaching supervision. Given the social costs and the real state expenses for the production of each doctoral thesis (whether it is prepared in the course of training in a doctoral school or extramurally), the idea of independence of the doctoral thesis cannot be interpreted as producing a thesis independently of the prevailing scientific craftsmanship in a given area of knowledge. Learning the ins and outs of the scientific craftsmanship, of the scientific method, requires training. This means that the preparation of doctoral theses should be supervised and that doctoral dissertations should be categorised as guided scientific work. The requirement of independence in the preparation of a doctoral student's scientific achievement does not therefore exclude the possibility of the doctoral theses being supervised by an eminent specialist, in Poland by a person having the status of an independent scientific worker (habilitated doctor or professor). At the same time, this guidance of doctoral theses is to constitute the foundation and axis of doctoral students' training at the doctoral school.[146]

The conditions accompanying the production of a doctoral thesis as a part of training at a doctoral school are regulated in detail in Poland. The *Law on Higher Education and Science* provides that in the course of education in a doctoral school, a doctoral student has the right to substantive supervision over their scientific and research work and didactic work. This supervision shall be exercised by a promoter(s) designated for the doctoral student or by a promoter and an assistant promoter. The progress in training and in the completion of the research work shall require preliminary evaluation after the end of the second year of training as a condition for the possibility of continuing the doctoral studies.

During the course of training, the doctoral student shall, in particular, have the right to be supervised by the promoter in the development of the Individual Research Plan (hereinafter IRP) and in the subsequent implementation, in accordance with the timetable, of the research tasks specified therein. Under Article 204(2) and Article 205(1) item 4 LHES, the content of the IRP can be modified, and the change is formally made by submitting an annex to the IRP. The subjective scope of an amendment to the IRP has not been limited in any way, which means that it may concern minor modifications to the research plan and the timetable or be of fundamental nature, including a change in the subject and scope of the planned scientific achievement. It should be emphasised that this modification may also lead to a change in the qualification of the planned doctoral dissertation in terms of the scientific discipline and field. It is therefore possible both to change the discipline within a scientific field and to assume that the dissertation will be interdisciplinary. Taking into account the very wide range of possible changes to a doctoral student's research plan, the legislator has granted them the right to extend

[146] Cf. Pieter, *Praca naukowa* [Scientific Work], 235–236 and 253–254.

the deadline for submission of the dissertation specified in the IRP by a maximum of two years, and the Regulations of doctoral schools should precisely specify the conditions for granting permission for such an extension.

Taking into account the possible far-reaching, including substantive, changes to the subject matter of the scientific achievement described in the IRP, the legislator has guaranteed the doctoral student, in the course of training in the doctoral school, the right to initiate the procedure for changing the promoter or promoters or the promoter and assistant promoter (Art. 205(1) item 1 LHES). This procedure can take the form of both revocation of the promoter or assistant promoter in question and the appointment of another person in their place or, merely, revocation of one of two or more promoters or assistant promoters. In case of submitting an application for revocation of a promoter, the dean of the doctoral school is obliged to assess the merits of the application from the point of view of ensuring that the doctoral student is provided with appropriate scientific care during the implementation of the IRP, by a person who has the necessary knowledge and competence to provide substantive support according to the subject matter of the planned research achievement and the scope of the research plan.

A doctoral student's education at a doctoral school ends with: the completion of a programme of study guaranteeing the attainment of learning outcomes at level 8 of the Polish Qualifications Framework and the submission of a doctoral dissertation. An analysis of the provisions of the Law on Higher Education and Science makes a clear distinction between the stage of training in a doctoral school and the requirement to ensure, in the course of that training, proper scientific supervision of the implementation of the IRP and progress in research work, on the one hand, and the moment of submitting the doctoral dissertation and the assumption of substantive responsibility for it by its promoter, on the other.

The legislator has significantly changed the role of the promoter(s), as well as the object of their responsibility in the procedure for the award of the doctoral degree, in relation to the previous legislation. Namely, the no longer applicable Act of 14 March 2003 on Academic Degrees and Academic Title and Degrees and Title in the Field of Art[147] (hereinafter: Act of 2003),

[147] Journal of laws 2017 item 1789 as amended.

in Article 13(1), reads: "a doctoral *dissertation under preparation, supervised by a promoter or a promoter and an assistant promoter* […]." This meant that the process of preparing the doctoral dissertation could only start once the doctoral procedure has been opened and the promoter(s) appointed for the doctoral student. Consequently, the promoter(s) were obliged to direct the doctoral student's scientific work, and the dissertation was produced under their supervision. When this regulation was in force, it was stressed in the literature that

> […] in view of the wording of paragraph (1), however, it has to be assumed that there are no grounds for considering as a doctoral thesis not only a book published before the opening of the doctoral procedure, but also any element of a collection of chapters or a collection of articles published or accepted for print before the opening of the doctoral procedure, because at that time there was no promoter under whose supervision it was to be "under preparation" (and thus not even "prepared"—the legislator uses the expression indicating the necessity for the duration of the process of producing the dissertation, not its immediate appearance).[148]

The current provision on this matter, Article 190(1) LHES, uses a different formula: "The scientific supervision over the *preparation of* the doctoral dissertation shall be exercised by a promoter or promoters or by a promoter and an assistant promoter." In proceedings for the award of the doctoral degree, a promoter is the scientific adviser of a doctoral student who has supervised the preparation of a particular submitted doctoral dissertation. Indeed, the literature points out that:

> The provision of paragraph 1 defines in general terms the tasks of the promoter and of the assistant promoter (supervising the preparation of the doctoral dissertation; hitherto the term "dissertation under preparation" was used) […] When the wording of Article 189, second sentence, and of Article 190(1) is juxtaposed, a lack of clarity can be seen as to whether—which was out of question in the doctoral procedure so far (cf. note 2 to Article 187)—a candidate for the doctoral degree may present a finished dissertation, including one published in the form of a monograph, and the preparation of the dissertation by the (previously

[148] See: H. Izdebski and J. M. Zieliński, *Ustawa o stopniach naukowych i tytule naukowym. Komentarz* [The Act on Academic Degrees and Academic Title. Commentary], Edition II, LEX 2015.

> appointed specifically for this purpose) promoter may consist in writing an opinion necessary for the initiation of proceedings. In any case, the above possibility cannot be entirely excluded.[149]

The role of promoter in promotion proceedings may be assumed by the scholar who has supervised the preparation of the specific doctoral dissertation and has given a positive opinion on its substantive merit. Only a scholar may be appointed to such a role who, by virtue of having the adequate knowledge and competence, can take responsibility for the dissertation's substantive correctness. A promoter in the promotion procedure is therefore the person substantively responsible for the final result of the doctoral student's scientific work.[150] Consequently, it does not necessarily have to be the scholar who provided scientific supervision throughout the training and research activities of the person preparing the dissertation. This principle applies irrespective of the mode of preparation of the doctoral dissertation: in a doctoral school or extramurally.

It may be added that in both cases the conduct of research activities and the preparation of the doctoral thesis is contemplated by the legislator as a process involving a certain time frame. In case of training in a doctoral school, this framework is strictly defined,[151] while in the extramural mode it is neither statutorily defined nor limited. The legislator requires that the

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[149] See: H. Izdebski, "Komentarz do art. 190," in *Prawo o szkolnictwie wyższym i nauce. Komentarz* [Law on Higher Education and Science. Commentary], ed. J. M. Zieliński and H. Izdebski [The Act on Academic Degrees and Academic Title. Commentary], Edition II, LEX/el. 2021., Art. 190.

[150] H. Izdebski, "Postępowanie w sprawie nadania stopnia doktora" [Procedure for the Award of the Doctoral Degree], in *Metodologia dysertacji doktorskiej dla prawników. Teoria i praktyka* [Doctoral Dissertation Methodology for Lawyers. Theory and Practice], ed. H. Izdebski and A. Łazarska (Warszawa: Wolters Kluwer Polska, 2022), 56–57.

[151] Art. 201. 1. Doctoral education shall last from 6 to 8 semesters. […];

Art. 204. 1. The education of a doctoral student shall end with the submission of their dissertation.

2. The individual research plan shall specify the deadline for submission of the doctoral dissertation. This deadline may be extended, but by no longer than two years, pursuant to the rules laid down in the regulations of the doctoral school.

3. At the request of a doctoral student, education shall be suspended for the period corresponding to the duration of maternity leave, leave on the conditions of maternity leave, paternity leave and parental leave as defined by the Act of 26 June 1974—Labour Code.

person preparing the dissertation be provided with access to the research infrastructure of the higher education institution[152] and also ensured the scientific supervision by the promoter(s) or the promoter and assistant promoter, including the right to be awarded a doctoral scholarship.[153] In the course of the training and research activities of a person preparing a doctoral thesis, the doctorate awarding entity may, even repeatedly, change the persons acting as promoter or promoters or promoter and assistant promoter, respectively, of that doctoral candidate. Such a change may take place regardless of whether the doctoral dissertation is prepared extramurally[154] or in a doctoral school.[155] As can be seen from the above, a change of promoter, promoters or assistant promoter, apart from fortuitous events, is necessary when this is required by substantive considerations. Namely, when the doctoral student changes the research plan to such an extent that the subject and scope of the planned dissertation is distant from the scientific specialisation of the previous promoter or promoters. Such a modification results in the fact that the previous promoter or promoters can no longer effectively guide the doctoral student's scientific work and, in the future, take substantive responsibility for the end result of their research activity—the planned dissertation. The rationale for changing a promoter is therefore the lack of adequate knowledge, competence and skills of the promoter(s)

[152] The legislator, in Article 217c LHES, has in fact provided that: "The senate or the scientific council shall determine by resolution the conditions for the use of the research and IT infrastructure of the doctorate awarding entity by persons preparing a doctoral thesis extramurally."

[153] Article 217b: "The provisions of Article 212 and Article 213 shall apply mutatis mutandis to persons preparing an extramural dissertation to whom a promoter or promoters or a promoter and an assistant promoter have been appointed."

[154] Article 192(2)1. "The senate or scientific council shall determine the mode of awarding a degree of doctor, in particular:

(1) the manner of appointment and change of the promoter, promoters or assistant promoter in case of persons applying for a degree of doctor in extramural mode."

[155] Art. 205.1: "The regulations of the doctoral school shall establish the organisation of education to the extent not regulated by this Act, in particular:

(1) the manner of appointment and change of the promoter, promoters or assistant promoters;

(2) the manner of documentation of the course of education;

(3) the manner of conducting the mid-term evaluation;

(4) the conditions for the extension of the deadline for submitting a doctoral dissertation."

within the scientific specialisation in which—after modification of the research plan—the planned doctoral dissertation is to be submitted. The purpose of changing the promoter(s) is thus to reach a condition in which the person acting as promoter is in fact responsible for the substantive content and scientific merit of the doctoral student's findings presented in the doctoral dissertation, as they have supervised its preparation.

Importantly, under Article 189 LHES, a doctoral student shall enclose the doctoral dissertation and the favourable opinion of the promoter(s) to the application to initiate the proceedings for the award of the doctoral degree. This provision does not mention the assistant promoter as the person entitled to give an opinion on the dissertation. This is a natural consequence of the status of assistant promoter. The legislator has decided that scientific supervision over the preparation of the doctoral dissertation, can be exercised independently by one promoter or cooperatively by several promoters who are equal to each other. Their role in the formation of the scientific achievement is therefore to be equivalent. The literature explains that: "[…] the new solution of supervision by several promoters, on an equal footing, is intended to apply to the case of an interdisciplinary dissertation, when the identification of the leading discipline may present some difficulties."[156] Alternatively, the scientific supervision over the preparation of the doctoral dissertation may be carried out by a promoter and an assistant promoter, whose status is no longer equal. Hence, the literature emphasises that the Act clearly distinguishes the concept of promoter from that of assistant promoter, which means "that whenever the Act refers to a promoter or promoters, such provision does not refer to an assistant promoter."[157] Consequently, it is indicated in literature that:

(a) "The submission of doctoral thesis allows to have it evaluated by a promoter. A positive opinion of the promoter is one of the conditions for the initiation of proceedings for the award of the doctoral degree (Article 189)."[158]

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[156] See: M. Dokowicz, "Komentarz do art. 190," in *Prawo o szkolnictwie wyższym i nauce. Komentarz* [Law on Higher Education and Science. Commentary], ed. J. Woźnicki (Warszawa: Wolters Kluwer Polska, 2019).

[157] See: M. Dokowicz, "Komentarz do art. 190," in *Prawo o szkolnictwie wyższym i nauce* [Law on Higher Education and Science].

[158] See: H. Izdebski, "Komentarz do art. 204," in J. M. Zieliński, H. Izdebski, *Prawo o szkolnictwie wyższym i nauce. Komentarz* [Law on Higher Education and Science. Commentary], Edition II, LEX/el. 2021.

b) "In order for a submitted doctoral thesis to allow initiation of proceedings for the award of the doctoral degree, the Act requires a positive opinion from the promoter(s) (Article 189 LHES). However, it does not require the opinion of an assistant promoter."[159]

3.2.1. Doctoral Dissertation as a Basis for Obtaining a Doctoral Degree in Poland

Under Article 186 of the Law on Higher Education and Science, the degree of doctor in Poland is awarded to a person who:

(1) has a professional degree of master of science, master of engineering or equivalent, or holds another diploma entitling to apply for the award of a doctoral degree in the country in whose system of higher education the higher education institution that issued the diploma operates;

(2) has achieved the learning outcomes for the qualification at level 8 of the Polish Qualifications Framework, including confirmation of knowledge of a modern foreign language at a proficiency level of at least B2;

(3) has a track record of at least:

   (a) one academic article published in an academic journal or in peer-reviewed post-conference materials of an international conference which, in the year in which the article was published in its final form, was included in a list drawn up in accordance with the regulations issued under Article 267(2)(2)(b) LHES, or

   (b) one academic monograph published by a publishing house which, in the year of publication of the monograph in its final form, was included in the list drawn up in accordance with the rules issued under Article 267(2)(2)(a) LHES, or a chapter in such a monograph, which, in the case of multi-author publications, fulfils the requirement, as specified by the doctorate awarding entity, of an independent creative contribution to the creation of those works;

[159] I. Florczak, "Komentarz do wybranych przepisów ustawy—Prawo o szkolnictwie wyższym i nauce" [Commentary on Selected Provisions of the Act—Law on Higher Education and Science], in *Akademickie prawo zatrudnienia. Komentarz* [Academic Employment Law. Commentary], ed. K. W. Baran (Warszawa: Wolters Kluwer Polska, 2020), Art. 204, 355–358.

(4) presented and defended a doctoral thesis;
(5) has fulfilled other requirements specified by the doctorate awarding entity, which may concern both the scientific output or the demonstration of an independent scientific achievement, the creation of which is documented by a series of thematically related multi-author publications.

In addition, in exceptional cases, justified by the highest quality of scientific achievements, the doctoral degree may be awarded to a person who does not meet the above requirements, who is a graduate of a first degree programme or a student who has completed the third year of a uniform master's programme. Such a person, upon being awarded the doctoral degree, shall at the same time obtain a university degree within the meaning of LHES.

The fundamental prerequisite for the award of the doctoral degree is, of course, the submission and subsequent defence of the doctoral thesis. Under Article 187 LHES:

(1) "The doctoral dissertation demonstrates the candidate's general theoretical knowledge in a discipline (or disciplines) and the ability to conduct research or artistic work independently.
(2) The subject matter of the doctoral dissertation shall be an original solution to a scientific problem or in terms of the application of results of own scientific research in the economic or social sphere, or an original artistic achievement.
(3) The doctoral dissertation may be a written dissertation, including a scientific monograph; a collection of published and thematically related scientific articles; design, construction, technological, implementation or artistic work; as well as an independent and separate part of a collective work."

In the provisions of Article 177(5) and (6), the legislator referred to interdisciplinary scientific achievements, assuming two alternative solutions:

(1) If a doctoral dissertation covers scientific issues from more than one discipline, the discipline in which the doctoral is granted shall be indicated.
(2) If the doctoral dissertation covers scientific issues from more than one scientific discipline within a given field of science and it is not possible to indicate the discipline in which the doctoral should be granted, the degree of doctor shall be granted in the given field of science.

It is evident from the regulations quoted above that the Polish legislator, in the proceedings for the award of a doctoral degree, requires examination of the doctoral dissertation and the scientific achievement expressed in it through the prism of four questions:

(1) Does the dissertation confirm that the author has the ability to conduct scientific work independently?
(2) Does the dissertation present a scientific achievement based on the original scientific findings of its author?
(3) Does the scientific achievement presented in the dissertation represent the author's individual (independent) contribution to the state of knowledge?
(4) Indication in which area of knowledge the scientific achievement presented in the dissertation was made and what its nature is. Specifically, is the achievement of a disciplinary or interdisciplinary nature, and if of an interdisciplinary nature, in which area did it contribute to the state of knowledge: to a scientific discipline or to a specific scientific discipline?

In the light of the remarks made previously, the determination that the scientific achievement presented in the dissertation constitutes an *original contribution to the state of knowledge* should not present significant difficulties to an experienced reviewer, or raise doubts that would be difficult to resolve. The dissertation, as a creative scientific work, should present one's own, authorial and original (containing elements of novelty in relation to the existing state of knowledge) solution to the undertaken problem (scientific issue).[160] In the first place, the reviewer should verify whether the scientific research has actually been carried out and whether the research results are true and obtained in a correctly planned, in methodological terms, research process. In the second place, the reviewer should assess whether the contribution is original. A sufficient prerequisite for positive verification of this requirement should be the determination of elements of novelty in the scientific findings of the doctoral student. These qualitatively new contributions to the state of knowledge can be expressed both in the subject and scope of the research under-

160 A. Łazarska, "Dysertacja doktorska—istota, cel i metodologia" [Doctoral Dissertation—Essence, Purpose and Methodology], in *Metodologia dysertacji doktorskiej dla prawników. Teoria i praktyka* [Doctoral Dissertation Methodology for Lawyers. Theory and Practice], ed. H. Izdebski and A. Łazarska (Warszawa: Wolters Kluwer Polska, 2022), 71.

taken, regardless of whether they take the form of novel research or research of a cumulative or replicative nature. The contribution must be expressed in, albeit a small but qualitatively new and, at the same, time significant (relevant and valuable), contribution to the state of knowledge of at least incremental nature. It does not necessarily have to be a breakthrough contribution (scientific discovery). The originality of the dissertation may also consist in intellectual novelty of the analyses, conclusions or syntheses made in the work. However, the grasp of the "merit in science," as specified in legal terms, in the process of reviewing a doctoral dissertation and making factual conclusions about the significance for science and the state of knowledge of a scientific achievement, is highly evaluative and subjective.

Verification of two further premises that the dissertation must fulfil can nowadays pose considerable difficulties. The conditions of scientific research in the 21st century, especially in the area of hard sciences and natural sciences, are often characterised by interdisciplinary nature and conduct of the research in multi-author teams. As a result, research results are published in multi-author publications, from the content of which it may not be easy to extract an independent contribution of the doctoral student. In consequence, when the dissertation takes the form of a mono-authored written work, it is much easier for the reviewer—when examining its content—to assess whether its author has made an original and independent contribution to the state of knowledge, and thus whether they have acquired the *ability to conduct scientific work independently*. On the other hand, when a doctoral dissertation is presented in the form of a series of thematically related multi-author articles, it will not be easy to assess the author's *ability to conduct research independently and the author's individual contribution to the state of knowledge* within the team research. The reviewer has to examine not only the content of the dissertation itself, but also has to take into account a number of other discipline-specific factors determining the doctoral student's research independence and demonstration of individual contribution to knowledge.

The independent nature of the doctoral student's contribution to knowledge, confirming the ability to conduct research independently, may be considered by comparing the subject, scope and content of the dissertation with other works in the literature addressing the same or a related scientific issue. In order to confirm the independent nature of the conduct of research and the contribution made, it is necessary to exclude a close content correspondence of the dissertation to the available literature on the subject. The determination of the existence of such a content-based correlation should be considered, firstly, from the perspective of copyright law, and it should be examined whether there has been an unlawful attribution of authorship to the whole or a part of another person's work or a deliberate misrepresentation as to the authorship of a work in the form of an overt or covert appropriation of another person's work in whole or in part. Overt plagiarism takes the form of direct attribution of authorship to another's work or part of it by presenting it as one's own work. Implicit plagiarism, on the other hand, consists in the inclusion of another person's work in whole or in part in one's own work, including in particular through such editorial modification or the use of borrowings that, despite the modifications used, the subject matter and the manner in which the work is written still express a sense of another person's creative work. However, the reviewer should not stop at such findings. Secondly, they should verify whether there has been an infringement of someone else's copyright or related rights otherwise than as specified in copyright law (within the meaning of Art. 287(2)(4) LHES). Such other infringement of someone else's copyright was the subject of analysis in one of the cases for the declaration of invalidity of an administrative decision awarding a doctoral degree, pending before a Polish administrative court. The decision reads as follows:

> a doctoral dissertation, which should evidence the ability to conduct scientific work independently, is a dissertation that should be prepared by a doctoral student taking into account the rules of reliable conduct of scientific research, including the rules on using other people's scientific output and citation. […] a set of these rules is included in the Code of Ethics for Researchers, as well as in the Collection of Principles and Guidelines entitled Good Conduct in Science.[161]

As a consequence, obtaining a doctoral degree on the basis of a body of work created in violation of the law, including copyright or good manners in science regarding the rules of using other people's scientific work and citation, constitutes a binding premise for reopening of the administrative proceedings for

[161] Judgment of the Voivodeship Administrative Court in Warsaw of 12.11.2020, II SA/Wa 1681/20, LEX no. 3152269.

the award of a doctoral degree. In the case under analysis, the key issue was not how the sources were obtained but how they were used. The analysis of the content of the candidate's doctoral dissertation and a monograph by another person led to the conclusion that the doctoral student conducted scientific research non-independently. An expert in copyright law, appointed by the doctorate awarding entity, stated in the conclusions of his written opinion that a comparison of the disputed doctoral dissertation with another person's habilitation monograph did not provide sufficient grounds for assuming that there had been copyright infringement within the meaning of copyright law. However, the expert noticed in the dissertation a phenomenon of inappropriate use of so-called indirect sources, "that is, the use for the purposes of the argument not of the source from which they [particular thoughts] directly derived but of secondary material, that is, the citation of a given source in other works. The rules of ethics do not prohibit the use of indirect sources, nevertheless, good morals dictate that such a situation should be reflected in the way in which such source is cited. Consequently, in the case of so-called indirect use of a source, this fact should be reported in an appropriate note. Failure to reach for the original source, despite citing it is, in the first place, a violation of good practice in scientific research. […] [The expert opinion showed] that K. G., in approximately 20% of the work's volume, used for the preparation of the dissertation […] scientific research carried out by other authors without indicating the sources from which the information used was derived. In particular, this applies to the monograph […] by P. D. […] the above-mentioned unreliability in the conduct of scientific research by K. G. manifests itself in the construction of footnotes, the errors identified, which would not have been reproduced by K. G. if he had accessed direct sources, as well as the fact of formulating in the dissertation the same or substantially similar conclusions as made by P. D. and W. L.[162]" The way in which scientific sources were used led to the conclusion that the doctoral student conducted his research in a non-dependent manner, duplicating of the train of thought of other authors. Such finding affected the overall assessment of the doctoral dissertation and its author. It was concluded that the doctoral dissertation did not represent an original solution

[162] Judgment of the Voivodeship Administrative Court in Warsaw of 12.11.2020, II SA/Wa 1681/20, LEX no. 3152269.

to a scientific problem and did not demonstrate the ability of its author to conduct scientific work independently and, as such, failed to meet the statutory requirements for the award of the doctoral degree.

In the case of submitting for evaluation in the promotion procedure a dissertation constituting a co-authored publication or one series (collection) of published and thematically related multi-authored articles (and possibly multi-authored patents for inventions), the reviewer is forced to apply additional rules of evaluation. When verifying the fulfilment of the prerequisite of independent contribution to knowledge and acquisition of the ability to conduct research independently, the reviewer should refer to the provisions of the Polish Code of Ethics for Researchers, which addresses this issue in detail in Section 3.3.5 Authorship and Publication. Under that rule: "[a] co-authored publication intended as a basis for the application for an academic degree or title should contain a separate, self-authored section or be edited in such a manner as to allow the evaluation of the precisely identified contribution of each co-author to the publication." In case of a dissertation submitted as a part of a collective work, the mere analysis of the editorial treatment of the doctoral student's scientific achievement within the structure of the collective work (the way in which it is separated as an individual section or chapter) should allow to determine infallibly and precisely the subject and scope of their self-authored work.

When assessing a dissertation in the form of a collection of published and thematically related multi-authored articles, the editing of the articles and the adopted method of authorship attribution will be decisive, along with the possible specification of the subject and scope of the creative contributions to specific articles. It should be noted that nowadays, as far as authorship attribution is concerned, many journals require the use of an anti-hierarchical list of authors in which the adopted order reflects actual contributions to a given paper. Furthermore, in addition to the requirement to use a so-called ordered list of authors, many periodicals require precise specification of the contribution of individual authors to the research and to the creation of a given paper. The application of these rules considerably facilitates the assessment of the subject and importance of the doctoral student's contribution to each paper within a monothematic publication series.

This issue was considered by Professor Jerzy M. Brzeziński,[163] who pointed out that in the case of multi-author publications comprising a doctoral dissertation, it is necessary to examine the importance of the doctoral student's contribution to the creation of the individual papers. Namely,

> were they the author of the idea or the author of the theoretical model, or the author of the method and design of the empirical study, or the author of the statistical analysis of the data, or were they the person responsible for the whole article? For it is one thing when the doctoral student co-author merely conducted the research according to someone else's idea and design, and another when the research was their own idea, or an idea co-authored (with their promoter) and, then, that idea was the basis for conducting the research. In the latter case, I have no doubt about the legitimacy of including such an article in the doctoral cycle. In the former case, I also have no doubt that such an article can only serve as additional reinforcement of the main articles that make up the doctoral cycle. Ideally, already at the time of printing the article, usually in the form of a footnote on the first page, there should be information about the substantive (and not just the percentage) contribution of the individual co-authors to the work in question. Otherwise, the reviewer will not be able to assess the scientific value of the doctoral student's actual contribution to the work. Of course, the co-authorship of the promoter of such a multi-authored article is only justified if the other authors (and not only the doctoral student) accept their contribution to the article, customarily defined by the order of authors and the relevant attributions included in the footnotes. The problem disappears when all authors are members of the same research team headed by the promoter. However, if the other co-authors are not doctoral students of promoter X, the promoter only becomes co-responsible for that article and not for the entire doctoral project. In my opinion, if a given multi-author article is to be included in a monothematic set of articles comprising the doctoral thesis of one of the co-authors, the other co-authors should be informed of this intention and should consent to it. Indeed, it is conceivable that the other co-authors also think about the same thing. I would not accept such a situation that one article makes up the dissertation of several doctoral students.

[163] J. M. Brzeziński, "Praca doktorska jako cykl publikacji" [Doctoral Thesis as a Publication Cycle], *Forum Akademickie* 9 (2014): 39 and n.

It should also be noted that the Polish legislator has authorised doctorate awarding entities to determine the methods of demonstrating authorship of a scientific achievement documented by multi-author works. Moreover, certain indications in this matter are provided by established practice. Exercising such legislative delegation and referring to the established practice, drawing on the solutions under the previous statutory framework,[164] in such cases the doctoral student is required to submit co-authorship statements, confirming their contribution to the research and creation of each of the works making up the evaluated series of thematically related publications. In fact, the previously applicable rules provided that: "[w]here a doctoral thesis is an independent and distinct part of a collective work, the candidate shall submit declarations from all of its co-authors specifying the co-authors' individual contributions to it. If the collective work has more than five co-authors, the candidate shall submit a statement indicating their individual contribution to the work, and statements from at least four of the other co-authors. The candidate shall be exempted from the obligation to submit a declaration in the event of the death of a co-author, in the event of the co-author being declared dead, or in the event of the co-author's permanent disability rendering it impossible to obtain the requisite declaration."

It should be added that in many areas of knowledge, in the case of a doctoral dissertation constituting a monothematic series of multi-author publications, the doctoral student is required to produce a so-called guide to this series, in which they demonstrate, in a scientifically mature manner, their independent contribution to knowledge and the ability to formulate research theses, design research and conduct research independently of the promoter.

In summary, appropriate attribution of authorship of multi-authored works making up a series of thematically related articles, the doctoral student's own statement and those of their co-authors about their creative contributions to the research and publication, and the so-called guide to scientific achievement

[164] Act of 14 March 2003 on Academic Degrees and Academic Title and on Degrees and Title in Art, Journal of Laws 2017, item 1789 as amended; Regulation of the Minister of Science and Higher Education of 19 January 2018 on the detailed procedure and conditions for conducting activities in the doctoral procedure, in the habilitation procedure and in the procedure for the award of the title of professor, Journal of Laws 2018, item 261 as amended.

should allow the reviewer to precisely pinpoint the doctoral student's contribution to knowledge and to assess its importance. It is worth recalling at this point that, according to a well-established custom in the world of scientific research (not only in the Polish reality), doctoral students are usually the first authors in those publications that are closely related to their doctorate. If they decide to present their doctoral thesis in the form of a collection of publications with an accompanying commentary, this first position among co-authors is, in principle, required. Unfortunately, this obvious, in our opinion, condition is not always fulfilled.

Based on his experience as a reviewer, Adam Proń is also aware of cases in which a doctoral dissertation was based on four publications, two of which were closely related to the topic of the dissertation, and in these two the doctoral student was the first author. In the other two, only a part of the research described related to the topic of the doctoral dissertation, and the doctoral student was one of many co-authors. Such doctoral defences should definitely be avoided. Moreover, it is important to stress the importance for the doctoral training of the requirement to prepare a dissertation in the traditional form of an academic monograph. Indeed, writing a dissertation forms an important part of the training, and develops the candidate's academic culture. Furthermore, presentation of the research results in the form of a classical dissertation removes the problems associated with the order of co-authors of the works published by the doctoral candidate. While the publication of at least a part of the research results is a prerequisite for the admission to the dissertation defence in case of doctorates in chemistry, the rank of the doctoral student within the group of co-authors of an article does not actually affect the award of the doctoral degree, but is very important when it comes to applying for a *magna cum laude* distinction. It should be postulated that promoters and doctoral students abandon the option of presenting the dissertation as a collection of thematically related publications, even when there is not the slightest doubt that the doctoral student's contribution to all publications relating to the dissertation was the greatest. Indeed, the didactic value of preparing a traditional dissertation in doctoral training cannot be overestimated.

Another important issue is the answer to the question in which area of knowledge the doctoral degree should be awarded when the subject of the scientific achievement presented in the doctoral dissertation is of an interdisciplinary nature. In making this determination, the Polish legislator prescribes the application of the previously cited rules under Article 177(5) and (6) LHES.

The cited regulations describe a situation in which a doctoral dissertation covers scientific issues from more than one scientific discipline, meeting the prerequisites of a scientific achievement of an interdisciplinary nature. According to these provisions, when the subject and scope of such achievement:

(a) reaches beyond the boundaries of a single field of science (it is specific to two or more fields of science), it becomes necessary to designate for the achievement the leading field of science and discipline in which the degree will be awarded, as it is not legally possible to award a doctoral degree in two or more fields of science;
(b) falls within more than one discipline within a given field of science, it being possible to identify the discipline in which the preponderant increment of knowledge has occurred and which is therefore dominant and leading for this scientific achievement, the degree shall be awarded in the discipline and the field of science to which that discipline belongs;
(c) falls within more than one discipline within a given field of science, whereby it is impossible to indicate the leading discipline for the achievement, the degree shall be awarded in a field of science.

3.2.2. Prerequisites for Awarding the Degree of Habilitated Doctor and for Obtaining the Title of Professor in Poland

Under Article 219 of the Law on Higher Education and Science, in Poland, the degree of habilitated doctor is awarded to a person who:

(1) holds a doctoral degree;
(2) has a track record of scientific or artistic achievements that represent a significant contribution to a specific discipline, including at least:
    (a) one academic monograph published by a publishing house which, in the year of publication of the monograph in its final form, was included in the list drawn up in accordance with the rules issued under Article 267(2)(2)(a) LHES, or

(b) one series of thematically related academic articles published in academic journals or in peer-reviewed materials from international conferences, which, in the year of publication of the article in its final form, were included in the list drawn up in accordance with the regulations issued under Article 267(2)(b) LHES, or
(c) one original design, construction, technological or artistic achievement realised;

(3) demonstrates significant scientific or artistic activity pursued at more than one university, scientific institution or cultural institution, particularly abroad.

An achievement of a habilitation candidate may form a part of a collective work if the individual contribution of the habilitation candidate consisted in elaboration of a separate subject matter.

Under Article 227 of the Law on Higher Education and Science, the title of professor in Poland is awarded to a person who:

(1) holds a doctoral degree and:
(a) has outstanding national or international academic achievements,
(b) participated in the work of research teams carrying out projects financed through national or foreign competitions, or completed scientific internships in scientific institutions, including foreign ones, or conducted scientific research or development work at universities or scientific institutions, including foreign ones.

In exceptional cases, justified by the highest quality of scientific or artistic achievements, the title of professor may be awarded to a person holding a doctoral degree. The provisions of paragraph 1 shall apply *mutatis mutandis*.

An achievement of a candidate for the title may be a realised original design, construction, technological or artistic achievement.

Those aspiring in Poland to obtain the degree of habilitated doctor or the academic title, and, thus, the status of an independent researcher authorised to guide the scientific work of doctoral students and to act as promoter of doctoral dissertations, are required by law to have, first and foremost, qualified scientific achievements. When applying for the award of a habilitated doctor degree, these achievements should be distinguished not only by their originality but also by their significant contribution to the development of a specific discipline. On the other hand, a person may apply for the title of professor if they have outstanding scientific achievements of national or international scope, representing an outstanding contribution to the development of a field of science or a field of science and a discipline or disciplines, respectively. The aforementioned prerequisites are the most important in assessing whether an applicant meets the requirements for the award of the degree/title.

A person aspiring to the habilitated doctor degree may demonstrate a significant contribution to a specific discipline by invoking the authorship of:

(1) academic monograph,
(2) an editorially separated part of a collective work, which constitutes the author's elaboration of a scientific issue specifically addressed in the separated part,
(3) one series of thematically related academic articles published in academic journals or in peer-reviewed materials from international conferences,
(4) one realised original design, construction, technological or artistic achievement.

In the case of an application for a professorship, the legislator has not defined what form academic writing should take so as to document the outstanding nature of research results and scientific findings, as a basis for the award of a professorship. This issue is resolved by the well-established custom of taking into account the same forms of documentation of scientific achievements as presented at earlier stages of the academic career. In support of the aspirations to the title, scientific writing may therefore take the form of a monograph, a part of a collective work or one series of published and thematically related scientific articles. At the same time, the legislator decided that an outstanding scientific achievement may also be realised in the form of an original design, construction, technological or artistic achievement.

Looking for guidelines on how to qualify the requirements for those applying for scientific promotion, it should be recalled at the outset that the assessed output must follow the requirements provided for a doctoral thesis. Thus, the output should confirm the general theoretical knowledge in a discipline or field of science related to the achievement, the ability to conduct scientific research independently, and present an original solution to a scientific problem. The scientific achievement submitted for evaluation in the promotion procedure, should constitute a qualitatively new achievement, particularly, not having been subject to evaluation in previous procedures for the award of the degree of doctor or habilitated doctor respectively.[165]

As far as their evaluation is concerned, scientific achievements under consideration should have the characteristics of significant contribution to the development of a specific discipline or outstanding contribution to the state of knowledge in a scientific field or field and discipline or disciplines, respectively. Undoubtedly, both of these prerequisites are vague. As such, they require the scientific community in the given discipline or field of science to establish certain guidelines or customs when assessing the achievements of an applicant for promotion. The basic requirements that the scientific community must set for a peer-reviewed scientific achievement should give a positive answer to two essential questions: (1) whether the achievement in question has positively influenced the state of scientific knowledge, resulting in its augmentation, development and (2) whether the subject, scope and nature of the achievement in question are significant (non-trivial) for the development of the state of knowledge and at the same time of greater importance than expected at earlier stages of the scientific career. Thus, these should be such scientific achievements in relation to which there is no doubt that they concern themes (topics) hitherto not taken up in science at all or not exploited to such an extent as in the assessed achievement. Therefore, they must absolutely fulfil the premise of scientific novelty, as only then can a contribution to the state of scientific knowledge be ascertained.[166] At the same time, they should be achievements whose importance and significance for the development of science in a given area of knowledge is significantly greater than at lower stages of the scientific career. These achievements may, in particular, lead to a significant development in the area of science by presenting for evaluation a scientific discovery or a new theory or a new or significantly modified scientific method. An achievement for a professorship should meet the linguistic definition of eminence (outstandingness). Outstanding means

165 Cf. H. Izdebski, "Komentarz do art. 219," in *Prawo o szkolnictwie wyższym i nauce. Komentarz* [Law on Higher Education and Science. Commentary], ed. J. M. Zieliński and H. Izdebski, Edition II, LEX/el. 2021.

166 Cf. K. Ślebzak, Komentarz do wybranych przepisów ustawy—Prawo o szkolnictwie wyższym i nauce [Commentary on Selected Provisions of the Law on Higher Education and Science], in *Akademickie prawo zatrudnienia. Komentarz* [Academic Employment Law. Commentary], ed. K. W. Baran (Warszawa: Wolters Kluwer Polska, 2020), Art. 219, 392–400.

"standing out above the average, rising above the surroundings, unusual, uncommon, exceptional," as well as "significant in size, intensity."[167] Subsidiarily, the level of a scientist's influence on the state of knowledge can also be assessed by their position in the scientific community. The circumstance of widespread respect and recognition of the scientist's scientific achievements in their environment, expressed by numerous presentations at prestigious scientific conferences and congresses, should not escape the eye of a skilful reviewer. Of course, assessing the importance and significance of an achievement is an extremely difficult task. Some guidelines in this matter were proposed by Józef Pieter,[168] which he developed in his own practice as a reviewer in promotion proceedings. Describing these principles, Pieter formulated a kind of *savoir-vivre* of a reviewer in the form of a set of good practices. Namely, he explained that although, as a reviewer of doctoral and habilitation theses, he did not follow a uniform pattern of conduct, in certain respects he acted consistently. Namely:

1. I have always tried to situate the problem of a given work against a broader background, usually of isolated parts of a given scientific specialty. For example, in a review of a habilitation thesis […] on the Raven's Precision Test—in the context of a general, introductory characterisation of the current scientific situation with regard to tests designed mainly to find out the level and quality of someone's individual general intelligence.
2. I have also tried to find out for myself, to indirectly answer, before the Council, the question of what the author of the paper has achieved that has contributed to scientific progress—for example, by posing a new problem, constructing a new working method, advancing an interesting hypothesis, stating previously unknown facts, or a combination of all of these.
3. If necessary, I noted errors of reasoning, information or shortcomings in this regard, however, I never accentuated such shortcomings, especially if they were not significant against the background of the overall work and the "new steps forward."

[167] https://sjp.pwn.pl/.

[168] J. Pieter, *Autorskie kłopoty. Maszynopis 1974 r.* [Author's Troubles. Typescript 1974] (Warszawa: Wydawnictwo Naukowe PWN, 2019), 144–150.

4. Accordingly, I did not summarise the peer-reviewed work, as is not infrequently practised, nor did I confine myself to drawing up a list of faults; which is also the case. I have always considered, and still consider, reviews of this kind to be worthless from the point of view of scientific progress, and indirectly socially harmful. I regard them as such in every case, whether the author, as a result of a "critical analysis," concludes that, "despite everything, the work should be assessed positively" or if they decide that "therefore, unfortunately, the work does not meet the requirements" for a dissertation or a doctoral thesis.
5. Finally, I have been afraid, like the proverbial fire, of being accused of any subjectivity in my assessment and have avoided statements or formulations that could be explained as being dictated by non-factual motives.[169]

Pieter also pointed out that:

> A more or less negative-critical stance in my reviews (of doctoral theses, habilitation theses and applications for promotion to the title of professor) was expressed—if I had grounds to do so—in two ways: 1. the relative brevity of the reviews, and 2. the lack or scarcity of statements as to the scientific value of the work or output in question. Ultimately, it is difficult to praise what is not there. And I find it immoral to "inflate" real values beyond measure. In line with this attitude, I even disapproved of such reviewers who "made a mountain out of a molehill," whether in a positive or negative sense. For example, the reviewer of a certain habilitation thesis, which was a modest compilation, but nevertheless judged by him to be an "outstanding scientific work." (How can one have a shred of respect for such a reviewer!)
>
> In a few cases, I did not take on the role of a reviewer when I considered, after reading the work or familiarising myself with someone's scientific output, that I would not have the grounds to write a positive opinion "in good conscience." In a few others, I have assessed the work in question negatively. However, in all cases of this kind, I have tried to highlight the qualities or achievements deserving recognition. And in no case have I allowed myself to use emotional or coarse phrases, such as "work of no value." […] It is understood that it is satisfying to give a positive opinion on scientific works (doctoral theses, habilitation theses—

[169] Pieter, *Autorskie kłopoty. Maszynopis 1974 r.* [Author's Troubles. Typescript 1974], 146–147.

> also master's theses) or promotion applications when there are no grounds for reservations, and even more so when there are grounds for emphasising the "pros," for example, in the form of excellent "logic" or methodology, clarity of style, transparency and communicativeness of the work, or scientific achievements, especially real achievements in the ascertainment of facts previously unknown, confirmation or denial of working hypotheses, etc.[170]

As far as the requirements for the form of presenting the scientific output are concerned, reference to authorship of an editorially separate and independently developed part of a collective work or monograph should not give rise to doubts among reviewers. The situation is different in the case of a series of thematically related academic articles. Documenting a scientific achievement in such form may cause doubts and discrepancies in the assessments of reviewers. The literature[171] formulates guidelines as to what requirements it should meet. It has been clarified that the cycle should:

(1) correspond, in scientific value and effort required for its preparation, to the scientific value and effort expected of a scientific monograph in a given scientific promotion;
(2) be the result of a planned scientific endeavour, the scientific results of which the authors decided, in advance, to announce in the form of creating and publishing a series of papers, presenting a solution to an original scientific question.

Consequently, the series of articles under consideration cannot be a haphazard collection of publications which have been *post facto* or, even worse, loosely combined into a series taking into consideration their topic and subject matter.

Krzysztof Ślebzak, on the other hand, under the previously applicable legislation, in reference to the then newly introduced concept of a monothematic publication cycle, imposed the following requirements on such cycle:

(1) it should correspond—in terms of scientific value—to a habilitation dissertation as hitherto understood,

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170 Pieter, *Autorskie kłopoty. Maszynopis 1974 r.* [Author's Troubles. Typescript 1974], 147–148.

171 D. P. Kała, "Szczegółowe przesłanki nadania stopnia doktora habilitowanego" [Detailed Prerequisites for the Award of the Habilitated Doctor Degree], *Ruch Prawniczy, Ekonomiczny i Społeczny* no. 3 (2022): 37–52, https://doi.org/10.14746/rpeis.2022.84.3.03.

(2) confirmation of the existence of a series is possible when the individual publications, taken together as a whole and therefore "compiled," as it were, can be published as a collection of publications, forming a monographic work, and this without the need for major reworking, modification or substantial amendment to the text; this means that proving the existence of a series in a habilitation procedure cannot be reduced to a conceptual exercise on the part of the reviewer, the effect of which will be to bring together a number of publications in such a way that, subject to certain conditions, they can only be recognised as a series on the additional condition that the publications are modified in terms of content,
(3) The existence of a cycle presupposes, in principle, its conscious creation,
(4) As with a doctoral thesis or habilitation dissertation, a monothematic publication series would be expected to be up-to-date and to take into account the state of knowledge at the date of the commencement of the promotion procedure,
(5) the assessment of the existence of a significant contribution should be considered taking into account the date of submission of the application and not the period of creation of the leading part or also the whole of the publications included in the monothematic series.[172]

Furthermore, the following thesis has been formulated in literature:

> Due to the periodic, staggered creation of a cycle, the scientific articles presented in the cycle do not have to represent the state of the art as at the date of the application for the award of habilitation. The cycle should include articles devoted to a selected topic (which constitutes a common leitmotif, denominator for the entire cycle) and, as a whole, make a significant contribution to the development of a particular discipline.[173]

[172] K. Ślebzak, "Jednotematyczny cykl publikacji jako przesłanka nadawania stopnia doktora habilitowanego nauk prawnych" [Monothematic Publication Series as a Prerequisite for Awarding the Degree of Habilitated Doctor of Legal Science], *Państwo i Prawo*, 7 no. 68 (2013): 36.

[173] D. P. Kała, "Szczegółowe przesłanki nadania stopnia doktora habilitowanego" [Detailed Prerequisites for the Award of the Habilitated Doctor Degree].

Of course, it is impossible to agree with such a thesis. Obsolescence of scientific findings made in a work planned to be included in the cycle should imply an update (appropriate correction) of the research process implemented so as to develop a scientific dissertation covering the current state of knowledge.

Relating these indications from the literature to the requirements for a series of thematically related published articles in the promotion procedure, it should be noted that they are not fully adequate to scientific achievements in the area of hard sciences or natural sciences. Research activities carried out in this area of knowledge are very often of a collaborative and interdisciplinary or even transdisciplinary nature. As a consequence, the publication cycle comprises a set of multi-author papers in which the published research results may interact with and influence more than one scientific discipline. As a result, it is not possible to fulfil the expectation formulated in the literature that the publications forming the cycle "taken together as a whole and therefore 'compiled,' as it were, can be published as a collection of publications, forming a monographic work, and this without the need for major reworking, modification or substantial amendment to the text."[174] At the same time, one must agree that their creation should be a conscious act and should correspond to the amount of work and scientific value traditionally attributed to a scientific work presented in the traditional form of an academic monograph.

How, then, should a series of thematically related publications be properly constructed, given that it is a collection of multi-author and multi-disciplinary articles? The answer to this question is provided by established practice, which has adopted certain solutions. The collection of articles that form such a cycle, confirming the existence of an authorial (in the sense of independent), original (in the sense of qualitatively new) and significant (in the sense of appropriately significant or outstanding) contribution to the state of knowledge of the person applying for scientific promotion, should meet the following requirements:

(1) be the result of conscious action of the researcher, that is, the implementation of a planned scientific endeavour seeking answers to consciously posed scientific questions;

[174] Kała, "Szczegółowe przesłanki nadania stopnia doktora habilitowanego" [Detailed Prerequisites for the Award of the Habilitated Doctor Degree], 45.

this does not mean research carried out on the basis of a closed, non-modifiable research plan; the established research plan, with a view to solving the scientific problem, may be continuously verified and adjusted in accordance with the research results obtained;

(2) be enclosed with a so-called guide in which the applicant for scientific promotion demonstrates the authorship of the scientific achievement documented by this body of work; this implies that the applicant for scientific promotion must undertake and carry out conceptual work in which, by extracting from the multi-authored and often interdisciplinary works their own creative contributions to the research results announced, the applicant combines such contributions into such series and demonstrates that the cycle indeed exists;

In turn, the conceptual work combining a collection of works into a series should also fulfil certain conditions. If these requirements are fulfilled, the development of a series corresponds fully to the workload and scientific value (in the sense of a precise explanation of the subject and scope of the research and the scientific findings made as a result of the implemented research process) expected of the preparation of a scientific monograph. The conceptual work, expressed in the so-called scientific achievement guide, should result in:

(1) defining in its content the subject and scope of the achievement by naming it, that is, formulating the title (topic) of the scientific achievement,
(2) including in its content a description of the state of knowledge that existed before the research was undertaken, together with a convincing justification demonstrating the rationale for undertaking the research on the scientific problem or research question concerned, that is, it is required to show that such a scientific problem existed and needed to be explained or researched,
(3) demonstrating, in the guide, how the results of the research published in a cycle of related works contributed to the solution of the research problem formulated at the outset; such contribution can be either positive or negative, that is, it can either positively verify the scientific theses and hypotheses formulated at the outset or negatively verify them, as it can happen that a methodologically well designed scientific experiment fails; a paper announcing

such a scientific finding adds value to the state of knowledge, albeit in a negative aspect,
(4) confirming the authorship of the scientific achievement by the person applying for promotion, that is, that the solution to the original scientific problem is the result of that person's independent (intellectually independent) efforts from the moment of conceiving the scientific thesis, through designing the research work, carrying out the research in a team, to analysing the research results and making the scientific findings.

Demonstration of authorship of a scientific achievement may be achieved and confirmed by proper attribution, in accordance with the customary practice in a given area of knowledge, of the authorship of the individual articles forming a series of thematically related works, in particular in an ordered list of authors, the order of which is based on the importance of their contribution to the research. As an alternative, the applicant for promotion may submit their personal and the selected co-authors' declarations indicating their substantive contribution to each paper, allowing an assessment of their role and contribution to the paper's creation, including the initiation and conduct of the research leading to the published results.

In answering the question how the attribution of authorship of an article to be included in a series of thematically related papers should proceed, according to what order, in the case of habilitation, two following cases should be distinguished:
(1) Doctors conducting research as part of a larger research group usually led by a professor;
(2) Doctors working independently or as part of a small research group they have formed themselves.

Re (1) Doctors who are members of a large research group should be very prudent in the selection of publications presented as a habilitation achievement. In those papers where a co-author is the professor leading the group, habilitation candidates should be first and "star" authors. Publications in which the habilitation candidate is the last and "star" author and where there are no habilitated doctors or professors among the co-authors are also viewed very positively by habilitation committees. It should also be borne in mind that direct collaboration between a habilitation candidate and a doctoral candidate may lead to a conflict of interest, since the inclusion of an article as part of the collection of "doctoral" publications excludes its attribution to the collection of publications describing the habilitation achievement, and *vice versa*. Collaboration between a habilitation candidate and a doctoral candidate should therefore be thoroughly considered in the context of minimising conflicts of interest.

Re (2) Habilitation candidates working independently or leading a small research group of MSc, or possibly PhD, students are in a much better situation. In such cases, obtaining the first and/or "star" author status is relatively straightforward.

Candidates for the title of professor, on the other hand, should have an established scientific identity, that is, be perceived by the community as outstanding specialists in a certain, generally very narrow, area of science forming part of a particular scientific field or discipline. They must therefore show a significant number of publications in this field in which they are "star" authors, that is, coordinating the research. This requirement is often difficult for habilitated doctors working in departments headed by authoritarian bosses, who are often co-authors of all papers published by their subordinates. In his reviewing experience, Adam Proń had a case of reviewing an application for a professorship presented by an almost 50-year-old scientist, author of approximately seventy papers. Only in a few of them, published in recent years, the name of the head of his department did not appear. This pathology results in the scientific achievements of the candidate for the professorial title being perceived by the community not as independent, but as inspired and assisted by the superior.

To conclude these reflections, it is worth asking the question what should a full academic career path lead to, starting from the status of a researcher (adept of science—doctoral student and doctor), through the status of an independent academic employee (habilitated doctor empowered to guide the scientific work of doctoral students) and culminating in the title of professor? Obviously to the ideal of a scholar and teacher. What are the requirements for such a person? An accurate answer was probably given by Jan Szczepański, who wrote as follows:

> The ideal university lecturer… would be a person who, on the one hand, has mastered a subject as an independent thinker and researcher, and, on the other hand, as a teacher who knows how to instil in their students the spirit of scientific research and attract the most gifted among them to participate in scientific work. In order to fulfil these conditions, erudition, that is, a wealth of scientific knowledge, and an excellent mastery of scientific methods, as

well as the ability to see things from the right perspective and to contribute one's own ideas to scientific work, are necessary. Only they will be excellent university lecturers who possess both these qualities to a high degree. However, one more thing must be assumed. According to Cato's well-known expression—*orator est vir bonus dicendi peritus*[175]—a university professor should be a person of high morals, capable of instilling in the souls of their students high aspirations, above all the aspiration to understand the essence of things, proud independence of thought, noble modesty manifested in the absence of arrogance and vanity.[176]

4. Author of Research Outcome versus Scientific Authorship[177]

4.1. Research Group Leader versus Reliable Attribution of Authorship of a Scientific Paper versus Scientific Authorship

Research in the field of hard and natural science is rarely carried out alone. Research projects carried out in these areas of knowledge often require teamwork, including also interdisciplinary collaborations. Multi-person research teams are formed by researchers representing various scientific specialities and centres, including those from abroad. Research results obtained in collaboration are published in multi-author scientific papers or patent applications for inventions. Authorship in science is a particularly thorny issue. The framework of scientific authorship differs from the logic of authorship applicable in intellectual property law. They are regulated by ethical codes for researchers, which are only supplemented by copyright rules. In practice, the

[175] The orator is a good man skilled in speaking.

[176] J. Szczepański, *Socjologiczne zagadnienia wyższego wykształcenia* [Sociological Issues of Higher Education] (Warszawa: Wydawnictwo Naukowe PWN, 1963), 230 et seq., quoted after: J. Szczepański, *Problemy i perspektywy szkolnictwa wyższego w Polsce* [Problems and Prospects for Higher Education in Poland], (Warszawa: Państwowe Wydawnictwo "Wiedza Powszechna," 1969), 89.

[177] This part of the study was prepared through substantive consultation and on the basis of discussions with Prof. Eugene B. Postnikov (Department of Theoretical Physics, Kursk State University, Radishcheva st., 33, Kursk, 305000, Russia).

right to be a scientific author is based on the link between intellectual contribution to a scientific project and the obligation to credit and reward it with authorship of research work. At the same time, the definitions of scientific authorship have not been codified in one official set; what more, they change according to scientific discipline or institution. This naturally raises several problems related, firstly, to the attribution of authorship of scientific works or patents and, secondly, to the accumulation of the body of work necessary to demonstrate authorship of scientific achievement by individual members of research teams when applying for the award of a degree or title.

A significant role in solving such problems is played by the leader (i.e., a person playing the role of a project's manager) of the research team or the multi-member management (leadership) of a specific interdisciplinary research project. It is the project leader or leadership who is responsible for the correctness of the research concept (scientific hypothesis) and proposed theoretical or experimental methods for its verification—confirmation or refutation, the reliability of the conducted research procedure and the substantive value of the elaboration of the obtained research results together with their analysis and indication of the noticed regularities in the form of a manuscript of a scientific publication or application for a patent for an invention.

The project leader or its collegial leadership—with reference to the frameworks of scientific authorship in force in the scientific world—should, when publishing the jointly obtained research results, ensure that the list of authors of the paper or invention includes every author of a significant and creative contribution to the research. Co-authorship should be based on the author's actual contribution to the research's design and/or conduct, on the co-authorship of the study of research results, or on its critical analysis and correction. A common-sense rule of thumb can be adopted in this regard that the list of authors of a scientific paper should include those without whom the publication or invention could not have been produced, as well as those whose contribution to the research translated into getting scientific results and findings.

Scientific authorship is based on honour and a responsibility for the integrity of the research work and the scientific value of the published research results. It often occurs that scientific papers contain errors, the detection of which threatens the author with a loss of prestige and esteem in the scientific community. Therefore, in this environment, the custom has become entrenched in agreeing to co-author a scientific paper only if a scientist's participation in the project has been essentially creative; it means it did not consist solely in suggesting a given issue or directing its solution "from afar." Scientists who respect the ethical principles that bind them when granting permission for their name to be listed as an author of a scientific paper consider it necessary at least to study the manuscript of the article carefully, trace the argumentation, check validity of the data used for their processing and interpretation, either provided by a team's experimentalists or taken from scientific literature, and thoroughly verify the scientific findings. A sound analysis of a scientific work's message, the correctness of the research results obtained and the conclusions drawn from the research should lead either to an unequivocal acceptance of the results of the work or their negation due to the errors detected or to a critical revision of both the scientific concept itself and the research methodology applied with the effect of even significant corrections of the scientific findings made. The latter task belongs to the interdisciplinary research team's leader(s).

The order of names in the list of authors of a paper should follow the custom of the scientific discipline or area of knowledge. It should be accepted by all co-authors, preferably at an early stage in preparing the paper or patent application. In practice, alphabetical, hierarchical or anti-hierarchical author lists are used. An alphabetical list is based on the alphabetical order of the group members' names. The hierarchical list reflects each author's position in the research group's hierarchy. An anti-hierarchical list, also known as an ordered list, is established according to the importance and significance of each team member's contribution to the research; the closer the position on the author list is to the first position, the more significant the author's contribution to the research has been. An ordered list of authors exposes the importance of the contribution to the research not only by the first author but also by the last author and by the one or ones who have been assigned the position of the so-called corresponding (star) author. In some areas of knowledge and some countries (e.g., physical chemistry or Russia, Israel, Spain), such a designation in the list of authors of a scientific publication provides an unambiguous indication to the scientific world that the first author, the last author and the corresponding author have played a leading role in the research process. This usually means that the contribution of the first author's work to the research process was the greatest (in the sense of most time-consuming). In contrast, the last and corresponding authors played a significant role in the establishment of the scientific hypotheses, as well as in the analysis of the obtained research results discussed in this paper. Such positions on the article's list of authors help confirm their individual and significant contributions to developing a particular discipline.

So obtaining such a prominent position in the list of authors is not without significance in Poland when applying for a scientific degree or title by the procedure based on scientific achievements consisting of a collection of published and thematically related scientific articles. It is essential, especially in the case of applying in Poland for a degree of habilitated doctor that gives the scientist the status of an independent researcher authorised to supervise doctoral theses. It is expected that such persons should have the function of a research team leader, directing team research work related to the realisation of their original scientific concept. Fulfilment of this condition may be based on formal legal grounds when the researcher obtains a research grant to implement a specific scientific project. Usually, research financed from external sources (e.g., receiving an NCN (National Science Centre) or FNP grant (Foundation for Polish Science)) obliges the grantee to form a scientific research team to carry out the project, which gets support. This premise can also be proven by the publication of multi-authored works involving a team composed of junior staff, doctoral students and students and representatives of other scientific domains, whose contribution to the research project served in solving the scientific question posed by the researcher who is planning to apply for the habilitated doctor degree.

Similar requirements are imposed on applicants for a titular professorship, with the proviso that their scientific achievements should not be merely significant from the perspective of existing scientific knowledge in a given research area. It is required that their contribution to the state of knowledge should comprise outstanding scientific achievements at home or abroad, and the applicants' independence in research should be unquestionable. It is worth considering the critical issue when accumulating scientific achievements necessary to apply for the title. The inclusion in the list of co-authors of papers of a person who has an established reputation (authority) in the scientific community and who, at the same time, is the supervisor (team leader) of the person applying for the title is not well regarded. It has the effect of attributing to that person the central and causal role in the creation of the work and the responsibility for its correctness regardless of what position they occupy in the list of authors of the publication. Consequently, it would be challenging to accept in the process of title application if the list of co-authors of a series of thematically related scientific articles, which should show individual and outstanding contributions to the knowledge of the applicant, contained a person of much higher scientific status who additionally is a supervisor in the research group.

Thus, the most crucial element in the application for a scientific degree or a scientific title is that the applicant must demonstrate the authorship of independent and creative scientific achievement. That achievement is a contribution to the state of knowledge, which should be significant in the case of a habilitation and outstanding in the case of a professorship. When such achievement is documented by a series of thematically related multi-authored articles, the demonstration of the authorship requires the applicant to know the customs developed in this respect. In the so-called guide to multi-authored works describing this achievement, the researcher should assess the scientific concept set at the beginning of the research project and the correctness of its implementation in individual works. Analysing the scientific findings in the particular papers forming the series, the researcher should define the aim of the research (to formulate a scientific hypothesis) and then prove that the individual papers serve to verify the scientific assumptions made at the outset correctly. Subsequently, they should adequately argue the correctness of the scientific findings and demonstrate their independent and significant contribution to the state of the art in the given area of science. A researcher applying for a degree or title can demonstrate the independence and significance of the research contribution by an appropriate position in a list of multi-authored papers. The modern predominant interdisciplinarity (and even transdisciplinarity) of scientific projects determines that a person accumulating scientific output for a degree or title often does not have the opportunity to obtain a prominent position in the list of multi-authored papers. This does not mean that such a person will be denied the chance to apply for scientific promotion. The burden of demonstrating authorship of a scientific achievement documented by a series of multi-authored papers will concentrate on the appropriate development of the so-called scientific achievement guide.

Thus the group leader, when directing research carried out by a team, should take care not only of the integrity of the projects and the proper attribution of authorship of the papers when publishing the joint research results. But also, the leader should take care of the intellectual development of the team members and support them in pursuing the status of scientific sovereignty when conducting research. This scientific sovereignty should be manifested in the ability to undertake scientific research independent of the previous leader, in the autonomous establishment of research concepts and hypotheses, and in the freedom to use the scientific method applicable in the given area of knowledge. The attainment of research independence by an applicant for the title should be demonstrated in particular by the ability to guide the scientific development of successive generations of young scholars, that is, by directing the research work of doctoral students.

4.2. The Phenomenon of Mentoring in Science

There is the phenomenon of mentoring in science, observable, especially in the hard and natural sciences. Mentoring should not be equated with the formal, legal, or administrative function of the head of a department or establishment or the manager/leader of a formally established research group in a scientific institution. The formal administrative head acts as an intermediary between the university authorities and administratively subordinate employees, represents their interests, and supervises and coordinates their further individual scientific development and that of the entire department or chair or research group. It is worth noting that managers are appointed based on the rules applicable to the academic unit (e.g., on the criterion of seniority, possession of a degree or title). This is not necessarily conducive to identifying natural leaders who enjoy the qualities required of a mentor in science. Nonetheless, when a managerial position is held by a person of recognised and unquestionable scientific authority, who is held in high esteem in the scientific community and possesses the qualities appropriate for mentoring, they can successfully mentor administratively subordinate staff.

Younger scientists, especially PhD students, young doctors, and habilitated doctors supervising the research work of their first doctoral student, despite their relatively high involvement in the development of the scientific idea and research work, frequently need the support of a more experienced scientist. Often, the involvement of such a scientist and their supervision of the research guarantee the scientific level of the projects carried out and the articles published. It is also an integral part of young scientists' shaping process, which is conducted by teaching them the research methodology and preparing them for further scientific work. Objectively speaking, the task of experienced researchers and group leaders is to support the realisation of valuable research, which is not necessarily solely leading by themselves. Their role is to create a friendly climate for conducting research, discussion and to foster cooperation. The leader shows the team members correct patterns of behaviour, and attitudes in line with ethical standards, moderates the scientific debate in the team and points out possible directions of progress to younger colleagues. Because of their experience, the leader should be responsive in matters of disagreement. Tasks defined in this way require that the leader has certain qualities. Qualities such as knowledge and experience come to the fore, but also the ability to pass on knowledge and competence to others should be present. A mentor should therefore have extensive scientific knowledge and be highly skilled and competent in the scientific method. A mentor must be able to teach and even nurture young researchers. After all, imparting dry, encyclopaedic knowledge is no different, or not much, from reading from a book. Only the relevant experience, gained in solving scientific problems allows the Mentor to impart knowledge in the context of its practical application. Significantly, purely theoretical knowledge of the method of how to carry out some measurement/chemical reaction may not be sufficient to do so efficiently. In practice, it may not be enough, for example, when in the article, the author of the scientific procedure's description has omitted specific obvious steps, using so-called mental shortcuts. The lack of required experience may also result in too long a time taken to prepare and perform a pre-designed experiment. As a result, the results obtained (e.g., a chemical reaction) may turn out to be unrepresentative, deviating from the desired result. At the same time, excellent knowledge, competence, and experience, unsupported by the ability to transfer knowledge, preclude the possibility of acting as a mentor. Similarly, the ability to communicate easily with the scientific community, including sharing knowledge unsupported by extensive knowledge, competence, and experience, also excludes the possibility of acting as a mentor. This is because a teacher with the qualifications under consideration will not have the ability to shape the way of thinking and create desirable attitudes and competencies in young science students and thus will not be able to play the role of an actual leader of a research team.

Thus, a leader-mentor is a person with relevant knowledge and experience and specific personality traits. A mentor is a broad-minded person, open and ready for discussion, including critical discussion, with the ability to lead a team skilfully. In practice, enforcing or ordering effective cooperation between team members is impossible. It should emerge naturally, depending on the research needs and the topic currently being pursued, and be supported in a skilful and sometimes even discreet manner by the team leader and senior staff. The group leader-mentor should have a well-defined vision of the scientific development of the group and the role of individual group members in its work. Let us suppose that the scope of the group's scientific research activities is more generally defined. In this case, the group leader can allow individual group members more freedom in their scientific work. In this situation, in addition to carrying out the basic activities imposed by the group's research profile, they can undertake activities closer to their individual interests. As a result, each member will see their own further scientific progress within the group rather than outside it. They will not see their membership in the group as an obstacle to further development, but, on the contrary, as a prerequisite for their consistent and often spectacular scientific development, including the possibility of accessing prestigious research internships or research grants. The team leader's ability to formulate and articulate a vision for joint research projects while empowering individual group members, rather than objectifying them as mere uncreative doers, is the hallmark of a good mentor. By allowing or encouraging them to undertake their research projects, they should gradually shape the scientific independence of individual group members and thus prepare them to step forward as leaders of their research groups in the future. Properly developing a research group, both scientifically and in terms of interpersonal relations, requires that its leader shows significant commitment and contribution to its work, often even more than that of other colleagues. In this way, mentor can become a role model, an example to follow. Otherwise, co-workers may feel exploited by the leader.

4.3. Case Studies in Hard and Natural Sciences

> A quotation from John William Strutt, Lord Rayleigh (Nobel Prize in Physics, 1904):
> By a fiction as remarkable as any to be found in law, what has once been published, even though it be in the Russian language, is usually spoken of as "known," and it is often forgotten that the rediscovery in the library may be a more difficult and uncertain process than the first discovery in the laboratory. In this matter we are greatly dependent upon annual reports and abstracts.
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> Lord Rayleigh, "The Progress of Physics" (Presidential address before the meeting of the British Association for the Advancement of Science, Montreal, 1884). *The Scientific Monthly* 45 (1937): 385–401. The full text is available via https://www.jstor.org/stable/pdf/16370.pdf

The scientific work of researchers working in the domain of hard sciences and natural sciences, who use research methods and techniques of both theoretical and experimental nature in their scientific activity, begins with establishing a research concept/hypothesis. This activity involves deciding on an object of research and a particular direction or area to pursue an investigation. This is usually the idea of a specific person or, especially in the case of interdisciplinary research, a group of people. Conducting the research project requires the construction of a concept and assumptions for the project, together with selecting research methods suitable for solving the scientific problem posed. In the course of the creative process, the scientific idea contained in that concept undergoes further natural evolution. Such a process involves the originator(s) and an appropriately selected group of collaborators. The critical opinions of the latter, supported by their specialist knowledge, competencies and research experience, often influence how the research is carried out, the research methods and techniques used, and further transformations of the stated initial scientific idea.

The overriding aim of implemented research process becomes the collection of reliable scientific data (e.g., physicochemical) relevant to the research thesis/hypothesis so that its objective and substantively correct verification is possible (e.g., due to the application of appropriate statistical or chemometric methods). Then the task is their detailed and in-depth analysis to solve the research problem posed at the beginning of the scientific process.

The subject and scope of the project determine the composition of the research group, which people often form from different research centres. As a rule, the future team leader formulates the research problem and invites appropriate scientists to cooperate, thus creating a team/research group. By definition, this should be a scientific problem, the realisation of which requires implementing a long-term process, going beyond the cooperation established to produce one or two scientific publications. Such scientific collaborations may prove to be sustainable and scientifically beneficial for all research group members. The research contribution conferring on its author the right to become a co-author of a scientific publication can take various forms. The case studies would help determine what kind of contribution to research should be rewarded with scientific authorship.

4.3.1. Casus Organic/Inorganic Chemistry—Synthetic Chemist

Synthetic chemists' contributions[178] can be of various kinds. The object of their research work may be the construction of an idea (concept) for the preparation procedure of a new chemical compound not existing in nature with specific (designed) properties, or elaboration a synthetic pathway enabling the reproduction of a chemical compound exiting in nature [hereinafter collectively: object]. These theoretical assumptions need to be verified in laboratory work, which boils down to a time-consuming and complicated procedure for synthesising the expected compound, the success of which is uncertain because it is the result of research work rather than routine and repetitive tasks of which character is purely technical. Once the results of the said research have been obtained, the synthetic chemist can publish them in an independent scientific publication.[179]

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[178] This part of the study was prepared through substantive consultations and on the basis of discussions with such scientists as: Assoc. Prof. Dr Łukasz John (Faculty of Chemistry, University of Wrocław, Poland), Assoc. Prof. Dr Joanna Feder-Kubis (Chemistry Faculty of Wrocław University of Technology), Prof. Dr Kamil Kamiński, Prof. Dr Ewa Schab-Balcerzak (Faculty of Science and Technology of the University of Silesia in Katowice) and Dr Yaroslav Grosu (Institute CIC Energigune, Spain).

[179] J. Feder-Kubis, "Synthesis and Spectroscopic Properties of Symmetrical Ionic Liquids Based on (−)-Menthol," *Journal of Molecular Liquids* 226 (2017): 63–70, https://doi.org/10.1016/j.molliq.2016.08.112.

> In scientific papers focused on the description and analysis of new compounds, there is no need, and little point, for the scientist who made the discovery to demonstrate additional properties or potential applications of the compounds in question with the help of other research groups. In experimental papers, chemists describe in detail all their work aimed at the elaboration of the synthetic procedure leading to the planned new compounds. The vast majority of the manuscript is then devoted to the description of the synthesis methodology, structural analysis of the compounds obtained and determination of their physico-chemical properties. The chemist lists all the details related to the elaborated method of compound preparation and other methodological details. The paper is frequently completed by the description of the reaction mechanisms.[180]

It should be noted, however, that publishing a single-author paper is not simple. Editors of really prestigious journals publishing original synthesis papers expect the new compound to have some unique, preferably unexpected and attractive properties for other scientific fields. The number of synthesised or discovered, well-defined chemical compounds runs into the many millions, and only a tiny fraction of these find any interest from scientists who are not chemists. If a synthesised chemical compound shows interesting properties or potential for some application, it may even become a reason to form an interdisciplinary scientific team. "A description by a synthetic chemist of the characteristics of new compounds often forms the basis for subsequent directional and specialised research in interdisciplinary groups, since these specific features frequently inspire researchers from other fields to undertake collaborative research. It is widespread to find original synthetic papers that also contain elements, which go beyond the domain of synthetic chemistry, such as proving the feasibility of a specific (even unexpected) reaction by computational methods or confirming the structure with methods from other parts of science (e.g., crystallography)."[181]

[180] From a conversation with Assoc. Prof. Dr J. Feder-Kubis.

[181] From a conversation with researcher J. Feder-Kubis. See, for example: J. Feder-Kubis, B. Szefczyk, and M. Kubicki, "Symmetrical Imidazolium Chloride Based on (−)- Menthol: Synthesis, Characterisation, and Theoretical Model of the Reaction," *The Journal of Organic Chemistry* 80, no. 1 (2015): 237–246, https://doi.org/10.1021/jo502317m; P. Maksym, M. Tarnacka, A. Dzienia, K. Matuszek, A. Chrobok, K. Kaminski, and M. Paluch, "Enhanced Polymerization Rate and Conductivity of Ionic Liquid-Based Epoxy Resin," *Macromolecules* 50, no. 8 (2017): 3262–3272, https://doi.org/10.1021/acs.macromol.6b02749.

The experimental research work therefore allows the researchers to carry out scientific activities both independently and as part of a team. The experimental participation in team research and a collaborative project can be of a different nature. It can take the form of an independent, creative and unquestionably original contribution to a joint scientific project, when the chemist performs the synthesis of objects whose synthesis formula procedure they have discovered or created. The contribution may also only be independent and creative when the chemist undertakes in a project the synthesis of an object already described in the literature by another researcher (i.e., an object whose structural characteristics and method of synthesis have been discussed in another scientific publication).[182] However, although this contribution will not be original, it meets the criteria for scientific authorship as being independent and creative. The latter means that a known object is syntesised not *per se* but either as a step of a more general route or for its usage for original comparative tests required for validation new objects. The highly time-consuming laboratory work of the chemist, leading to the synthesis and separation of a particular chemical compound and its subsequent purification, cannot be classified as specialised and routine. To achieve the goal, the researcher continuously controls the ongoing process, modifying the reaction conditions, for example, by changing the temperature, pressure, catalysts, composition of the reaction medium and proportions of the reagents, in order to correctly and (as far as possible) with high efficiency obtain the desired reaction product—a desired object with precisely defined structural characteristics and properties. At the final stage of the research process, the chemist should verify the correctness of the result achieved by means of appropriate spectroscopic and analytical tests, in order to confirm the structure of the material obtained and, at the same time, its purity. Among the chemists of

[182] Performing the synthesis of an object (whether of one's own making or someone else's—according to a recipe known from the literature) is not a routine, repeatable and reliable laboratory activity. Performing it successfully requires extensive specialist knowledge, experience and competence, as well as access to expensive laboratory equipment, but also a creative approach. The synthesis of an object is always preceded by theoretical work, requires the formulation of assumptions for appropriate chemical reaction schemes and mechanisms, and is expected to result in the production of an object with well-defined properties and desired characteristics.

the older generation, there is an iron rule, which is unfortunately increasingly rarely respected, of demonstrating the reproducibility of the new synthesis procedures developed. In other words, it is considered unacceptable to publish the preparation of a new compound or a new method of synthesising an already known compound if their correctness has not been verified at least twice in independent experiments carried out either by the discoverers themselves or by collaborating researchers. Departure from this principle results in a large number of preparative recipes in the modern chemical scientific literature that cannot be reproduced. Thus, in the process of synthesising an object, there is a state of uncertainty about the final result, which is required when demonstrating the creative character of the resulting research target as a manifestation of human scientific creativity. The lack of routine, repeatability and reliability of the techniques used in the process of synthesising an object also fulfils the premise of individuality as a manifestation of scientific creativity. In particular, studies of the compliance of the properties of the manufactured object with the model assumptions of both its structural characteristics and purity are very important. It is the latter findings that condition the usefulness of the object created by the chemist for further research work carried out by the established interdisciplinary research team.

The synthesis of an object previously known from the literature can constitute not only an independent and creative contribution to a scientific project, but also an unquestionably original one, when the chemist sets themselves the goal of obtaining a chemical compound on a larger than laboratory scale, that is, 1/4-technical, semi-technical (known as pilot scale), technical (process) or industrial scale. It needs to be clarified that to produce an object on the increased scale of a unit operation, it is not enough to convert the quantities of chemicals required for synthesis by a simple ratio. Considering both the theoretical and technical aspects, planning a synthesis process at an increased unit operation scale requires an enormous amount of creative work on the part of the synthetic chemist, the outcome of which is uncertain. The research process assuming an increased unit operation scale involves many problems that need to be solved, as the optimisation of the chemical reaction conditions changes considerably. Frequently, other changes also occur, such as a change in heat transfer conditions, which in some cases can make laboratory-safe processes extremely dangerous when carried out on a larger scale, even using the same reagents. Often, increasing the scale involves, for example, the use of other raw materials—available on an industrial scale rather than a laboratory scale, which dramatically changes the course of the synthesis procedure.[183] Consequently, it is important to strive for a precise design of the synthesis process in such a way that the transfer of scale does not affect parameters such as: yield, high product quality, relative cheapness and reliability of the object synthesis in the increased scale, safety or environmental friendliness of the synthesis process, etc. Another example of an unquestionably original, creative and independent contribution to research is the optimisation or simplification of the synthesis process of an object known from the literature with the effect of significantly modifying such parameters of the synthesis process as increasing the yield of the chemical reaction or significantly reducing the number of reaction steps. Such a contribution to research should be evaluated in terms of an important scientific discovery.[184]

The role of chemists in a team-based interdisciplinary research project can be classified as a partner, one of the team members, or as the lead,[185] when they formulate (or co-formulates) the

[183] B. Woźniakowski and A. Grotowski, "Scale-up and Test Planning," *Physicochemical Problems of Mineral Processing* 9, no. 1 (1975): 17–24.

[184] M. Janeta, Ł. John, J. Ejfler, and S. Szafert, "High-Yield Synthesis of Amido-Functionalized Polyoctahedral Oligomeric Silsesquioxanes by Using Acyl Chlorides," *Chemistry A European Journal* 48 (2014): 20, 15966–15974, https://doi.org/10.1002/chem.201404153. This paper describes the synthesis of compounds known from the literature, nevertheless in a significantly modified form that guarantees the optimisation of synthesis conditions. Instead of using substrates in the form of carboxylic acids or anhydrides, acyl chlorides (carboxylic acid chlorides) were used. As a result of such a change in the synthesis process of the object, there was an increase in synthesis yield from about 60% to almost 100% and a reduction in reaction time from several weeks to a few hours.

[185] The researcher Ł. John cites the following scientific papers, in the case of which it was necessary to establish an interdisciplinary team comprising experts from such fields as: chemistry, physics, material engineering or medicine in order to fully realise the assumed research objectives: Ł. John, M. Podgórska, J.-M. Nedelec, Ł. Cwynar-Zając, and P. Dzięgiel, "Strontium-Doped Organic-Inorganic Hybrids Towards Three-Dimensional Scaffolds for Osteogenic Cells," *Materials Science and Engineering C—Materials for Biological Applications* 68 (2016): 117–127, https://doi.org/10.1016/j.msec.2016.05.105 (chemists and medicine); Ł. John, M. Janeta, M. Rajczakowska, J. Ejfler, D. Łydżba, and S. Szafert, "Synthesis and Microstructural Properties of the Scaffold Based on a 3-(trimethoxysilyl) Propyl Methacrylate-POSS Hybrid towards Potential Tissue Engineering Applications," *RSC Advances* 6, no. 70 (2016): 66037–66047, https://doi.org/10.1039/C6RA10364B (chemists and materials engineers); E. Jallot,

scientific thesis and designs the research process. Whether, in an interdisciplinary project, the chemist co-authors the research concept or merely provides the research object, the importance and significance of their contribution to the research cannot be questioned. The analysis of the ethical standards of scientific authorship and the customs established in the scientific community both in the country[186] and abroad[187] leads to the conclusion that

J. Lao, Ł. John, J. Soulié, P. Moretto, and J.-M. Nedelec, "Imaging Physicochemical Reactions Occurring at the Pore Surface in Binary Bioactive Glass Foams by Micro Ion Beam Analysis," *ACS Applied Materials and Interfaces* 2, no. 6 (2010): 1737–1742, https://doi.org/10.1021/am1002316 (chemists and physicists).

[186] The creative contribution of a synthetic chemist to a scientific publication, the subject of which is the presentation of detailed results of objects provided by the synthetic chemist and their analysis, is of such importance that the co-author status of the scientific publication is unquestionable. As an example, Professor E. Schab-Balcerzak cites the work of the synthetic chemist Eugenia Grabiec, Ph.D., from the Centre for Polymer and Carbon Materials of the Polish Academy of Sciences, based in Zabrze: D. Sęk, E. Grabiec, A. Miniewicz, and A. Sobolewska, "Influence of Pol(amide-imide)s Structures on Holographic Recording," *Proceedings of SPIE* 5724 (2005): 311, https://doi.org/10.1117/12.585018, in which the polymer assembly of interest was described for the first time. The mentioned medium was again synthesised for detailed studies by the team of researchers and their subsequent publication in the paper: A. Kozanecka-Szmigiel, K. Switkowski, E. Schab-Balcerzak, and E. Grabiec, "Two-photon Induced Birefringence in Azo-dye Bearing Polymide: The Birefringence Changes versus the Writing Power," *Applied Physics B: Lasers & Optics* 105 (2011): 851–855, https://doi.org/10.1007/s00340-011-4547-7. The indicated team did not dispute the right to the status of co-author of the synthesised publication, which provided them with the object of scientific inquiry.

[187] Researcher Y. Grosu explains that the role of the synthetist in the creation of a scientific paper cannot be overestimated. A synthetist is therefore entitled to the status of co-author of a scientific publication, even though they did not conduct the directional research announced in the research paper and, as a result, did not actively co-author the manuscript of the scientific publication. In the opinion of the cited scientist, a sufficient basis for recognition of co-authorship of a synthetist is the mere provision by the synthetist of a research object and a contribution work in the form of structural characterisation and purity of the object. As justification for his position, Dr Y. Grosu cites the following situation: "I found a scientific article dedicated to the characterisation of a very interesting material [below item 1]. I contacted the author and suggested to him that we could collaborate to study his material carried out under new (different) conditions. As a result of this contact, I received the material and several others from this research group. The research results obtained were very good and resulted in the publication of a scientific article [below item 2], which was later selected for the cover of a journal [below item 3]. After the entire article was written, the team of material developers helped me to describe the material synthesis procedure and the structural characteristics

the right of a chemist to obtain the status of a co-author of a scientific publication in such factual circumstances should not be questioned.[188] Less discernible is the practice of physicists citing

of the material studied." See (1) J. H. Wang, M. Li, and D. Li, "An Exceptionally Stable and Water-Resistant Metal—Organic Framework with Hydrophobic Nanospaces for Extracting Aromatic Pollutants from Water," *Chemistry A European Journal* 20, no. 38 (September 15, 2014): 12004–12008, https://doi.org/10.1002/chem.201403501; (2) Y. Grosu, M. Li, Y. L. Peng, D. Luo, D. Li, A. Faik, J.-.M. Nedelec, and J.-P. Grolier, "Communication: A Highly Stable Nonhysteretic {Cu2 (tebpz) MOF+ water} Molecular Spring," *ChemPhysChem* 17, no. 21 (July 21, 2016): 3359–3364, https://doi.org/10.1002/cphc.201600567; (3) Y. Grosu, M. Li, Y. L. Peng, D. Luo, D. Li, A. Faik, J.-.M. Nedelec, and J.-P. Grolier, "Inside Back Cover, A Highly Stable Nonhysteretic {Cu2 (tebpz) MOF+ water} Molecular Spring," *ChemPhysChem* 17, no. 21 (November 7, 2016): 3576–3576, https://doi.org/10.1002/cphc.201601107.

[188] Researcher Ł. John draws attention to another important issue, namely the question of sources of funding for scientific research carried out within the framework of cooperation of a team of scientists. In order to carry out the individual parts of the research project necessary for the creation of a scientific publication, including the synthesis of the object of the research team's future scientific inquiries, funds are required to, inter alia, purchase materials or research apparatus and maintain it in a condition fit for scientific research. It is customary for a scientist to receive funding for their research from a ministerial grant awarded to the scientific unit where they are employed, or from external sources, for example, grants awarded for research by NCN (National Science Centre), NCBiR (The National Centre for Research and Development), FNP (Foundation for Polish Science) and others. A way for a scientist to demonstrate that they have properly used the funds granted to them (for their intended purpose) for scientific research is for the scientist to publish a sufficient number of scientific papers in which, in addition to the author's affiliation, the creative contribution to the publication is marked with the source of funding for the part of the research they have performed. Consequently, if the chemist, in creating their creative contribution to the research work, finances it with funds allocated to their research activity, they have an additional title to recognise their status as co-author of the research work that was produced using his scientific work and the funds allocated to their scientific research. The source of funding for the research work may result in the need for the interdisciplinary team of researchers to conclude a joint research agreement before proceeding. Such an agreement may regulate not only the subject matter and nature of the creative contribution of individual researchers, but also the subject matter of an equivalent consideration for its performance. This consideration may boil down to guaranteeing the co-author status of a scientific publication to be produced in the future, or determining the amount of remuneration due for the performance of the creative contribution to the publication. It should be emphasised that, also in the second case under consideration, it is necessary to indicate in the scientific publication the subject and nature of the author's creative contribution. However, this will be done in the form of a footnote (acknowledgement) informing who

other people's work by indicating that "[t]he studied compound was prepared according to a procedure described in detail in reference XXX," and physics journal editors usually accept this.[189] This highlights a problem in authorship attribution between synthetic chemists and physicists, as the latter often consider that when investigating the physical properties of a new compound or material produced by a synthetic chemist the co-authorship of the chemists in the first article on the said research is sufficient. Physicists often publish several additional papers of a purely physical nature in which they do not include the contribution of synthetic chemists. This practice should be considered inappropriate and only acceptable if the new compound or material becomes commercially available, or if the synthetic chemists producing it receive a fee for performing the synthesis.

When considering the question of a chemist's entitlement to the status of co-author of a scientific publication, two main cases must be distinguished. Firstly, when their intellectual contribution concerns the development of the concept of the object, its synthesis and the creation, as a contribution to a scientific publication, of a work within the meaning of the Copyright Act, describing the characteristics of the chemical compound synthesised, the course of the synthesis, the results of the structural analysis and the purity of the research object. Secondly, when the actual participation of the chemist in the research process of a broader group of scientists boils down to making (according to their own idea or an idea known from the literature) an object (performing its synthesis) for further application research, as its full characterisation has already been published in the scientific literature.

In the first of the cases indicated, the co-authorship status of the chemist cannot be in any doubt, as the works created by them (being a verbal representation, by means of diagrams and mathematical and chemical symbols, together with a discus-

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and in which scientific (or industrial) unit performed the specific research used in the work, and not by designating the author as a co-author of the scientific publication. Indeed, payment of remuneration does not allow one to appropriate the authorship of another's creative contribution to a scientific publication and to identify oneself as its author.

[189] Purely physics journals (such as *Physical Review Letters*) sometimes do not include a description of the synthesis of an object, but only a literature reference to the article in which such a synthesis is described. In other words, the description of the synthesis itself does not condition the acceptance of the paper for publication.

sion of the original, and therefore creative and individualised, research process) are, as it were, incorporated into the text of the manuscript by the team of scientists formed. The second case may be the subject of controversy, although unjustified in our view. Doubts may arise when the subject of a scientific publication is a creative analysis exclusively of the results of laboratory experiments of an object provided by a chemist. Namely, in the reality of a particular case, due to the identity of the content, the work developed by the chemist devoted to the structural characteristics and purity of the compound, describing the results of the experiments of, respectively, the spectroscopic analysis of the compound and its purity, and thus compliance with the standard, may be quoted after a previously published work with his co-authorship, which was devoted to the object itself, that is, its structural characteristics, purity and the process of its synthesis ("recipe" for synthesis).

Referring to the facts thus delineated, it should be noted that:

(1) the chemist created the research object and then handed over to the collaborating team of scientists a description of its demonstrative structural characteristics. As a specialist, in handing over the object, they could also comment on its suitability for the scientific instrumentation used by the collaborating team of scientists with a different speciality. Not every object is fit for every scientific investigation. Consequently, when a team of scientists establishes research goals and designs scientific experiments (whether in the field of basic or applied research) before embarking on the research process, it does so on the basis of the information provided by the chemist about the object and the features, which it demonstrates (conditioning its suitability for specific directional research) and—expressed in the form of a work—the structural characteristics of the synthesised object, verified by compound purity tests and spectroscopic analysis (also communicated in the form of a work).

(2) the possibility of any research being carried out by the research group is conditional on the chemist performing creative laboratory work, regardless of whether they have synthesised an object of their own or someone else's authorship. Furthermore, a condition for the results and their analyses presented in the research team's scientific publication to be recognised as correct is that the chemist performs spectroscopic studies confirming the exemplary

> structural characteristics of the object and its purity, and then captures them in the form of a work (and a contribution work to the resulting scientific publication) describing their results. It should be emphasised that the chemist is not exempted from the obligation to carry out these analyses and create a work of contribution to a scientific publication describing their results, even if they synthesise the same object for the hundredth time. This is because the decisive factor here is the lack of routine nature of the activities performed in the synthesis process, which has already been mentioned many times, which occurs especially when the chemist increases the scale of the unit operation. The studies analysed also constitute a kind of "quality control." The requirement for the chemist to maintain scientific integrity means that each time an object is synthesised, they are obliged to perform spectroscopic analysis and purity testing to confirm the correctness of its structural characteristics and purity.

For these reasons, it must be concluded that in each of the cases considered, the chemist has a significant share in initiating the scientific idea, conceptualising and designing the research, or legitimises a significant share in the acquisition of data, as required by the ethical standards of scientific authorship.

When applying in Poland for a scientific degree of a doctor or a habilitated doctor, as well as the title of professor, the scientific achievement presented by the synthetic chemist may be documented by a series of thematically related publications. Doctoral dissertations may also be presented in the form of an unpublished written work. In promotion proceedings, it is expected that an applicant for a habilitated doctor degree or title based on a series of thematically related articles should have a prominent position in the list of their authors. It is desirable that, at least in some of the papers comprising the series, this position should be the first position combined with the status of corresponding author or either first author or corresponding author. To demonstrate the value and significance of the contribution to the research project and the article's formation, the promotion applicant may include personal and co-authors' statements indicating and confirming their contribution to each of the papers. In the promotion procedure, when assessing the achievements of a researcher, it is also essential to take into account their scientific status as determined by bibliometric indicators such as the number of citations of their independent works and the Hirsch index or the prestige of the journals in which their work has been published and the management of research projects.

4.3.2. Casus of Physics and Experimental Physical Chemistry—Experimentalists

Experimental physics and physical chemistry are areas of research activity in which researchers, based on the state of the art, design and conduct scientific investigations (experiments)[190] to solve a posed scientific problem. Experimentalists often form collaborations with theoreticians and even interdisciplinary teams researchers representing various, complementary scientific specialities in order to achieve their research goals. The research uses both commercially available highly specialised scientific equipment and experimental tools constructed by the experimentalist themselves, who adopt already existing instruments to the specifics of their research (planned measurements),[191] as well as a unique scientific and research apparatus with the development of a measurement technique can be designed.[192]

The role of the experimenter in the research process is to establish the properties (characteristics) of the studied materials or other objects. The intellectual contribution of the experimentalist, specialized in some particular kind of studies or experimental techniques, to collaborative research can be of various kinds. Firstly, with the use of highly specialised knowledge and

[190] This part of the study was prepared through substantive consultation and on the basis of discussions with the following scientists: Prof. Dr Kamil Kamiński and Prof. Dr Sebastian Pawlus (Faculty of Science and Technology, University of Silesia in Katowice), late Prof. Jean-Pierre E. Grolier—Professor Emeritus of the Blaise Pascal University—Clermont-Ferrand II, Institute of Chemistry in Clermont-Ferrand, Prof. Stanisław Lechosław Randzio—Professor Emeritus of the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw, creator of scanning transitiometry, whose theoretical assumptions and construction of prototype apparatus he presented in his habilitation thesis, receiving his doctoral degree in 1985.

[191] As an example, a case in point is the construction of a special cell for spectroelectrochemical studies by researchers from a team led by Prof. Mieczysław Łapkowski, head of the Department of Polymer Physicochemistry and Technology at the Silesian University of Technology, which was adopted to an existing spectrometer.

[192] An example is provided by scanning transitiometry—see later in this paper.

competence and the application of appropriate measurement procedures, the experimenter can perform the experiment and obtain only, or perhaps as much as, the research result (scientific data) of interest/important to the team, but without analysis of these data. Secondly, as an expert in a given measurement technique, the experimenter can only creatively interpret the already experimentally acquired scientific data, creating a contribution work (scientific work) to a future multi-author work.[193] Thirdly, the scientist may perform both of these activities by demonstrating unquestionable title to co-authorship of the scientific work, as they have acquired the scientific data used in the work and interpreted them, an then created a contribution implemented into the manuscript of the scientific work.[194]

[193] From an interview with Prof. Dr S. Pawlus. The doctor's role in the research process in obtaining the research results presented and analysed in the following paper boiled down to performing the analysis of the dielectric data obtained and then interpreting the research results and co-authoring the publication manuscript; he did not perform the analysed measurements: A. Sieradzki, S. Pawlus, S.N. Tripathy, A. Gągor, M. Ptak, M. Paluch, and M. Mączka, "Dielectric relaxation and anhydrous proton conduction in $[C_2H_5NH_3][Na_{0.5}Fe_{0.5}(HCOO)_3]$ metal-organic frameworks," *Dalton Transactions* 46, no. 11, (2017): 3681–3687, https://doi.org/10.1039/C6DT04546D.

[194] From a conversation with Prof. Dr Kamiński. Examples of papers in which the contribution to the research of Dr Magdalena Tarnacka consisted of calorimetric measurements and their elaboration (interpretation): E. Kamińska, K. Adrjanowicz, M. Tarnacka, K. Kolodziejczyk, M. Dulski, D. Zakowiecki, L. Hawelek, I. Kaczmarczyk-Sedlak, G. Garbacz, and K. Kamiński, "Impact of Low Molecular Excipient on the Liquid-crystalline Ordering as well as Global and Local Dynamics in the Glassy State of Itraconazole, Molecular Dynamics Studies," *European Journal of Pharmaceutics and Biopharmaceutics* 88, no. 3 (2014): 1094–1104, https://doi.org/10.1016/j.ejpb.2014.10.002; K. Adrjanowicz, K. Kolodziejczyk, W. K. Kipnusu, M. Tarnacka, E. U. Mapesa, E. Kaminska, S. Pawlus, K. Kaminski, M. Paluch, "Decoupling between the Interfacial and Core Molecular Dynamics of Salol in 2D Confinement," *The Journal of Physical Chemistry C* 119, no. 25 (2015): 14366–14374, https://doi.org/10.1021/acs.jpcc.5b01391; E. Kamińska, M. Tarnacka, P. Wlodarczyk, K. Jurkiewicz, K. Kolodziejczyk, M. Dulski, D. Haznar-Garbacz, L. Hawelek, K. Kamiński, A. Wlodarczyk, and M. Paluch, "Studying the Impact of Modified Saccharides on the Molecular Dynamics and Crystallisation Tendencies of Model API Nifedipine," *Molecular Pharmaceutics* 12, no. 8 (2015): 3007–3019, https://doi.org/10.1021/acs.molpharmaceut.5b00271. The analogous nature of the research contribution of Prof. Dr K. Kamiński to the papers: M. Paluch, S. Pawlus, S. Hensel-Bielowka, K. Kamiński, T. Psurek, S. J. Rzoska, J. Ziolo, and C. M. Roland, "Effect of Glass Structure on the Dynamics of the Secondary Relaxation in Diisobutyl and Diisoctyl Phthalates," *Physical Review B* 72, no. 22 (2005): 224205, https://doi.org/10.1103/PhysRevB.72.224205, and was concretised in the performance of

When the role of the experimenter in the research process is limited to conducting the measurement, qualifying their contribution to the research as unquestionably creative, giving rise to a right to scientific authorship, is not straightforward. In this matter, it is necessary to verify whether, in the course of conducting the experiment, the operator must demonstrate only highly specialised knowledge and skills and meticulous adherence to measurement procedures, or also "creative invention." In the opinion of representative researchers, an experiment corresponds to the requirements of creative scientific activity when one of two conditions is met. Firstly, when the researcher is expected not only to make use of specialised knowledge and competence and knowledge of procedures but also, to use the scientific equipment to design a scientific experiment precisely, the course of which is not determined solely by the measurement procedure. For example, the researcher is required to construct additional elements that do not form part of the standard equipment of the measuring device, such as the design of the measuring vessel. Secondly, when due to the uncertainty of the possibility of obtaining the desired result the researcher acts as an active creator of the course of the research process while experimenting. That is, the specifics of the study or the object under investigation require that the operator of the measuring device during the experiment reacts to the received partial experimental data and continuously corrects the course or even modifies the original assumptions of the investigation.

In summary, the operator's role of a measuring equipment, even a highly specialised, may boil down to the routine application of procedures, which ensures the correct measurement results, or to an unquestionably creative research activity. When the experimenter is only obliged to apply strictly defined research procedures, the experiment has a non-creative character.[195] The

high-pressure dielectric measurements together with the analysis of the obtained data.

[195] From an interview with Prof. Dr K. Kamiński, it appears that research carried out using differential scanning calorimetry applied to obtain specific experimental data of a test material (a given object) with characteristics well known to the experimenter can provide examples of this type of experiment. At the Institute of Physics of the University of Silesia in Katowice, the analysed measurements are performed using apparatus from METTLER TOLEDO (STARe System). Using a scanning calorimeter, the molecular and macroscopic properties of the materials under investigation are measured. Using the thermal analysis technique, the research method determines such calorimetric

experimenter obtains the necessary information on the characteristics of the measured object (e.g., a chemical compound such as a commercially available ionic liquid) from the professional literature or the manufacturer (developer) of the object.[196] Such research contributions are not creative and, as such, do not confer a title to co-authorship of a future scientific publication,[197] unless otherwise stated in the joint research agreement. In the absence of a consensus of the research team about the experimenter's co-authorship, they should either be remunerated for their work or their contribution to the research should be duly acknowledged and recognised by including appropriate acknowledgements for the transfer of the experimental result used in the scientific work.

It should be noted that a clear alternative categorisation of a scientific experiment as either creative or non-creative research activity is often not possible. The cases of dielectric spectroscopy technique and scanning transient spectroscopy can provide an example here. Research using broadband dielectric spectroscopy (BDS),[198] among others, is carried out using equipment manufactured by Novocontrol Technologies. The research process carried out using this method allows the experimenter to monitor and determine various properties of the material under investigation,

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properties as heat capacity, enthalpies of chemical reaction phase transitions and phase transition temperatures in the temperature range from –150°C to 1600°C.

[196] In the case of differential calorimetry, the researcher should obtain data enabling them to clearly define phase transitions, enthalpy/heat of phase transitions, etc., and then carry out the measurement. The role of the differential scanning calorimeter operator in the course of preparing and performing a measurement is reduced solely to observing the procedures accompanying sample preparation, which, although highly specialised, are routine and repeated for a specialist, and setting up standard measurement conditions on the instrument. His research activity cannot be described as designing a scientific experiment.

[197] As an example of this type of contribution to scientific work, which did not give rise to the title of co-authorship of a scientific publication, Prof. Dr K. Kaminski cites: L. Hong, B. Begen, A. Kisliuk, S. Pawlus, M. Paluch, and A. P. Sokolov, "Influence of Pressure on Quasielastic Scattering in Glasses: Relationship to the Boson Peak," *Physical Review Letters* 102, no. 14 (2009): 145502, https://doi.org/10.1103/PhysRevLett.102.145502. As part of the research work for this paper, the cited scientist was supposed to perform high-pressure measurements for polystyrene. However, he did not analyse the data obtained. The results of these measurements were used in the paper and are also presented in Figure 4 panel b. The cited author assessed that his intellectual contribution to the study was not significant

[198] From an interview with Prof. Dr S. Pawlus.

from basic ones, such as its dielectric constant, to much more complex ones, such as the emergence of temperature-dependent relaxation processes of various types, attributed to different molecular motions. Such an investigation can be used, among other things, to determine the properties of the glass transition in polymeric materials, phase transitions in liquid crystals, the relaxation dynamics of ceramic materials, the crystallisation process, or the stability of pharmaceutical materials. In these types of experiments, it is necessary to establish and control many parameters that determine the value of the final result. For these reasons, the correct preparation of an experiment requires, among other things, determining in which temperature range the experiment is to be conducted, what the electric field to be used is to be (measuring the voltage, the distance between electrodes of the measuring capacitor), the frequency range in which the measurements are to be made, which measured quantity will provide the most information about the material under investigation (e.g., conductivity, dielectric permittivity), etc. Modern BDS equipment, which is widely used today, allows full control of these parameters and automation of the measurements carried out. However, efficient use of this investigation method and obtaining correct results using this highly specialised equipment requires the operator having special knowledge and competence, and extensive experience in using the experimental technique described.

Despite these considerations, it is not always possible for the experimenter performing the research with the measurement technique being analysed to obtain the result of this experiment in an act of scientific creation. It is accepted in the scientific community that the attribution of creative character to the research results obtained using the BDS method depends on the nature and degree of involvement of the measurement instrument operator in the design of the research and the experiment itself. Namely, when, by design, they are not to be involved holistically in the ongoing research project, beyond commissioning a single measurement, their participation may be reduced to making a significant but non-creative contribution to the research announced in a scientific publication. This is the case when the experimenter receives from the scientist designing the research (the person who set the research theses and defined the method of their verification) the material/sample (the object of research) and precise instructions as to how and at what conditions the scientific experiment should be conducted. By way of example, these instructions include indications, inter alia, as to the type of measuring capacitor that should be used, as well as at what temperature, measuring voltage, and frequency range of the measuring field the measurement is to be performed. In effect, the conditions of the scientific experiment are entirely designed by the scientist commissioning the desired measurement of the supplied sample of the material under investigation. The role of the experimenter is to perform, using specialised competence, the measurement designed by the commissioning entity. Thus, they are left no room for their initiative, being obliged only to follow almost mechanically the instructions of the experiment designer. Moreover, they do not need to be informed in detail about the purpose of the study or the research project as a whole. As a result, even when the preparation of the measurement itself requires experience due to the complexity of the measurement equipment and the nature of the object under study, there is still a lack of creative contribution by the experimenter to the research to be announced in a scientific publication. In the case under consideration, an experimentalist who has made a significant but non-creative contribution to the research to be published in a scientific paper may be entitled to the status of its co-author when such an entitlement arises from the content of the joint research agreement binding the parties, or when, in addition to carrying out the measurement, they are the author of the elaboration (discussion) of the analysis of the result obtained, that is, they have created a contribution work to that paper.[199]

However, the role of the measuring instrument operator can take on a different form. Scanning Differential Calorimetry technique is an instructive example. Interpretation of DSC results is not always easy or trivial. Often, it requires additional research or finding correlations between results obtained by different complementary testing methods. In such cases, the DSC instrument operator's the co-authorship should be taken into account. This is especially the case when the author of the research design provides the experimenter not only with the material to be studied, together with instructions for the preparation and execution of the experiment expected by the experimentalist,

[199] For example: A. Sieradzki, S. Pawlus, S. N. Tripathy, A. Gągor, M. Ptak, M. Paluch, and M. Mączka, "Dielectric Relaxation and Anhydrous Proton Conduction in $[C_2H_5NH_3][Na_{0.5}Fe_{0.5}(HCOO)_3]$ Metal-organic Frameworks," *Dalton Transactions* 46, no. 11 (2017): 3681–3687, https://doi.org/10.1039/C6DT04546D.

but also informs the experimenter about the main assumptions and objectives of the research project to be carried out and, as a result, of the DSC measurement itself. Thus, the author of the research concept obliges the equipment's operator, for example, to monitor the behaviour of specific physical phenomena in a given temperature range. The experimentalist, having this knowledge, can proceed in two ways. They can perform the measurement exactly according to the instructions, without analysing the correctness of the result obtained, and thus without verifying the correctness of the experiment designed by another person, the performance of which led to the result obtained. They may also do otherwise, that is, taking into account the assumptions and purpose of the designed experiment, may monitor the course of the measurement, and then, when finds that, with the given measurement parameters, the result expected by the designer has not occurred, they may, after consultation with them or on their own, modify the experimental conditions in such a way as to increase the chance of obtaining a positive (expected) result of the measurement. Thus, if, for example, the operator observes that the crystallization phenomenon from the liquid state has not occurred in the temperature range under study, they may enlarge the temperature range by continuing the experiment while going beyond its original design. The second behaviour of the experimenter under consideration undoubtedly constitutes the performance of a significant and creative contribution to scientific research announced in a scientific publication. Namely, seeing that the result of the commissioned measurement was not positive, they modified its parameters to increase the chance of success of the research. Regardless of the content of the joint research agreement between the parties, because of this type of contribution to the research, the experimenter has the title to become a co-author of the scientific publication.

It is apparent that it is extremely rare that the role of the experimenter in the research process will be limited to the execution of routine procedures. They are usually expected to estimate the course of the experiment on an ongoing basis, with the possibility of modifying the original assumptions according to the partial results obtained. An example of such an experiment could be performing DSC measurements to determine the molecular and macroscopic properties of a specific material when the operator is not familiar with the characteristics of the tested object. The experimenter does not have clearly defined (certain) data on phase transitions, enthalpy or heat of phase transitions. Consequently, using their specialist knowledge and competence, for example,, to determine the temperature of the glass transition, they should design a scientific experiment, predetermining the likely temperatures of the phase transition (e.g., melting, transition to the glass state at high-pressure conditions), using other experimental methods or observations, when dealing with a crystalline sample, or selecting the rate of cooling, when the sample crystallises on decreasing temperature.[200] In the case in question, the operator of the differential scanning calorimeter is required to supervise the entire measurement process—from the correct preparation of the sample to monitoring the measurement in real-time with possible modifications of the investigation procedures used. The realised research process fulfils the prerequisites of scientific creativity. Consequently, the result obtained corresponds to the characteristics of a creative and significant contribution to scientific research to be presented in a scientific publication. Regardless of whether or not the experimenter created a contribution work for a scientific publication containing detailed analysis and observed correlations of the obtained measurement result, by submitting the experimental result to the research team, they get the title of co-authorship of the scientific work.

[200] Prof. Dr K. Kamiński cites the publication as an example: E. Kamińska, O. Madejczyk, M. Tarnacka, K. Jurkiewicz, K. Wolnica, W. E. Śmiszek-Lindert, K. Kamiński, and M. Paluch, Anhydrosaccharides—"A New Class of the Fragile Plastic Crystals," *Journal of Chemical Physics* 148, no. 7 (2018): 074501, https://doi.org/10.1063/1.5011672, explaining that for the research announced therein, his team performed, among other things, measurements of new anhydrosaccharides for which the temperatures of phase transitions and transitions to the plastic phase were not determined. In turn, postdoctoral researcher S. Pawlus cites a paper as an example of a publication illustrating such a contribution to research: S. Pawlus, C. M. Roland, S. J. Rzoska, J. Zioło, and M. Paluch, "Effect of Temperature and Pressure on Segmental Relaxation in Polymethylphenylsiloxane," *Rubber Chemistry and Technology* 76, no. 5 (2003): 1106–1115, https://doi.org/10.5254/1.3547790, in which the relaxation dynamics of the segmental relaxation process associated with the transition to the glassy phase was investigated for a number of polymers from the PMPS family. The study was carried out both at ambient pressure and under high-pressure conditions. One of the study's results is the determination, by a method other than calorimetry, of data reporting how the temperature of the glass transition changes with rising pressure. Furthermore, it was possible to determine this temperature under high-pressure conditions, which is not possible in standard calorimetric measurements.

Another example of the experimenter's creative contribution to scientific research is the study of molecular dielectric relaxation (dynamics) on organic glasses prepared in thin films of a few hundred to a few nanometres in thickness. The measurements of interest are performed using a specially designed capacitor.[201] Solid materials with well-characterized physicochemical properties are often the object of such investigations. The analysed measurement aims to verify how this type of material will behave at the nanometre scale. To carry out such an experiment, the operator should design its course, starting with determining the preparation of the sample to be measured. In this case, the sample preparation way even determines the experiment's success. Namely, it is necessary to decide on the method by which thin layers will be applied (spin coating vs. physical vapour deposition). It is also essential to choose the correct parameters: substance concentration, solvent, speed, evaporation rate, temperature, and type of substrate. This is because they affect the thickness of the layer and its homogeneity. Determination of the latter parameters requires the use of such highly specialised techniques as atomic force microscopy (AFM). In addition, it is necessary to define a framework for the physicochemical stability of the nanometric layers obtained, the temperature conditions under which the layers obtained will still be stable and under which the solvent evaporation process will take place. Once the sample has been made in the creative preparation process, the experimenter must mount it in a specialised capacitor (NanoKit) with a vapourised gold electrode. At this stage of the experiment, they should take care to select the right top electrode with a unique geometry. Only after this has been done can the experimenter proceed to the experimental part of the designed experiment.

The correct execution of dielectric measurements requires not only highly specialised knowledge and competence and a great deal of experience on the operator's part but also a great deal of patience and manual dexterity. During the measurements,

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[201] At the Institute of Physics of the University of Silesia in Katowice, the measurements analysed are carried out using equipment manufactured by Novocontrol Technologies. The design of the NanoKit capacitor is based on nanostructured electrode arrays made of SiO_2 doped to conduct Si ($\varrho \approx 0.002$ Ωcm). The lower cover has a well-defined rms roughness of approximately 0.5 nm. In contrast, the top electrode of the capacitor contains nanostructures of different heights, e.g. 60 nm, which create a distance between the electrodes to prevent them from short-circuiting.

the instrument operator cannot be passive. They are required to monitor the course of the experiment in real-time due to the fact that very often electrical contact is lost, short circuits occur, and in a certain temperature range, destruction of the layers formed may also occur. With this type of measurement, the value of the result obtained is unknown. Nevertheless, an interesting phenomenon has been observed. Very often, the dynamics of nanometric layers made of polymeric materials are very close to that measured for solid material. Therefore, determining whether there is a difference between the molecular mobility in nanometric films and solid samples is very important.

Another example of a scientific experiment with great potential to demonstrate scientific creativity in the course of its implementation is the application of the previously discussed BDS measurement method to high-pressure investigations.[202] Taking up this issue, it should be noted that until recently such equipment was not commercially available in the form of integrated measurement sets. Only apparatus for testing in atmospheric pressure conditions was available, and instructions on how to conduct such tests were provided by the manufacturer during the installation of the equipment at the customer's site.

For these reasons, only a few centres in the world carried out high-pressure dielectric investigations using equipment made in-house, comprising measurement components from different manufacturers. As a result, an expert in this field of research is usually a researcher with a unique measuring device (constructed in a modular arrangement according to their research needs) and highly specialised knowledge, competencies, skills, and experience. This generally makes them a part of the research team in the role of designer of the high-pressure BDS experiment. Consequently, their role in the research process is concretised in the unquestionable participation in the establishment of the research goal, the conduction of the experiment and the analysis of the results obtained, together with their elaboration in the form of interpretation of scientific data and the creation of a contribution work for scientific publication.[203]

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[202] At the Institute of Physics at the University of Silesia in Katowice, the measurements analysed are performed using modular apparatus, the main components of which come from companies such as Unipress, SITEC and Novocontrol Technologies.

[203] An example of a publication demonstrating such a contribution to the research of an experimenter is the work by S. Pawlus, M. Paluch, and M. Dzida,

An interesting example of an evidently essential and creative contribution of the experimentalist to scientific research is research using the scanning transitiometry technique.[204] Its foundations as a new, original measurement technique, together with a prototype of a scientific and research apparatus based on this technique, were developed at the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw. These were presented in his habilitation thesis by Professor Stanisław L. Randzio. Subsequently, with Professor Randzio's participation, advanced, researcher-designed prototypes of scanning transitiometers were built at Brigham Young University (BYU) in the USA and at Université Blaise Pascal (UBP) in France. In the following years, European cooperation further improved the developed measurement method.[205] It emerged as an improved alternative to the measurement techniques and equipment inherent in scanning calorimetry and thermal analysis.[206]

The design of the scanning transitiometer is unique.[207] Firstly, the technology of construction of the scanning transitiometer

"Molecular Dynamics Changes Induced by Hydrostatic Pressure in a Supercooled Primary Alcohol," *The Journal of Physical Chemistry Letters* 1, no. 21 (2010): 3249–3253, https://doi.org/10.1021/jz101288v. The role of Prof. Dr S. Pawlus in obtaining the research results presented and discussed in this work boiled down to performing high-pressure dielectric measurements of the presented samples and then analysing the obtained data. The contribution to the research, however, was concretised not only in the performance of measurements, but also (or perhaps above all) in the determination of the research thesis, the creation of the concept of the work and the preparation of the manuscript for publication.

[204] It was compiled on the basis of available literature and factual consultation, as well as interviews with scientists such as the late Prof. J.-P. E. Grolier and Prof. S. L. Randzio.

[205] It should be emphasised that scanning transitiometry, as a method and device for studying physicochemical transformations, constitutes an invention within the meaning of the Act of 30 June 2000—Industrial Property Law, covered by patent protection in most EU countries and the USA.

[206] The latter was an important issue resolved in the process of obtaining patent protection for the scanning transitiometer. In applying for the patent, the differences between the measurement capabilities of the indicated research techniques and scanning transitiometry were demonstrated in detail, while at the same time proving that these techniques are not equivalent to it. The uniqueness and originality of this technological solution is expressed: in the design of the apparatus and its modularity, in the measurement technique and the multidisciplinary spectrum of research applications.

[207] S. L. Randzio, "Scanning Transitiometry," *Chemical Society Reviews* 25, no. 6 (1996): 383–392, https://doi.org/10.1039/CS9962500383.

allows its technical parameters to be adopted each time to the individual research needs of the entity ordering this apparatus. As far as functionality is concerned, the instrument is unique in that the scope of its research applications is determined by the needs expressed by the researcher when ordering the equipment.[208]

[208] For example, from a grant of PLN 1,603,000 received in 2009 from the Fund for Polish Science and Technology, an investment was made in apparatus—the purchase of a transitiometer with equipment. Thus, in 2012, the Institute of Chemistry at the University of Silesia in Katowice was equipped with a scanning transitiometer of a typical design, but with an extended research spectrum, i.e., one that allows the following types of research to be performed: simultaneous recording of heat flow and changes in the volume of the substance under investigation, together with the possibility of tracing the evolution of phase transitions and processes resulting from continuous changes in temperature, pressure or volume of the sample under strictly defined conditions of the other parameters of the state; simultaneous determination of the physico-chemical properties, both thermal and mechanical, of the sample under investigation (e.g., thermoelastic coefficients, thermodynamic coefficients, thermal and mechanical properties of the sample under investigation). Simultaneous determination of physicochemical properties, both thermal and mechanical, of a tested sample (e.g., thermoelastic coefficients, heat capacity) of many gaseous, liquid and solid substances in a very wide range of pressures (from 0.1 MPa to 700 MPa) and temperatures (from 173 to 673 K), with a measurement resolution of the differential detector registering heat flow of several tens of nanowatts and volume changes of 10^{-6} cm^3, with pressure measurement accuracy of at least 0.15%; scanning of state parameters in the following ranges: temperature (from 0.1 to 5 mKs^{-1}), pressure (from 0.001 to 0.05 $MPas^{-1}$) and volume (from 5×10^{-6} to 10^{-4} cm^3s^{-1}); determination of substance properties and transformations in a supercritical fluid environment; measurements with continuous and step changes in sample state parameters; performing measurements using small sample volumes ranging from 0.5 to 2.5 cm^3.

On the other hand, a scanning transitiometer of unique design was made for Professor Valentin A. Eroshenko, commissioned by l'Ecole Polytechnique, Paris, France, a scanning transitiometer of unique design was fabricated for the purpose of performing intrusion-extrusion studies of liquids into porous materials. The results of studies the intrusion-extrusion of liquids in porous materials using a scanning transitiometers (with different construction solutions) were presented in the following papers: O. V. Ievtushenko, V. A. Eroshenko, Y. G. Grosu, J.-M. Nedelec, and J.-P. E. Grolier, "Evolution of the Energetic Characteristics of {silicalite-1 + water} Repulsive Clathrates in a Wide Temperature Range," *Physical Chemistry Chemical Physics* 15, no. 12 (2013): 4451–4457, https://doi.org/10.1039/C3CP44587A; A. R. Lowe, W. S. Y. Wong, N. Tsyrin, M. A. Chorążewski, A. Zaki, M. Geppert-Rybczyńska, V. Stoudenets, A. Tricoli, A. Faik, and Y. Grosu, "The Effect of Surface Entropy on the Heat of Non-Wetting Liquid Intrusion into Nanopores," *Langmuir* 37, no. 16 (2021): 4827–4835, https://doi.org/10.1021/acs.langmuir.1c00005; M. Chorążewski, P. Zajdel, T. Feng, D. Luo, A. R. Lowe, C. M. Brown, J. B. Leão, M. Li, M. Bleuel, G. Jensen, When purchasing such equipment, an informed researcher has the opportunity to define their research needs on an individual basis, exerting a significant influence on both the design of the apparatus created for them and the subject matter and scope of its research applications. It should be noted that the scanning transitiometer is a modular instrument, which allows for its easy expansion or modification in the case of the emergence of new research problems. Consequently, it is possible to reconstruct and extend the transitiometer at any stage of solving a scientific problem. As a result, the scanning transitiometer allows scientific research to be carried out on a scale unattainable by a traditional scanning calorimeter. In order to conduct scientific research using a traditional calorimeter in the same spectrum of applications, the researcher would have to have at least several calorimeters, each of which would be used in solving only a selected type of scientific problem.

The operator of the scanning transitiometer, adjusting the measurement parameters of the apparatus (e.g., measuring vessels) to the scientific goal set in the research concept, clearly shows a creative contribution to scientific research. These conditions mean that it cannot be excluded from the process of a problem statement and then designing a scientific experiment, which, unlike the previously discussed research methods, also includes the possibility of complex reconstructing the measurement system.[209]

The innovation of the analysed measurement technique is the fact that the transitiometer makes it possible to determine simultaneously the thermal and mechanical properties of the tested sample, and, thus to obtain simultaneously complete ther-

D. Li, A. Faik, and Y. Grosu, "Compact Thermal Actuation by Water and Flexible Hydrophobic Nanopore," *ACS Nano* 15, no. 5 (2021): 9048–9056, https://doi.org/10.1021/acsnano.1c02175.

[209] In the context of these considerations, Professor S. L. Randzio drew attention to the occurrence in the scientific community—in his opinion—of a reprehensible practice, consisting in a kind of 'buying' of scientific values and publishing them as one's own scientific achievements. This phenomenon consists in ordering specific measurements or original scientific apparatus from a well-known company or scientific team, and then—after paying for such a 'service'—the research results obtained in this way are published under one's own name, often without reference to their source or methods/instruments.

mophysical parameters of the studied processes.[210] Commercially available calorimeters only allow the determination of the thermal effects of the transformations taking place during the measurement. Simultaneous recording of heat flow and volume changes, together with the possibility of tracing the evolution of the phase transition of the substance under study, caused by changes in temperature and pressure, brings a more detailed description of the phenomenon under study. Transitiometer-based measurements are performed with a continuous change of sample pressure range from 0.1 MPa to 700 MPa and at temperatures from 203 K to 673 K.[211] Such a range is not possible with traditional calorimeters.

A significant achievement of the developers of this measurement method is the construction of an innovative measuring element, referred to as a differential detector. The know-how they have developed in this area is expressed, among other things, in the fact that it is the extremely sensitive measuring element that can operate over a very wide temperature range (from 173 K to 673 K) with an extremely high measuring resolution of up to several tens of nanowatts.[212]

The uniqueness of the functions and applications of the analysed method of scanning transitiometry used in transitiometers is expressed in the multidisciplinary spectrum of research applications. There is no measuring device among traditional calorimeters (as a single device) with at least a similar spectrum of research applications. The scanning transitiometer has found application in scientific projects such as:

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[210] See M. Wilken, K. Fischer, and J. Gmehling, "Communication: Transitiometry: pVT Ccanning Calorimetry for the Simultaneous Determination of Thermal and Mechanical Properties of Materials," *Chemical Engineering & Technology* 25, no. 8 (2002): 779–784, https://doi.org/10.1002/1521-4125(20020806)25:8<779::AID-CEAT779>3.0.CO;2-X.

[211] See: J.-P. E. Grolier and F. Dan, "Calorimetric Measurements of Thermophysical Properties for Industry, Chemical Thermodynamics for Industry," in *Chemical Thermodynamics for Industry*, ed. T. M. Letcher (London: The Royal Society of Chemistry, 2004), 144–158.

[212] The design of the differential detector has not been disclosed. This invention, as it has not been disclosed, is legally protected under the regulations of the Act on Combating Unfair Competition of 16 April 1993 as a company secret. At the same time, pursuant to the disposition of Article 79 of the Act of 30 June 2000—Industrial Property Law, an entrepreneur's secret may be used, similarly to an invention covered by patent protection, only on the basis of a licence agreement, and the creator of the apparatus has not concluded such an agreement with anyone.

– simultaneous determination of thermoelastic coefficients and heat capacity of liquid[213] and solid samples, e.g., polymers[214];

– study of the properties of liquid crystals, polymers, monomer-polymer systems under extreme conditions of pressure and temperature, where relaxation and phase transitions occur[215];

– testing and modelling equations of state for solids and liquids[216];

– study of changes in the properties of solid materials, including polymers, due to interactions with gases that are aggressive to the structure of the material under study and with supercritical gases[217];

– determination of phase transformations (polymorphic) and determination of phase diagrams of liquids, polymers, pharmaceuticals under extreme conditions of pressure and temperature;

– determination of diffusivity and thermal conductivity of bulk materials (e.g., building material composites) in the temperature range from −50°C up to 200°C at ambient pressure;

– synthesis/degradation of polymers with a recording of the effects of temperature and pressure on the chemical transformation and simultaneous sampling of the reaction mixture

[213] J. Nowottny, *High-Pressure Calorimetry: Evaluation of Methods and Measurement of Heat Capacities* (Düren: Shaker Verlag Gmbh, 2021).

[214] See: Wilken, Fischer, and Gmehling, "Communication: Transitiometry: pVT Scanning Calorimetry," 1300.

[215] See: Grolier and Dan, "Calorimetric Measurements of Thermophysical Properties," 144–158.

[216] S. L. Randzio, "From Calorimetry to Equations of State," *Chemical Society Reviews* 24, no. 5 (1995): 359–366, https://doi.org/10.1039/CS9952400359.

[217] T. Yamada, S. A. E. Boyer, T. Iyoda, H. Yoshida, and J.-P. E. Grolier, "Effects of CO2 Pressure on Isotropic Transition of Amphiphilic Di-block Copolymer (Communication)," in *37èmes Journées de Calorimétrie et d'Analyse Thermique & Symposium de Thermodynamique des Fluides Complexes*, Pau (France), 30 Mai–2 Juin 2006, *Journal of Thermal Analysis and Calorimetry* 89, no. 3 (2007): 717–721, https://doi.org/10.1007/s10973-006-7960-0; K. Fischer, M. Wilken, and J. Gmehling, "The Effect of Gas Pressure on the Melting Behavior of Compounds," *Fluid Phase Equilibrium* 210, no. 2 (2003): 199–214, https://doi.org/10.1016/S0378-3812(03)00180-8; T. Yamada, S.-A. E. Boyer, T. Iyoda, H. Yoshida, and J.-P. E. Grolier, "Effects of CO_2 Pressure on Isotropic Transition of Amphiphilic Side-chain Type Liquid Crystalline Di-block Copolymers," *Journal of Thermal Analysis and Calorimetry* 89, no. 3 (2007): 717–721, https://doi.org/10.1007/s10973-006-7960-0; T. Yamada, S.-A. E. Boyer, T. Iyoda, H. Yoshida, and J.-P. E. Grolier, "Isotropic Transition of Amphiphilic Side-chain Type Liquid Crystalline Diblock Copolymers Effects of Nitrogen Pressure," *Journal of Thermal Analysis and Calorimetry* 89, no. 1 (2007): 9–12, https://doi.org/10.1007/s10973-006-8451-z.

at the relevant stages of the change; in this type of research, the scanning transitiometer is at the same time, a chemical reactor for dosing the reactants (continuously and pulsed) and a reaction calorimeter with simultaneous on-line UV-Vis-NIR monitoring[218];

– study of coal oxidation processes at elevated temperatures and pressures and determination of auto-ignition temperatures of coal dust mixtures together with other abrasive materials during the extraction of the raw material;

– kinetics of polymerisation[219];

– determination of the physical and chemical characteristics of fuels and biofuels, for example, their so-called thermodynamic derivative properties (isobaric expansion, isothermal compressibility, heat capacity),[220] together with determination of phase stability, with simultaneous determination of thermochemical coefficients in the vicinity of phase transitions and the critical point[221];

– examination of corrosion products of biomaterials (metallic, polymeric) in a model environment similar to tissues and body fluids to determine the mechanism of implant failure;

– study, over a wide pressure and temperature range, the thermodynamics of the reversible process of hydrogen absorption-desorption from materials characterised by a large internal storage capacity (sorption) of hydrogen, which makes it possible to determine the usefulness of the sorbent as a source of hydrogen in alternative fuel engines.

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[218] F. Dan and J.-P. E. Grolier, "Spectroscopic Screening for Complex Process Optimisation, Chemical Thermodynamics for Industry," in *Chemical Thermodynamics for Industry*, ed. T. M. Letcher (London: The Royal Society of Chemistry, 2004), 88–103; F. Dan and J.-P. E. Grolier, "The Use of Advanced Calorimetric Techniques in Polymer Synthesis and Characterisation," *Thermochimica Acta* 450, no. 1–2, (2006): 47–55, https://doi.org/10.1016/j.tca.2006.07.016.

[219] A. Dzienia, K. Koperwas, M. Tarnacka, M. Chorążewski, E. B. Postnikov, A. R. Lowe, K. Kamiński, and M. Paluch, "Direct Insight into the Kinetics of the High-pressure Step-growth Polymerization of DGEBA/aniline Model System," *Polymer* 172 (2019): 322–329, https://doi.org/10.1016/j.polymer.2019.04.001.

[220] M. Chorążewski, F. Dergal, T. Sawaya, I. Mokbel, J.-P. E. Grolier, and J. Jose, "Thermophysical Properties of Normafluid (ISO 4113) over Wide Pressure and Temperature Ranges," *Fuel* 105 (2013): 440–450, https://doi.org/10.1016/j.fuel.2012.05.059.

[221] S. L. Randzio, J.-P. E. Grolier, and M. Chorążewski, "High-Pressure 'Maxwell Relations' Measurements," in: *Volume Properties: Liquids, Solutions and Vapours*, ed. E. Wilhelm and T. Letcher (Cambridge: The Royal Society of Chemistry, 2015), 414–438.

It should be noted that the efficient (obtaining authoritative experimental data) performance of a scientific experiment with the use of the apparatus under discussion is undoubtedly a significant contribution of its operator to the conducted scientific research, which at the same time has a significant creative potential or even is creative. There are several arguments in favour of such a characterisation of the research result (measurement) obtained with the scanning transitiometer and the research technique that is scanning transitiometry: firstly, the uniqueness of the scientific research apparatus itself due to the fact that it is not commercially, generally available; secondly, the modular (as it is always adopted to the individually marked research needs of the ordering scientific institute) construction of this apparatus, with the possibility of its further modification and expansion according to the research needs of the operator; thirdly, the high knowledge, competence and skill requirements placed on the operator of this measuring apparatus, who should become an expert in a research technique such as scanning transitiometry. It should be clarified that the status of an expert in this measurement technique does not boil down to the fact that its operator has highly specialised knowledge to perform repetitive, routine and automated measurements. They must be highly competent to be able to design an experiment using a scanning transitiometer.

It should be emphasised that the use of this apparatus is never fully routine or automated. Consequently, the scientific results obtained using the apparatus and technique of scanning transitiometry are almost always obtained as a result of the implementation and realisation of a thought-technical process of a creative nature. If this feature does not occur at the measurement stage, then certainly earlier, at the stage of designing the scientific experiment, that is, determining the suitability of this measurement technique for verifying the research thesis set, and then selecting optimal conditions for the course and execution of the experiment itself. However, as a rule, a "creative" approach of the transitiometer operator will be required not only at the stage of designing the experiment, but also during its run. The correct execution of the experiment requires modelling its course according to the obtained partial measurement data. Only with such an approach can authoritative results—experimental data—be obtained.

The performance of analysing these data requires that the scientist undertaking this task has considerable knowledge and experience and that the thought process implemented for this purpose, leading to the formulation of relevant conclusions and inferences, corresponds to the characteristics inherent in scientific creation. The typical result of this process is the creation of a contribution (establishing that it is a work) to a scientific publication, consisting of the presentation of scientific data (represented by numbers, words, or in graphic form) obtained with a scanning transitiometer and their analysis, together with the formulation of relevant theses or hypotheses, conclusions or inferences, summarising the experiment and the results obtained during it.

Nevertheless, obtaining experimental data alone may be the basis for getting the status of the author of a scientific work. In such a case, it is required that the experimental data be obtained as a result of a manifestation of the creative activity of a man of an individual nature. An appropriate example here may be the study of the phenomenon of polymorphism of theophylline, a well-known drug against peripulmonary diseases. For many years, it was only by indirect methods that the polymorphism was shown to be enantiotropic (i.e., equilibrium) in nature. Calorimetrically, however, no one could see this transition, even using highly sensitive classical DSC calorimeters. Using a scanning transitiometer, B. Legendre and S. L. Randzio not only demonstrated that such a transition exists, but also measured its parameters accurately, using a very low heating rate and exploiting the high sensitivity of the calorimetric transitiometer detector.[222] A similar example is the polymorphism of a known component of new diabetes drugs under development. Two crystalline forms of this substance are known. Measurements of phase transitions of substances in forms with different crystal structures, performed with great care using the classical DSC method, failed to elucidate the nature of this polymorphism. It was not until the application of thermal perturbations and the long-term observation of the effect of these perturbations using a highly sensitive scanning calorimetric transistor detector that it was possible to detect that the two known crystalline forms are thermodynamically unstable and that their phase transitions lead to the formation of glassy phases by a mechanism known as virtual melting. Thus, the importance of studying the ther-

[222] B. Legendre and S. L. Randzio, "Transitiometric Analysis of Solid II/Solid I Transition in Anhydrous Theophylline," *International Journal of Pharmaceutics* 343, no. 1–2 (2007): 41–47, https://doi.org/10.1016/j.ijpharm.2007.04.015.

modynamic stability of crystalline drug components has been demonstrated.[223]

In the field of chemistry and experimental physics the scientific achievement presented by the researcher in the proceedings for the conferral of the PhD or habilitated doctor degrees or titular professorship in Poland, may be documented by a single series of thematically related multi-author publications. However, the doctoral dissertation is recommended to take the form of an unpublished monograph, that is, a compact written work. Making such an effort is of great value for the appropriate training of the young scientist to do research. When documenting the research output with a series of multi-authored papers, it is expected that a person applying for the degree of a habilitated doctor or the professor title on the basis of a series of thematically related articles would have a prominent position on the list of authors. In the assessment of a researcher's scientific output in the analysed area of research, it is also essential that bibliometric indicators determine the researcher's scientific status. Hence, it is also necessary to consider their scientific status as determined by scientometric indices such as the number of citations of papers and the Hirsch index or the prestige of the journals in which their work has been published and whether they have led research grants. Nevertheless, reviewers of promotion proceedings should be careful against uncritically taking into account the bibliometric parameters of the person whose achievements are being assessed. High citations of some papers may result from citing them in order to carry out a critical analysis of their scientific findings and even to show substantive errors in published works.

4.3.3. The Casus of Quantum Chemistry

Quantum chemistry is an area of research activity at the intersection of physics and chemistry, involving research of a purely theoretical nature as well as combined with elements of computer simulations.[224] The research uses quantum mechanics to describe

[223] S. L. Randzio and A. Kutner, "Metastability and Instability of Organic Crystalline Substances," *The Journal of Physical Chemistry B* 112, no. 5 (2008): 1435–1444, https://doi.org/10.1021/jp077161a.

[224] This part of the study was prepared through substantive consultation with Assoc. Prof. Dr Rafał Podeszwa.

atomic and molecular systems of interest to the chemical sciences. Advanced mathematical tools are used in the theoretical research and numerical methods are also employed. The scientific methods used are intended to better describe the atoms and molecules. The larger the molecule, the more time-consuming the computational studies (also the more accurate the method, the longer the calculations take). Quantum chemists constantly work to improve research methods and techniques.[225] The findings of

[225] In the science of the 1970s, Symmetry Adopted Perturbation Theory (SAPT) was developed for the description of molecules and has been continuously developed: B. Jeziorski, R. Moszynski, and K. Szalewicz, "Perturbation Theory Approach to Intermolecular Potential Energy Surfaces of van der Waals Complexes," *Chemical Review* 94, no. 7 (1994): 1887–1930, https://doi.org/10.1021/cr00031a008. H. L. Williams and C. F. Chabalowski, "Using Kohn-Sham Orbitals in Symmetry-Adapted Perturbation Theory to Investigate Intermolecular Interactions," *The Journal of Physical Chemistry A* 105, no. 3 (2001): 646–659, https://doi.org/10.1021/jp003883p put forward a scientific thesis on the possibility of using another methodwithin SAPT, namely density functional theory (DFT), which has been known for a long time but not yet used in this context. However, the results presented in this research were rather disappointing: the accuracy of the results was no better than those used to date. In their conclusions (without, however, numerical verification), the authors postulate the use of an additional method to correct the DFT results, i.e., a correction for asymptotic behaviour. In response to this publication, a German group (A. Heßelmann and G. Jansen, "First-order Intermolecular Interaction Energies from Kohn-Sham Orbitals," *Chemical Physics Letters* 357, no. 5–6 (2002): 464–470, https://doi.org/10.1016/S0009-2614(02)00538-9, and "Intermolecular induction and exchange-induction energies from coupled-perturbed Kohn-Sham density functional theory," *Chemical Physics Letters* 362, no. 3–4 (2002): 319–325, https://doi.org/10.1016/S0009-2614(02)01097-7) and an American group (A. J. Misquitta and K. Szalewicz, "Intermolecular Forces from Asymptotically Corrected Density Functional Description of Monomers," *Chemical Physics Letters* 57, no. 3–4 (2002): 301–306, https://doi.org/10.1016/S0009-2614(02)00533-X) of quantum chemists independently undertook studies that numerically verified this hypothesis. Thus, a new theoretical method consisting of a combination of the above was designed, and the validity of the results obtained was verified using the former as well as experimental methods. This resulted in a new method that was more efficient and faster than the original SAPT. The problem of *dispersion energies* remained, but this was solved in subsequent work (A. Heßelmann and G. Jansen, "Intermolecular Dispersion Energies from Time-dependent Density Functional Theory," *Chemical Physics Letters* 357, no. 5–6 (2003): 778–784, https://doi.org/10.1016/S0009-2614(02)01796-7 and "Intermolecular Dispersion Energies from Time-dependent Density Functional Theory," *Chemical Physics Letters* 357, no. 5–6 (2003): 778–784, A. J. Misquitta, B. Jeziorski, and K. Szalewicz, "Dispersion Energy from Density-Functional Theory Description of Monomers," *Physical Review Letters* 91, no. 3 (2003): 033201, https://doi.org/10.1103/PhysRevLett.91.033201). The German group named the method DFT-SAPT and the

quantum chemists form the basis for further research carried out in the area of modelling liquids, crystals, or proteins.

Research is conducted in teams formed by theoreticians or by quantum chemists and experimentalists. Often, programmers also join research teams. Programmers are essential to write code and make simulations. Publication of research results customarily takes the form of multi-author publications. The course of the research process in quantum chemistry follows the traditional rules of the scientific method, leading from the formulation of the scientific idea through to publication. The formulation of a research goal (the scientific problem to be solved) can be the result of an individual researcher's quest, as well as arise as a result of teamwork and also inspired by research published by other research teams. Often in quantum chemistry, research teams from different research centres work on similar scientific issues.[226] The author of the scientific idea is usually the leader (mentor). Once the scientific question has been identified, the team looks for ways to solve it, designing a research programme involving either theoretical methods or theoretical methods combined with experiment. It is customary for the group leader to indicate the direction of the research and

American group labeled it SAPT(DFT) and the method was subject to further development by these and other teams in the following years.

[226] An example is provided by studies undertaken independently by two research groups addressing the same issue—modification of a frequently used benchmark, the accuracy of which deviated from the state-of-the art after so many years of original publication: P. Jurečka, J. Šponer, J. Černý, and P. Hobza, "Benchmark Database of Accurate (MP2 and CCSD(T) Complete Basis Set Limit) Interaction Energies of Small Model Complexes, DNA Base Pairs, and Amino Acid Pairs," *Physical Chemistry Chemical Physics* 8, no. 17 (2006): 1985–1993, https://pubs.rsc.org/en/content/articlelanding/2006/CP/B600027D. Two papers on this issue were published almost at the same time: R. Podeszwa, K. Patkowski, and K. Szalewicz, "Improved Interaction Energy Benchmarks for Dimers of Biological Relevance," *Physical Chemistry Chemical Physics* 12, no. 23 (2010): 5974–5979, https://pubs.rsc.org/en/content/articlelanding/2010/CP/b926808a and T. Takatani, E. G. Hohenstein, M. Malagoli, M. S. Marshall, and C. D. Sherrill, "Basis Set Consistent Revision of the S22 Test Set of Noncovalent Interaction Energies," *The Journal of Chemical Physics* 132, no. 14 (2010): 144104, https://aip.scitation.org/doi/abs/10.1063/1.3378024. In the quantum chemistry community, when two or more research groups independently undertake research on the same topic and one group publishes first while the other are still working on the same task (leading to lesser impact of the publication of the subsequent teams or requiring reworking of the problem) is referred to by the term: "scooping" and occurs quite frequently.

decide on the appropriate research methods, while the other members of the group carry out the research project under the leader's supervision and support. Once the research results are obtained, the scientific data are compiled and published. The text of the paper is produced as a result of the collaboration of the entire group under the guidance of the group leader (mentor), and often each member of the group produces the relevant part of the manuscript of the forthcoming publication, which is an elaboration of the research results they were responsible for obtaining during the project. The order in the list of authors of a publication is based on the principle of the so-called ordered list of authors, in which the order of authorship attribution corresponds to the value of the contribution to the research process of the individual members of the research team. Consequently, the following rules apply. If there is a person in the group who has contributed the most work to the project from the point of view of time-consumption, they become the first author. Subsequent authors on the list are similarly weighted according to the labour intensity of their workload. Attribution of authorship can also take place according to other principles, when the work was divided into parts, for which individual members of the group were responsible and at the same time it is not possible to indicate who did the most or supervised the entire project. In such cases, authorship attribution is determined according to seniority and runs from the youngest to the oldest member of the group. The status of the corresponding (asterisk) author in quantum chemistry is peculiar, as the importance of their role largely depends on the country in which the research is conducted. In Poland, great importance is attached to the status of the corresponding author; it is the team leader and mentor of the group who led the research in the project, the results of which are announced in the publication. In contrast, in the United States, not as much importance is attached to the role of the corresponding author in a project. This status can therefore be given to the leader of a large research group and a large project, or to the person responsible for leading a smaller scientific project who knows all about it proper. In the latter case, the corresponding author is customarily the person who, in addition to carrying out the research tasks, has administered the research process and has the greatest knowledge of who was responsible for what in carrying out the research project. Consequently, when enquiries are made about clarifications undertaken in a published paper, the corresponding author will know to whom the enquirer should be directed.

In quantum chemistry, we can also encounter cases of unusual attribution of authorship. Such an example is provided by a research project announced in the paper: "Report on the Sixth Blind Test of Organic Crystal Structure Prediction Methods.[227] The attribution of authorship included 97 names of researchers specialising in quantum chemistry, and the status of corresponding author was given to first author A. M. Reilly,[228] who acted as coordinator of the scientific project and was also responsible for editing the entire article based on the submitted contribution pieces of the individual team members, discussing the result of their joint study. What is important here is that, in the course of working on the manuscript for publication, each member of the team was able to comment on the emerging work, and the contributions made by the collaborating groups were made available to readers along with the publication as "supporting information" (research reports) for this publication. What is interesting in the present case is how the research concept came about. The experimentalists succeeded in characterising the properties (structure) of five crystals by means of scientific experimentation (manual, apparatus). The task of the theoretical groups in the project was to predict the crystal structure with mathematical modelling

[227] A. M. Reilly*, R. I. Cooper, C. S. Adjiman, S. Bhattacharya, A. D. Boese, J. G. Brandenburg, P. J. Bygrave, R. Bylsma, J. E. Campbell, R. Car, D. H. Case, R. Chadha, J. C. Cole, K. Cosburn, H. M. Cuppen, F. Curtis, G. M. Day, R. A. DiStasio Jr, A. Dzyabchenko, B. P. van Eijck, D. M. Elking, J. A. van den Ende, J. C. Facelli, M. B. Ferraro, L. Fusti-Molnar, C.-.A. Gatsiou, T. S. Gee, R. de Gelder, L. M. Ghiringhelli, H. Goto, S. Grimme, R. Guo, D. W. M. Hofmann, J. Hoja, R. K. Hylton, L. Iuzzolino, W. Jankiewicz, D. T. de Jong, J. Kendrick, N. J. J. de Klerk, H.-Y. Ko, L. N. Kuleshova, X. Li, S. Lohani, F. J. J. Leusen, A. M. Lund, J. Lv, Y. Ma, N. Marom, A. E. Masunov, P. McCabe, D. P. McMahon, H. Meekes, M. P. Metz, A. J. Misquitta, S. Mohamed, B. Monserrat, R. J. Needs, M. A. Neumann, J. Nyman, S. Obata, H. Oberhofer, A. R. Oganov, A. M. Orendt, G. I. Pagola, C. C. Pantelides, C. J. Pickard, R. Podeszwa, L. S. Price, S. L. Price, A. Pulido, M. G. Read, K. Reuter, E. Schneider, C. Schober, G. P. Shields, P. Singh, I. J. Sugden, K. Szalewicz, C. R. Taylor, A. Tkatchenko, M. E. Tuckerman, F. Vacarro, M. Vasileiadis, A. Vazquez-Mayagoitia, L. Vogt, Y. Wang, R. E. Watson, G. A. de Wijs, J. Yang, Q. Zhu, and C. R. Groom, "Report on the Sixth Blind Test of Organic Crystal Structure Prediction Methods," *Acta Crystallographica Section B: Structural Science: Crystal Engineering and Materials* no. B72 (2016): 439–459, https://doi.org/10.1107/S2052520616007447.

[228] Affiliations: The Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB2 1EZ, England.

methods using only the chemical formula of the crystallized structure. The results of the actual (manual) experiment were reported to the group coordinator. The individual groups of theoreticians, working to develop theoretical (mathematical) methods and techniques leading to the description of the crystals, did not know the experimental data. The task of the project's coordinator was to compare the research results communicated to him by the groups of theoreticians with the experimental data in order to verify which theoretical methods proved useful. In the course of the research project, a kind of competition was announced to develop the best method. Each team presented 100 proposals for the crystal structure of any of the five species (each team could take part in predicting any number of unknown structures, from one to five). In the attribution of authorship of the publication announcing the results of this research, it was assumed that co-author status would be granted to each participant in the competition, regardless of whether or not the results they presented were in agreement with the experimental data since the negative results gave also valuable information about predicting power of a theoretical approach for a particular class of chemical compounds.

The phenomenon of guest (honorary) authorship or ghost authorship is not observed in the field of quantum chemistry. Scientific authorship is based on a real creative contribution to the research project. It is also closely linked to the responsibility for the quality and reliability of the research results announced in the paper. A significant and meaningful intellectual contribution to a scientific project, fulfilling the prerequisites of authorship in the sense of the Code of Ethics, can be recognised in quantum chemistry in the work of the Acknowledgements section. This is because publications include acknowledgements not only to the institutions funding the research or for technical assistance in conducting the research and collecting scientific data, thanks are also given to other scientists with whom the team consulted the research problem and who provided substantive support to the group.[229]

[229] Acknowledgements: We thank Dr Cary Chabalowski for providing a direction for this work, Prof. Bogumil Jeziorski for many insights, and both of them for helpful discussions in: A. J. Misquitta and K. Szalewicz, "Intermolecular Forces from Asymptotically Corrected Density Functional Description of Monomers," *Chemical Physics Letters* 357, no. 3–4 (2002): 301–306, https://doi.org/10.1016/S0009-2614(02)00533-X; Acknowledgment: The authors would also like to thank Krzysztof Szalewicz and Bogumil Jeziorski for reading and com-

Acknowledgements are made to researchers who have put computational tools freely available (software available under an open access licence) enabling their use in conducting research. Teams using such tools when publishing the results of research produced using them are required to cite the author(s) in the references to the paper along with the paper in which it was presented. It is acknowledged that when users discover deficiencies in a computational tool, if the creator of the tool improves the functionality of the software (enhances it or introduces an additional new module) for the purposes of the project in progress, recognition of the contribution to research is expressed in the status of co-author of the paper. Authorship of a scientific publication in quantum chemistry may also result from a critical analysis of a publication manuscript sent by another project team.

There are certain customs in quantum chemistry with regard to demonstrating authorship of a scientific achievement in promotion proceedings. When applying for a postdoctoral or professorial degree in Poland, the scientific achievement is documented by a series of thematically related publications. Doctoral dissertations, on the other hand, take the form of unpublished written work on the basis of which publications are prepared. In promotion proceedings, it is expected that an applicant for a postdoctoral degree or title should have a prominent position on the list of authors of the publications comprising the single-topic publications. It is desirable that, at least in some of the papers comprising the series, this should be the first position combined with the status of the corresponding author, or either the first author or the corresponding author. In order to demonstrate the value and significance of contributions to the research project, the applicant for promotion may include personal and co-authors' statements demonstrating and confirming their contribution to each of the papers. In the promotion procedure, when assessing a researcher's achievements, it is also important to consider their scientific status as determined by scientific metrics such as the number of citations of papers and the Hirsch index or the prestige of the journals in which their work has been published and whether or not they have directed research grants.

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menting on the manuscript in: H. L. Williams and C. F. Chabalowski, "Using Kohn-Sham Orbitals in Symmetry-Adapted Perturbation Theory to Investigate Intermolecular Interactions," *The Journal of Physical Chemistry A* 105, no. 3 (2001): 646–659, https://doi.org/10.1021/jp003883p.

4.3.4. Casus of Theoretical Physics

Conducting research activities in the field of theoretical physics[230] nowadays takes the form of team research by theorists within a scientific discipline or interdisciplinary collaboration with experimentalists.[231] Research results are very often published in multi-authored papers, although a mono-authored paper is welcomed when applying for scientific promotion in the body of work. The existence of minor or major dissimilarities in the various fields of theoretical physics should be highlighted. The theoretical physics of elementary particles stands out most for its distinctiveness. In this area of scientific specialisation, rules for the determination of contributions and the order of authors are similar to those developed in experimental-theoretical consortia (collaborations) centred around large-scale experiments. For most areas of theoretical physics, publications contain a so-called ordered list of authors, which reflects the amount of work carried out in the course of collaborative research, the commitment to the research goal and the realisation of the project, although, in the aforementioned theoretical particle physics, alphabetical order of authors is a general practice. The phenomenon of guest (honorary) authorship or ghost authorship is not discernible in theoretical physics research activities. Scientific authorship is based on real creative contributions to research. Furthermore, scientific authorship is closely linked to the ability to take responsibility for the quality and reliability of the research results announced in the paper. It is assumed that each co-author should be able to "defend" or demonstrate the reliability of the research results of the entire paper or at least a part of it, corresponding to their scientific speciality.[232] In theoretical physics, no special

[230] This part of the study was prepared through substantive consultation with Prof. Dr Jerzy Dajka.

[231] An example of scientific research where the experimentalist posed a research problem and then invited a specialist in theoretical physics to verify the experimental results. The referenced publication summarises a series of works in which experimentalist Prof. A. Ślebarski achieves research objectives in collaboration with theorists, here specifically Prof. M. Maśka: A. Ślebarski et al., "The Effective Increase in Atomic Scale Disorder by Doping and Superconductivity in Ca_3 Rh_4 Sn_{13}," *New Journal of Physics* 20 (2018), https://doi.org/10.1088/1367-2630/aae4a8.

[232] Example of an interdisciplinary paper in which a theoretical physicist was responsible for the statistical analyses, R. Tomaszewski, K. Pethe, J. Kler, E. Rutz, J. Mayr, and J. Dajka, "Supracondylar Fractures of the Humerus:

importance is attached to the corresponding (star) author. The corresponding author usually becomes the person whose job it is to oversee the publication process and liaise with the journal editor. It is customary to establish rules for the attribution of authorship of papers announcing collaborative research results early in the research process, especially when it is a representative of theoretical physics who invites the experimentalist to collaborate. The initiation, design and implementation of the research process and the creation of the publication are divided into the following stages of the research work:

(1) Emergence of a research question/hypothesis; it is formulated by one person, who then forms a research group or is put forward through scientific collaboration.
(2) Planning the research programme: the design of the research programme is composed collegially, i.e., is done by each future co-author within the boundaries of their scientific speciality.
(3) Conducting an experiment:

- In the case of collaboration between a theorist and an experimenter, the physical experiment is the responsibility of the experimenter, who, when inviting the theorist to collaborate, asks them to verify the theoretical results of the physical experiment obtained.
- In the case of "purely" theoretical work, each collaborator of the group in their research specialisation designs a theoretical scientific experiment using public numerical simulation tools[233] or uses tools of their own devising already developed or which have been created for a specific research project.[234]

Association of Neurovascular Lesions with Degree of Fracture Displacement in Children-A Retrospective Study," *Children* 9, no. 3 (2022), https://doi.org/10.3390/children9030308.

[233] An example of a co-authored paper using a computational tool such as QuTip (https://qutip.org/), which the author has put into the public domain. As a result, the creator of the research tool did not become a co-author of the publication, although he is cited in the paper using the tool https://qutip.org/citing.html. QuTip is freely available for use and/or modification on all major platforms such as Linux, Mac OSX and Windows as open source software (free of any royalty) for simulating the dynamics of open quantum systems. Example of use: J. Dajka, M. Łobejko, and J. Łuczka, "Leggett-Garg Inequalities for a Quantum Top Affected by Classical Noise," *Quantum Information Processing* 15 (2016): 4911–4925, https://doi.org/10.1007/s11128-016-1401-1.

[234] An example of a co-authored theoretical publication for which the theoreticians did the research work in collaboration with scientists from

(4) Analysis of the acquired research results: individual members of the research team analyse the data obtained and create a "contribution work" (scientific product) for use in a future scientific work (publication); group consultation takes place during the analysis of the results.

In theoretical physics, certain habits have become established regarding demonstrating authorship of scientific achievement in promotion proceedings due to its frequent documentation by a series of thematically related papers. It is welcomed if the degree applicant has highlighted their leading role in the team research by appropriately placing their name on the list of co-authors of the publications that make up the series. In the case of a doctoral dissertation or a habilitation thesis, the applicant should be the first author or an author of an equal contribution to research in addition to the other co-authors. In the latter case, usually, the articles contain all co-authors' statements of their equal contribution to the formation of the paper. When applying for a title, the applicants should occupy the first or last position on the list of authors in articles constituting a series of works demonstrating their outstanding scientific achievement. It should be underlined that the last position on the list of authors indicates the performance of the function team leader (e.g., research grant manager), which is particularly desirable when applying for the title. In theoretical physics, except for the leader, the order of other co-authors in articles usually results from agreement within the group. From the authors also require a precise indication of their substantive contribution to the project and research to avoid a polite self-limitation of their declared contribution. This is particularly important when a multi-author publication documents the scientific achievement of two or more persons at different stages of their scientific career, for example, it is part of a doctoral dissertation and a habilitation or a doctoral dissertation and a professorial achievement. It is noteworthy that an increasing number of prestige journals, publishing

the Faculty of Mathematics and Physics, University of Ljubljana, 1000 Ljubljana, Slovenia; For the scientists from Ljubljana, it may have been a sufficient contribution to the research to make available for the research a particular unique research tool and numerical technique for the study of quantum dynamics of many-body systems by them, and which is being developed in collaboration with the Slovenian centre by Prof. M. Mierzejewski. M. Mierzejewski, J. Bonča, and J. Dajka, "Reversal of Relaxation Due to a Dephasing Environment," *Physical Review A* 91, no. 5 (2015), https://doi.org/10.1103/PhysRevA.91.052112.

theoretical physics papers and also interdisciplinary ones, expect to specify the authors' contribution in the form of an appendix "author contribution," offering to choose from a group of possibilities such as "conceptualisation," "investigation," "methodology," "supervision," "writing," "software," "visualisation" and others. How this form of defining authors' contributions will be confronted with the abovementioned customs, which formulate an expectation of possessing a first or last position on the list of authors, remains an interesting research question. It will undoubtedly provide additional material for reviewers in promotion proceedings when judging whether the presented scientific achievement is an independent contribution of the applicant for scientific promotion to the existing state of knowledge. It is also worth highlighting that the dominant parameters of quality and legitimacy of an application for a degree or title are the quality of the publication, often measured by the prestige of the journal in which the work is published, as well as the management of research grants and the scientometric parameters describing the status of the researcher (number of citations and Hirsch index).

4.3.5. The Case of Particle Physics

> A quotation from Steven Weinberg (Nobel Prize in Physics, 1979):
> I concede that the scientific enterprise may look very different to experimental scientists, and most especially to those experimentalists in high energy nuclear physics who work in large research teams. […] I do not know to what extent a junior member of such a team can really get a hearing for an idea of his own.
>
> S. Weinberg, "Reflections of a Working Scientist." *Daedalus* 103 (1974): 33–45. The full text is available via https://www.jstor.org/stable/pdf/20024218.pdf

The principles of scientific authorship binding in nuclear and particle physics are a peculiar phenomenon. Research activities in this area have retained a disciplinary character to this day, with collaborators and subsequent authors of scientific publications being persons representing identical scientific specialities, that is, nuclear and particle physics. The specificity of conducting research and publishing its results in this area of knowledge was investigated by historian and sociologist of science Mario Biagioli. In a 2003 paper, Biagioli reported that, at the dawn of the 21st century, a team of particle physicists working in the CDF Collaboration (Collider Detector at Fermilab), formed a committee to develop rules of procedure for scientific collaboration in carrying out research projects.[235] The CDF Collaboration is a consortium of institutions and universities that support and operate the laboratory they have set up. Its personnel capacity is made up not only of scientists (physicists), but also of engineers, technicians and students, designated by their home institution to work at Fermilab. In order to be approved as a full member, one must hold a doctoral degree. At the CDF Collaboration, it is accepted that every publication coming out of the lab should include all the names on the so-called standard list of authors. This list can include up to hundreds of names, which are included in alphabetical order. In contrast to the ICMJE Recommendations, which exclude the scientific authorship of laboratory technicians or individuals who did not participate in the conceptual work, recognition of authorship within the CDF Collaboration is given regardless of the type of contribution to the collaborative project. Similarly, the position of the team member in the internal hierarchy is irrelevant. Students, technicians and physicists with a doctorate can be authors. One restriction applies here. Members of the research team only acquire the title of scientific authorship after having worked for one year in the laboratory and retain their author status for one year after completion of their work.[236]

The reason for the search for a new paradigm of scientific authorship in CDF Collaboration was the significant growth not only in the number of researchers, but even in the number of research groups and institutions collaborating on joint scientific projects. The size of these collaborations and the degree of interdependence that occurred between the teams was so significant that it was not possible to maintain the rules of authorship attribution inherent in copyright law or entrenched in ethical codes for scientists. In the rules of procedure developed at the time, the committee set out a definition of scientific authorship

[235] M. Biagioli, "Rights or Rewards? Changing Frameworks of Scientific Authorship," in *Scientific Authorship: Credit and Intellectual Property in Science*, ed. M. Biagioli and P. Galison (New York: Routledge, 2003), 269.

[236] Biagioli, "Rights or Rewards?", 269–271.

and the grounds for claiming recognition of that authorship. This proposal was approved in 1998. At the same time, similar guidelines for scientific authorship were being considered at other large laboratories such as CERN (European Organization for Nuclear Research) in Europe. In the guidelines authored by the CDF Collaboration, we do not find the principle, common in most disciplines in the sciences and life sciences, proclaiming the inextricable link between scientific authorship and responsibility for the quality and reliability of the research results announced in the paper. It is not required to identify a lead author who could take responsibility for the integrity and reliability of the entire publication. Instead, in the guidelines reviewed, we find detailed corporate protocols for the internal review of manuscripts for publication. The rule of thumb is that when a specific CDF Collaboration group wants to publish an article or present a paper at a conference, the text goes through three rounds of internal review. The first is the initial approval of the publication committee, the last two take place on the internal CDF website. The text is published and all members of the collaboration are invited to comment by email. Once the comments have been sent and responded to, a revised version is posted and the process starts from the beginning. If dissatisfied with the final version of the text, those whose name is on the Standard Author List can withdraw their name from the publication. Interestingly, in the reality of working in the CDF Collaboration, an article with fewer co-authors appears less (rather than more) credible than one with more names. Issues of identified misconduct in a research paper are dealt with internally, by special committees acting in accordance with the rules set out in the CDF bylaws, without the involvement of other agencies and institutions. CDF Collaboration members may be removed from the Collaboration if they are found guilty of professional misconduct.[237]

The findings made by Biagioli twenty years ago do not lose their relevance from the perspective of today's picture of scientific research. The degree of complexity and the size of research teams carrying out scientific activities in the field of nuclear and particle physics has only increased. An analysis of publications in this area of knowledge reveals that the average number of

[237] M. Biagioli, *Rights or Rewards? Changing Frameworks of Scientific Authorship*, in *Scientific Authorship: Credit and Intellectual Property in Science*, ed. M. Biagioli, P. Galison (New York: Routledge, 2003), 271–273.

authors for research in the field of heavy-ion collision physics at relativistic energies is 1000,[238] and in the field of nuclear reaction physics at intermediate energies there are several authors. Many important studies in this area of knowledge are carried out at the European Organisation for Nuclear Research (CERN, French: Organisation Européenne pour la Recherche Nucléaire).[239] Nuclear physicists and particle physicists collaborate at CERN, as does the CDF Collaboration, and the number of research teams they form, called Collaboration, is gradually increasing. Each Collaboration comprises both scientists and technical staff (engineers).

The research process begins with the initiation of the research concept, followed by the collaborative design and implementation of the research, and the results are published in a multi-author publication. It is customary for the research concept to be formulated by the various research groups, who then decide to cooperate and clarify the research thesis/hypothesis through collaboration. The time required to formulate the research thesis/hypothesis is on average about six months. The design of the research programme and determining the scope of the experiment are done collegially by the collaborating research groups. The experimental phase designed by the research group is carried out using accelerators and detectors at CERN. If a detector with the required functionality is not available, the project also includes the construction of a suitable detector, which precedes the experimental phase. The construction period of the detector is long, customarily taking several years, with the built device later being used for research for several to several years. The detector consists of a number of measurement systems, which are the responsibility of specific groups contributing to a given Collaboration. The implementation of the research project assigns different roles to the different categories of research team members. The technical staff is responsible for the technical perform-

[238] An example can be provided by a publication announcing the results of studies of nuclear reactions at relativistic energies, search for the critical point and studies of the hadronic gas—quark-gluon plasma phase transition, which were carried out at CERN: A. Aduszkiewicz, Y. Ali, E. Andronov et al., "Measurements of π±, K±, p and p¯ spectra in proton-proton interactions at 20, 31, 40, 80 and 158 GeV /c with the NA61/SHINE spectrometer at the CERN SPS," *The European Physical Journal* C 77, no. 671 (2017): 1–41, https://doi.org/10.1140/epjc/s10052-017-5260-4.

[239] This part of the study was prepared in consultation with Dr Seweryn Kowalski, Prof. UŚ.

ance of the detectors. The role of the scientists is to supervise the correctness of the measured physical quantities (data) and then, once the data have been obtained, to carry out their calibration. The process of collecting scientific data takes about four months and sometimes up to several months and it is dependent on the required statistics of the collected data. The calibration of the obtained scientific results takes on average between one and two years. Once the experimental phase is completed with the collection of scientific data and their calibration, it is time to analyse the research results and develop their interpretation including the preparation of the description (contribution works for future publication). This work takes a minimum of one year and is carried out by individual teams working together within a given Collaboration. This stage of the research project often involves face-to-face and teleconference meetings.

The next stage of the project is the preparation of a scientific publication. Taking into account the specificity of ongoing research projects in nuclear and particle physics, the paradigm of scientific authorship has been considered in detail at CERN and the rules for creating a list of authors of scientific publications have been defined.

The rules and procedures governing CERN publications and reports, as well as other publications arising from the work of CERN, are governed in detail by internal regulations.[240] The following basic rules for determining authorship of scientific works apply at CERN:

(1) only the scientists who are part of the Collaboration that received and compiled the published research results become authors of the publication; technical staff do not receive the right to scientific authorship, despite their contribution to the research by operating the detector in the course of its execution;
(2) the list of authors of a paper is compiled in alphabetical order;
(3) quite often there is a correspondent (star) author, this is usually the person who has put the most work (often purely technical) into compiling the scientific data.

The principles cited are general and directional in nature of the scientific authorship paradigm. The detailed rules for the

[240] Operational Circular N°6 Issued by Human Resources Division, June 2001, https://admin-eguide.web.cern.ch/en/circulaires-operationnelles.

attribution of scientific authorship are determined individually by each Collaboration operating within the structures of CERN. An example is provided by the document Bylaws of the NA61/SHINE Collaboration,[241] which reads:

> 1. Organisation overview.
>
> The NA61 Collaboration consists of institutions with full membership and limited membership. The spokesperson runs the daily business of the NA61 collaboration and represents it to the outside. The spokesperson reports to the Collaboration Board about all activities of the Collaboration and to the Financial Review Board on financial issues only. The Spokesperson is assisted by two deputy spokespersons, a resources coordinator and a contact person for the collaboration at CERN. The spokesperson team is advised and helped by conveners of the working groups. Collaboration meetings should be organised by the spokesperson typically twice each year. All technical innovations and analysis software developed in connection with the work of the collaboration shall be freely available within the collaboration. […]
>
> 4.6 Authorship.
>
> The chairperson of the Collaboration Board will maintain the Collaboration List comprising the collaborating institutions and the names of participating members. However, for each publication the Collaboration Board member from each institution will decide on the author list from that institution. For general guidelines, the authors of papers will be those collaborators who have contributed to the taking or analysis of the data reported in the paper and who have been collaboration members for six months or more. Normally individuals are dropped as authors one year after they leave the collaboration; however, individuals who have made special contributions to a given topic, such as hardware or software or analysis, should be retained on the author list of papers for which their work is relevant. Collaborators who have worked on the installation of new equipment but have left the collaboration prior to the taking of data will be included on the initial papers of the collaboration using that equipment. Technical papers need only list as authors those individuals who contributed to that project, but the NA61 Collaboration should be acknowledged.

[241] NA61_Bylaws_Approved_April2023.docx, https://edms.cern.ch/document/1512669/5.

> The authors of papers will be listed in alphabetical order, preceded or followed by the phrase NA61 Collaboration. Papers which result from student's theses should be so indicated by appropriate footnotes. Papers for conference proceedings are normally submitted in the speaker's name, plus other major contributors if appropriate, plus the other NA61 authors. The other NA61 authors may be abbreviated to NA61 Collaboration only if space is limited.
> 4.7 PhD theses.
> PhD theses based on work performed within the collaboration should be made publicly available.
> 5. Spokesperson.
> The spokesperson organises and directs the work of the collaboration. The spokesperson is advised and helped by deputy spokespersons and working group conveners. The spokesperson proposes two deputies and the contact person at CERN and appoints them after approval by the Collaboration Board. The spokesperson organises the collaboration meetings, typically two in each calendar year. The spokesperson ensures that regular phone or internet conferences to review, coordinate and plan the work of the collaboration are organised as necessary.

Similarly, their own rules of scientific authorship are defined by the collaborating institutions that run the Large Hadron Collider (LHC) or neutrino experiments. These institutions form a Collaboration Board, which manages the research work and the publication of research results. An example of the rules governing such boards is provided by the document: The CMS Constitution adopted by the CMS Collaboration.[242] That Collaboration:

> is led by the Spokesperson who is the Chairperson of the Management Board and the Executive Board and is responsible for the scientific and technical direction of the experiment, following the policies agreed by the Collaboration Board. The Spokesperson is the principal representative of CMS in interactions with CERN and its committees, with the wider physics community and with the general public. The Spokesperson is elected by the Collaboration Board. […]
> Annex 6: Authorship of CMS Physics Papers.

[242] https://alice-collaboration.web.cern.ch/sites/default/files/Documents/ALICEConstitution_1.pdf., https://userswww.pd.infn.it/~ugs/temp/ConstDraft/CMS_Constition_2010_r19-DG%20Nov11-2011.docx.

The authors of CMS physics papers are the members of a CMS Institution listed as physicists or graduate students in the CMS database who have spent a significant fraction of their working time for CMS. Engineers are included as authors if the same conditions as those required for physicists to qualify for authorship are satisfied.
To qualify for authorship, a person must have been a member of CMS for at least one year since registration with the CMS Secretariat. […] For each paper, the relevant date on which a person must have been a member of CMS to qualify for authorship will be defined by the Publications Committee at the start of the preparation of that paper's author list.
In principle everyone who has contributed to the experiment has the right to sign CMS physics papers within the framework of the Constitution and in particular according to the rules of this Annex. Persons, including CMS Affiliates and non-CMS members, who would not normally be included as authors according to the rules of this Annex, may sign papers to which they have made a significant contribution. However, such persons may only be added exceptionally as authors to specific papers, for which a case has been made and agreed to by the Authorship Committee.
Individual authors may choose not to sign any particular paper by informing the Chairperson of the Authorship Committee.
Authorship of a paper of a primarily technical nature does not need to conform to the rules of this Annex.
[…]
6.2 Author List.
The list of authors for CMS publications is based on the membership information for each Institution contained in the CMS database, which is maintained by the CMS Secretariat. This database also shows which members of CMS are currently entitled to be authors of CMS physics papers. The Team Leaders are responsible for ensuring that information in this database is up to date, and should send updates to the CMS Secretariat. Authors are listed in alphabetical order under the Institution to which they belong. This Institution must be a member of CMS. An author may appear only once in the list. If a person is also affiliated to another Institution, it may be mentioned in a footnote as "Also at." Upon request, an author who has moved to another Institution may have a footnote "Now at."

Institutions referred to in footnotes do not need to be members of CMS.

On papers published jointly by CMS and other experiments authors may be listed only once.

When analysing the rules at CERN for preparing a publication and sending it to the appropriate publisher, it should be noted that they are governed by specific, unique rules. When a research project enters this stage, a so-called editorial board is set up to oversee the publication preparation process. The Editorial Board, in collaboration with all the teams that make up a given Collaboration, drafts the text of the publication and establishes the list of authors in alphabetical order. These stages of scientific work take approximately one year. The principle applies that each co-author of a publication is the author of a specific contribution to the research, is the creator of a specific "scientific product" used in the publication. As a result, there is no "guest (honorary) authorship" or "ghost authorship" in nuclear and particle physics. Once the text of an article has been developed, it cannot be directly submitted to the chosen journal. The article is routed through an internal review process. Anonymous reviewers are appointed by CERN. The average time spent on this stage of the manuscript is about one month. The outcome of the internal review is the decision in which final form the publication is submitted to a scientific journal. Many times the internal review is critical and may even require significant changes to the text. It is important to note that even significant substantive changes to the text of the publication, which are the result of a critical internal review, do not result in the internal reviewers being granted the right to scientific authorship. It is worth reminding, according to the ethical standards of scientific authorship, a critical analysis of the text of a paper resulting in a substantive change can be rewarded by authorship rights. However, as with critical editorial reviews, it has been assumed rule that CERN's internal reviewers do not obtain authorship rights to the reviewed work. The head of the Editorial Board or the head of the Collaboration carrying out the project called Spokesperson is customarily responsible for submitting the manuscript to the relevant scientific journal and supervising the review process. The duration of the review depends on the journal and the indications in the review, but is customarily not less than about four months. All publications are reviewed by reviewers selected by the editor of the journal concerned. Following receipt of a review, it is customary to complete the paper.

Against the background of the discussed rules of scientific cooperation, the question arises about the applicable rules when applying for scientific degrees and titles. In the promotion procedure, the Polish legislator requires the scientist to demonstrate authorship of a scientific achievement that constitutes their independent contribution to the state of knowledge. The question arises as to what rules bind the scientist when preparing a doctoral dissertation and a habilitation thesis.

In the area of knowledge analysed, it is accepted that a doctoral dissertation takes the form of a written work in the form of a scientific monograph,[243] on the basis of which a scientific publication is prepared. A habilitation thesis may take the form of a collection of published and thematically related scientific articles as well as a monograph. The rule is that, in the case of theoretical dissertations in particle physics, it is possible to prepare the thesis on the basis of a series of thematically related articles due to the fact that the research is carried out in small research groups, in which the issue of indicating the individual creative contributions of the habilitator does not pose major difficulties.[244] In the case of research conducted in large groups and as part of large experimental work, habilitation thesis from a series of thematically related publications does not happen.[245]

4.3.6. A Case Study in Biomedical Sciences

Biomedicine is an area of research activity that applies the achievements of biological, biochemical, biophysical and biotechnological sciences to the development of medicine. The subject of interest to researchers is the physiological and pathological context of human health and advances in the treatment of diseases, taking into account the ethical issues involved (for example, in

243 https://radon.nauka.gov.pl/dane/profil/d92544c6-4df3-4dd0-a7a5-dfcf09f922ae.

244 See application for a postdoctoral degree based on a series of nine thematically related publications of a scientific achievement entitled *Investigation of Electromagnetic Processes in Ultrarelativistic Heavy Ion Collisions*, https://radon.nauka.gov.pl/dane/profil/4615cdf8-567c-4f36-8afb-46434c177406.

245 See application for a postdoctoral degree based on a published monograph on the scientific achievement entitled *Elliptical Flow and Case-to-Case Fluctuations in Heavy Ion Collisions at SPS Accelerator Energies* (Kielce 2016), https://wsp.ujk.edu.pl/nauka-i-badania/postepowania-awansowe/postepowania-habilitacyjne/.

vitro fertilisation or human cloning). Scientific findings from this scientific speciality accumulate knowledge about the human being, treatments, diagnoses and therapies for various conditions. As in other areas of science, biomedicine has also seen a steady increase in the number of research team members. This phenomenon has naturally translated into the emergence of tensions in the attribution of authorship of scientific works announcing the results of collaborative research.

Recognising this growing problem, the International Committee of Medical Journal Editors (ICMJE), an influential body representing editors of most English-language biomedical journals, has worked to develop Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. In these documents,[246] the ICMJE recommends that authorship be based on the following four criteria:

(1) "Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
(2) Drafting the work or revising it critically for important intellectual content; AND
(3) Final approval of the version to be published; AND
(4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

In addition to being accountable for the parts of the work done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors."

In doing so, the ICMJE stipulates that

> [a]ll those designated as authors should meet all four criteria for authorship, and all who meet the four criteria should be identified as authors. Those who do not meet all four criteria should be acknowledged. These authorship criteria are intended to reserve the status of authorship for those who deserve credit and can take responsibility for the work. The criteria are not intended for use as a means to disqualify colleagues from authorship who otherwise meet authorship

[246] https://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html.

> criteria by denying them the opportunity to meet criterion #s 2 or 3. Therefore, all individuals who meet the first criterion should have the opportunity to participate in the review, drafting, and final approval of the manuscript.[247]

In the recommendations cited, the ICMJE links scientific authorship with responsibility for the entirety of the published research results. The basis for becoming a paper's co-author is provided by the intellectual contribution to the research and the ability to take responsibility for the integrity and quality of the work as a whole. This principle of authorship is not possible when publishing the research results of large biomedical projects. Recognising this problem, the editorial committees of leading medical journals such as *JAMA*, *Lancet*, *Annals of Internal Medicine*, *British Medical Journal* and *American Journal of Public Health* have begun to reconsider the scientific authorship paradigm. However, there was unambiguous support for the need to follow the rules of authorship in the guidelines of ICMJE with some modifications. The principle that only real and valuable intellectual contributions to the research could be the basis for becoming a co-author of a paper was upheld, while the rule of responsibility for the paper and the research result announced in it was limited. A member of a multi-author research team is no longer responsible for the entire paper, but only for the relevant part of the paper in proportion to the subject matter and extent of the researcher's participation in the research and development of the manuscript. The order in which the names are listed in the list of authors should reflect, in descending order, the importance of their contribution to the research and to the creation of the paper. The object and extent of each author's contribution to the research should be clearly marked.

By way of example, the Instructions for Authors of *JAMA*[248] in the section Authorship Criteria and Contributions reads: Authorship credit should be based on four criteria following the guidelines of ICMJE), but:

> Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. One or more authors should take responsibility for the integrity of the work as a whole, from inception to

[247] https://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html.

[248] https://jamanetwork.com/journals/jama/pages/instructions-for-authors#SecAuthorshipCriteriaandContributions.

> published article. Each author should be accountable for the parts of the work he or she has done. In addition, each author should be able to identify which coauthors are responsible for specific other parts of the work and should have confidence in the integrity of the contributions of any coauthors. […] In addition, authors are required to identify their specific contributions to the work described in the manuscript. Requests by authors to designate equal contributions or shared authorship positions (e.g., co-first authorship) may be considered if justified and within reason.

JAMA also de-fetishises the importance of the corresponding (star) author, who falls off the pedestal of the research group leader. In the section Role of the Corresponding Author *JAMA* explains:

> A single corresponding author (or coauthor designee in the event that the corresponding author is unavailable) will serve on behalf of all coauthors as the primary correspondent with the editorial office during the submission and review process. If the manuscript is accepted, the corresponding author will review an edited manuscript and proof, make decisions regarding release of information in the manuscript to the news media or federal agencies, handle all postpublication communications and inquiries, and will be identified as the corresponding author in the published article. The corresponding author also is responsible for ensuring that the Acknowledgment section of the manuscript is complete (see Acknowledgment Section) and that the conflict of interest disclosures reported in the Acknowledgment section of the manuscript are accurate, up-to-date, and consistent with the information provided in each author's potential conflicts of interest section in the Authorship Form (see Conflicts of Interest and Financial Disclosures). The corresponding author also must complete the Acknowledgment statement part of the Authorship Form confirming that all persons who have contributed substantially but who are not authors are identified in the Acknowledgment section and that written permission from each person acknowledged has been obtained. Requests for co-corresponding authors will be considered on a very limited basis if justified, but no more than 2 co-corresponding authors will be permitted. In such cases, a primary corresponding author must be designated as the point of contact responsible for all communication about the manuscript and

article, manage the tasks described above, and will be listed first in the corresponding author section.

JAMA establishes the principle that changes to the list of authors may only be considered exceptionally, adding in the Changes in Authorship section:

> Authors should determine the order of authorship among themselves and should settle any disagreements before submitting their manuscript. Changes in authorship (i.e., order, addition, and deletion of authors) should be discussed and approved by all authors. Any requests for such changes in authorship after initial manuscript submission and before publication should be explained in writing to the editor in a letter or email from all authors.

These proposals aim to increase for readers, editors, reviewers and evaluators the transparency of the research process and the role of each researcher in creating the paper.[249] With these authorship attribution rules and the inclusion of additional information, the reader of the text will have a much better understanding of who did what in the course of the research and what they can take responsibility for. What is essential is that the right to be an author based solely on rules specific to copyright law has been broken. A scientific author began to be qualified by a description of what they had done in the course of the research process, based on a description of the subject matter and the importance of their intellectual contribution to the research. This highlighted a widespread trend in the sciences and life sciences to associate scientific authorship in biomedicine with the authorship of the intellectual contribution to the research, which can take various forms, not just a work in the sense of copyright. Scientific authorship is therefore invariably about rewards, not rights. The author is the creator of the work, but is also "produced" (i.e., recognised and rewarded for doing so) by the members of the research team for their essential and intellectual contribution to the published research results.

Invariably, however, scientific authorship is linked to responsibility for the quality and reliability of published research results. Members of the research team are responsible for the relevant part of the manuscript according to the subject matter and the importance of their contribution to the research and the part of their work. Notwithstanding this, recommendations

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[249] Biagioli, "Rights or Rewards?", 266–269.

from the scientific community indicate that one or more authors should take public responsibility for the integrity of the work as a whole, from when the research project is undertaken to the published article. Such a member of the scientific team should be distinguished in the list of authors of the paper with the position of last author or last and so-called star (corresponding) author. The obligating of such a principle in the scientific community is confirmed by the example of the circumstances surrounding the retraction of four articles co-authored by Gregg L. Semenza, from the Proceedings of the National Academy of Sciences (*PNAS*).[250] Gregg L. Semenza, a researcher from Johns Hopkins University, shared the 2019 Nobel Prize in Medicine or Physiology. Retractions were linked to images in the articles. According to *Retraction Watch*,[251] a representative notice about retractions is:

> We are retracting this article due to concerns with Figure 5. In Figure 5A, there is a concern that the first and second lanes of the HIF-2α panel show the same data, and that the first and second lanes of the HIF-1α panel show the same data, despite all being labeled as unique data. In Figure 5D, there is a concern that the second and third lanes of the HIF-1β panel show the same data despite being labeled as unique data. We believe that the overall conclusions of the paper remain valid, but we are retracting the work due to these underlying concerns about the figure. Confirmatory experimentation has now been performed and the results can be found in a preprint article posted on bioRxiv, "Homeostatic responses to

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[250] D. M. Gilkes, L. Xiang, S. J. Lee, P. Chaturvedi, M. E. Hubbi, D. Wirtz, and G. L. Semenza*, "Hypoxia-inducible Factors Mediate Coordinated RhoA-ROCK1 Expression and Signaling in Breast Cancer Cells," https://doi.org/10.1073/pnas.2213288119; G. Yuan, Y.-J. Peng, V. D. Reddy, V. V. Makarenko, J. Nanduri, S. A. Khan, J. A. Garcia, G. K. Kumar, G. L. Semenza*, and N. R. Prabhakar*, "Mutual Antagonism between Hypoxia-inducible Factors 1α and 2α Regulates Oxygen Sensing and Cardio-respiratory Homeostasis," https://doi.org/10.1073/pnas.2213287119; K. Lee, D. Z. Qian, S. Rey, H. Wei, J. O. Liu, and G. L. Semenza*, "Anthracycline Chemotherapy Inhibits HIF-1 Transcriptional Activity and Tumor-induced Mobilization of Circulating Angiogenic Cells," https://doi.org/10.1073/pnas.2213285119; D. Samanta, D. M. Gilkes, P. Chaturvedi, L. Xiang, and G. L. Semenza*, "Hypoxia-inducible Factors Are Required for Chemotherapy Resistance of Breast Cancer Stem Cells," https://doi.org/10.1073/pnas.2213289119.

[251] "Nobel Prize Winner Gregg Semenza Retracts Four Papers," https://retractionwatch.com/2022/09/03/nobel-prize-winner-gregg-semenza-retracts-four-papers/?fbclid=IwAR3YdWPToxFWc5B-F2pc2V6PQuY-e4G5dVD8pz28s0CMCD3GLZoVcMUMPMs.

hypoxia by the carotid body and adrenal medulla are based on mutual antagonism between HIF-1α and HIF-2α" (https://doi.org/10.1101/2022.07.11.499380). We apologize for the inconvenience.

The Nobel laureate has been prominent on the list of authors of all retracted papers. He has acted as a so-called star author (corresponding author). This was sufficient reason for the scientific community to hold this one of the authors publicly responsible for the lack of quality and reliability of the published research results and the lack of adequate quality of how they were presented. Leonid Schneider reports on this by explaining: "There are some recurrent author names suggesting naughty mentees or collaborators, but still, in many cases Semenza is the last and corresponding author, so the final responsibility is his. After all, also Nobel Prize recognition comes from that same last authorship."[252]

Given the complexity of research being conducted today, as well as its interdisciplinary nature, it is difficult to require that one or more authors can take such responsibility and act as guarantor. In the case of transdisciplinary projects in particular, it would be difficult to identify an individual who, as guarantor, could ensure the integrity of the entire project and organise, supervise and double-check the publication. The granting of guarantor status should be linked to the role of a kind of auditor who, with due diligence by reference to their knowledge and competence, acting in good faith, will verify the effects of the team's work before the publication of the research results. If, after the publication of the research results, errors are found in them or fraud is detected, they will immediately react to the disclosure of such information and make the necessary changes to the work (submit errata or retraction).

This finding can be contrasted with the practice of attributing authorship to selected publications dedicated to the formulation of treatment guidelines for selected diseases. The titles of such articles usually begin with the words "Guidelines…" or "Consensus for…" and the list of authors includes several dozens of names. Importantly, these articles are not scientific in the strict sense of the word, as they do not present new scientific findings,

[252] "Gregg Semenza: Real Nobel Prize and Unreal Research Data, *For Better Science by Leonid Schneider, on research integrity, biomedical ethics and academic publishing*" (October 7, 2020), https://forbetterscience.com/2020/10/07/gregg-semenza-real-nobel-prize-and-unreal-research-data/.

but rather deal with the practical application of these findings to determine the most appropriate treatment for a given disease based on a wealth of statistical material from treatment outcomes in multiple clinics in different countries. A paper co-authored by Professor Barbara Jarząb[253] from the Institute of Oncology in Gliwice can be cited as an example. Professor Jarząb was involved in research published in an article on the treatment of thyroid cancer,[254] "European Consensus for the Management of Patients with Differentiated Thyroid Carcinoma of the Follicular Epithelium,"[255]which is representative of the publications discussed here. The authors of this article are thyroid cancer endocrinologists. This is a very elite team, grouping together a team coordinating the collection of statistical data and one representative of endocrinologists from each European country (identified as: Group Author—the European Thyroid Cancer Taskforce). The text of the publication is mainly edited by the coordinator (Furio Pacini), who is the first author. Country representatives are listed after the coordinating authors, in alphabetical order of the countries they represent.[256] Professor Jarząb also co-authored, along with thirty-six other scientists and other contributors, of the article "Combination Chemotherapy in Advanced Adrenocortical Carcinoma."[257] This publication in the most prestigious medical journal is in turn an original paper on the treatment of adrenocortical carcinoma, a very rare but life-threatening disease. It presents comparative results obtained in many clinics around the world (multicentre randomised trial). Almost forty clinics

[253] She is Poland's most eminent endocrinologist, a member of the Polish Academy of Sciences and once a national consultant in endocrinology. While still a Barbara Gałęziowska, she won a silver medal at the International Chemistry Olympiad, but never studied chemistry.

[254] It is indicated in the section: Acknowledgements.

[255] F. Pacini, M. Schlumberger, H. Dralle, R. Elisei, J. W A Smit, and W. Wiersinga, "European Consensus for the Management of Patients with Differentiated Thyroid Carcinoma of the Follicular Epithelium," *European Journal of Endocrinology* 154, no. 6 (2006): 787–803, https://doi.org/10.1530/eje.1.02158.

[256] Additional members of the First International Randomised Trial in Locally Advanced and Metastatic Adrenocortical Carcinoma Treatment (FIRM-ACT) study group are listed in the Supplementary Appendix to that work.

[257] M. Fassnacht, M. Terzolo, B. Allolio, E. Baudin, H. Haak, A. Berruti, S. Welin, C. Schade-Brittinger, A. Lacroix, B. Jarzab, H. Sorbye, D. J. Torpy, et al., for the FIRM-ACT Study Group, "Combination Chemotherapy in Advanced Adrenocortical Carcinoma," *New England Journal of Medicine* 366, no. 23 (2012): 2189–2197, https://doi.org/10.1056/NEJMoa1200966.

participated in the study, hence the large number of dozens of co-authors. This group of forty collaborating clinics was organised by the lead authors gathered in the ENs@t scientific network. For this and similar articles, the text is edited by scientists from the research coordination group. The order of subsequent, non-coordinating group scientists is usually alphabetical or according to "merit," that is, according to the number of patients the author has induced to undergo a novel therapy. Co-authors outside the coordinating group are de facto not involved in the editing of the text, they are limited to approving the final version.

4.3.7. Conclusions

> All Nature and its laws lay hid in night.
> God said, Let Newton be! And all was light.
> — epitaph by Alexander Pope, D. Gjertsen, *The Newton Handbook* (London, New York: Routledge and Kegan Paul, 1986), 439.

Despite significant differences in the research subjects and the scientific method used in research in different domains of hard sciences and natural sciences, many common denominators can be identified. The paradigm of scientific authorship is not based on rules specific to intellectual property law. These rules prove unsuitable for regular collaborative research activities. This finding is valid whether the research activity is carried out by a few scientists in a narrow scientific domain or by large research groups of multidisciplinary character. Scientific authorship is based on a significant intellectual contribution to a research project, which may or may not necessarily express itself in developing part or all of a scientific publication, that is, a work within the meaning of copyright law. A Scientific Author is an individual who makes an original finding about the world that they demonstrate using the scientific method. Scientific authorship is also inextricably linked to the responsibility for the quality and reliability of the research process and the published research results. Depending on the area of knowledge, each author of a multi-authored paper is either responsible for the entire manuscript or for the relevant part of the manuscript within the field of research for which they were responsible (interdisciplinary projects). The principle of mutual loyalty and trust among team members is also required in research work.

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Index of Personal Names

Material Index—Terminology

Anna Chorążewska, Adam Proń

Intellectual Property Rights and Scientific Authorship:
Legal and Ethical Considerations
Case Study in Hard Sciences and Natural Sciences

Summary

The interplay between human rights and intellectual property law, particularly concerning protecting science creators' moral and property rights, has become increasingly pertinent in recent times. As early as the 1980s, technological advancements led to more complex research methodologies and collaborative dynamics among researchers, particularly with the rapid growth of interdisciplinary research. In the 21st century, these challenges have only intensified. Moreover, the emergence of "data-driven science," alongside financial considerations, national science policies, and the global influence of rapidly developing countries like China, significantly shape research agendas, especially in hard sciences, life sciences, and medicine. Consequently, there is a growing demand for transdisciplinary research projects involving multi-person teams comprising scientists and technical support staff. The outcomes of such projects often manifest in the form of multi-authored scientific publications or collaborative invention projects. The involvement of researchers in such projects can take various forms, from conceptualising scientific ideas and formulating hypotheses to conducting experiments, making a scientific discovery or establishing scientific truth, but also in merely designing an experiment or obtaining experimental data in a measurement process and analysing them with interpretation. However, not all research outcomes align neatly with the categories of intangible goods defined in intellectual property law, leaving researchers without legal protection for their contributions under copyright or patent law.

It should be explained that it is generally accepted in intellectual property law that a research contribution may obtain legal protection when it demonstrates the capacity to be established in the form of an intellectual good defined in the legal system. In the case of a work subject to copyright protection, the effect of the research activity should be established in any form, however impermanent, but stable enough to be perceived by persons other than the

creator. In addition, its nature should be individualised and thus constitute a materialised original product of the human intellect. In the research process, often important and essential research contributions, even those that condition the success of the entire project, do not demonstrate this capacity. The issue of the lack of adequate and effective guarantees for legal protection of the fruits of scientific labour has been recognised in the literature. The authors of this book have set themselves the goal of contributing to the ongoing discussion on this subject. They seek to answer questions regarding the definition of a science creator, the essence of scientific authorship, and the recognition of individual contributions to the advancement of knowledge in the contemporary world of team-based research conducted by large interdisciplinary teams.

The authors of the book examine the topic from various perspectives. Firstly, they explore the scientist's right to be recognized as a co-author of a scientific work, whether it is established in the form of a research article, a poster presentation, or an oral presentation at a conference. Secondly, they delve into the criteria used in academic promotion procedures to assess an individual's contribution to the state of knowledge, which is crucial for the award of scientific degrees. These analyses help identify the prerequisites necessary to establish authorship of scientific achievements presented in degree applications. It is worth noting that determining an individual's contribution to the advancement of knowledge is often complex. Scientific research typically involves building upon the work of predecessors and collaboration with other researchers. The complexity of research problems means that a researcher rarely works alone or as a member of a small research group. Consequently, in promotion proceedings, scientific achievements are often documented by multi-authored articles and inventions. Determining rightful authorship of scientific achievements resulting from collaborative research and building upon previous work requires exceptional clarity of thought, objectivity, and expertise in the relevant scientific fields.

Pursuing answers to these questions compelled the authors to undertake interdisciplinary analyses. Examining the legal framework surrounding scientific authorship, the right to authorship, and comparing them with associated ethical standards became necessary. Consequently, the considerations presented in this book are approached from the perspective of legal sciences, encompassing intellectual property law, jurisprudence, and science studies. The research problem was defined accordingly, and the authors' ambitious objectives shaped the structure of this work, dividing it into two parts. The first part, authored by Anna Chorążewska, analyses the freedom of scientific research as a constitutionally protected category and the legal foundations for safeguarding authorship of scientific works under Polish law, considering both domestic and comparative legal aspects. The analysis is grounded in the thesis that an individual making an independent, creative (original), and significant contribution to a collaborative research project has the right to be recognized as a co-author of the resulting scientific work, disseminating the jointly obtained research outcomes.

The second part of the book, co-authored by Anna Chorążewska and Adam Proń, a lawyer and a representative of hard sciences with considerable research and reviewing experience, examines the legal and ethical considerations surrounding team-based scientific research in the fields of hard sciences and natural sciences. This analysis is approached from a perspective shaped by the insights of science studies, with due consideration given to the historical evolution of the scientific system and the evaluation of scientists. The foundation of these considerations and their prism are the views of the precursor of science studies, Professor Józef Pieter (1904–1989), a Polish psychologist, philosopher and pedagogue, as well as an academic teacher at several Silesian universities. Pieter's seminal monographs, in which he analysed scientific work as a manifestation of human creative work, become a contribution for the authors in their research on such issues as types of scientific work, scientific method, the phenomenon of mentoring in science, the subject and nature of the contribution to research, legal and ethical grounds for attribution authorship of scientific works and authorship of scientific achievements.

The analyses conducted led the authors to two main findings. Firstly, the determination of binding ethical principles for the attribution of authorship of scientific works. Considering the legal and ethical context, the authors also address who is entitled to authorship of scientific work and who should only be mentioned in the article's Acknowledgments section. Secondly, within the legal and ethical framework and considering the comparative background, the principles for effectively demonstrating authorship of scientific achievement—namely, authorship of an independent and individualized contribution to the state of knowledge by degree or title applicants in promotion proceedings—are outlined. The text also discusses the proper documentation of authorship of such achievements in Polish promotion proceedings, which were not published as a single-author monograph but as a single series of thematically related multi-authored scientific articles. The book aims to stimulate discussion in the scientific community about the boundaries of science and the system of rewarding the contribution of individual scientists to the state of knowledge, both in terms of attributing authorship to scientific articles and promotion proceedings.

Keywords: freedom of science, intellectual property rights, scientific authorship, ethical rules of authorship attribution of research work, responsibility for the content of the publication, creator of science, procedure for the award of academic degrees and titles

Anna Chorążewska, Adam Proń

Prawo własności intelektualnej i autorstwo naukowe: Rozważania prawne i etyczne Studium przypadku nauk ścisłych i przyrodniczych

Streszczenie

W ostatnim czasie niezwykle aktualna stała się problematyka wzajemnych relacji między prawami człowieka a prawem własności intelektualnej oraz ochrony praw osobistych i majątkowych twórców nauki. Już w latach osiemdziesiątych minionego wieku, wraz z postępem technologicznym, metody prowadzenia badań i relacje pomiędzy współpracującymi badaczami stały się bardziej skomplikowane, szczególnie w świetle szybko rozwijających się badań interdyscyplinarnych. Obecnie, w XXI wieku, wszystkie te problemy stają się jeszcze bardziej złożone. Dodatkowo zjawisko *data-driven science*, uwarunkowania finansowe oraz polityka naukowa państw, a także presja wywierana na świat przez prężnie rozwijające się tak gospodarczo, jak i naukowo Chiny istotnie wpływają na kierunki badań, zwłaszcza w obszarze nauk ścisłych, przyrodniczych czy medycznych. Następstwem tych przemian jest wzrost zapotrzebowania na transdyscyplinarne projekty badawcze, realizowane przez wieloosobowe zespoły tworzone przez naukowców oraz personel wsparcia technicznego. Wyniki takich badań ogłaszane są w formie wieloautorskich utworów naukowych lub wieloautorskich projektów wynalazczych. Udział badacza w realizacji takich projektów może przybrać różną postać. Może polegać na postawieniu idei czy tezy badawczej, dokonaniu odkrycia naukowego lub ustaleniu prawdy naukowej, ale także jedynie na zaprojektowaniu eksperymentu czy otrzymaniu w procesie pomiarowym danych eksperymentalnych i ich analizy wraz z interpretacją. Rezultaty działań badawczych nie zawsze wykazują zdolności do wyrażenia w formie właściwej dla określonych w systemie prawa własności intelektualnej kategorii dóbr niematerialnych. W takich przypadkach naukowcy nie uzyskują ochrony prawnej dla owoców swej pracy—ani z prawa autorskiego, ani z prawa wynalazczego.

Wyjaśnić należy, że powszechnie w prawie własności intelektualnej przyjmuje się, że wkład w badania może uzyskać ochronę prawną, gdy wykazuje

zdolność do ustalenia w formie dobra intelektualnego określonego w systemie prawnym. W przypadku utworu podlegającego ochronie z prawa autorskiego efekt działalności badawczej powinien zostać ustalony w jakiejkolwiek postaci, chociażby nietrwałej, jednakże na tyle stabilnej, aby możliwa była jego percepcja przez inne osoby niż sam twórca. Ponadto jego natura powinna być zindywidualizowana, a zatem stanowić zmaterializowany oryginalny wytwór intelektu człowieka. W procesie badawczym często istotne wkłady w badania, nawet warunkujące powodzenie całego projektu, nie wykazują takiej zdolności. Problem braku odpowiednich i zarazem efektywnych gwarancji ochrony prawnej owoców pracy naukowej został już dostrzeżony w piśmiennictwie. Autorzy tej książki postawili sobie za cel włączenie się w prowadzoną w tym przedmiocie dyskusję. Poszukują odpowiedzi na pytanie, kim jest twórca nauki oraz na czym polega autorstwo naukowe i uznanie indywidualnego wkładu w stan wiedzy we współczesnym świecie badań prowadzonych zespołowo przez bardzo liczne interdyscyplinarne zespoły.

Autorzy niniejszej publikacji rozważają wskazany temat z wielu perspektyw. Po pierwsze przez pryzmat prawa naukowca do uzyskania statusu współautora pojedynczej pracy naukowej, ustalonej w formie naukowego artykułu czy posteru albo ustnie w formie wystąpienia konferencyjnego. Po drugie z punktu widzenia stosowanych w postępowaniach awansowych w sprawie nadania stopni naukowych lub tytułu kryteriów uznania istnienia indywidualnego wkładu w stan wiedzy osoby ubiegającej się o ich przyznanie. Te analizy prowadzą do ustalenia przesłanek, których spełnienie jest niezbędne do wykazywania autorstwa osiągnięcia naukowego określonego we wniosku o nadanie stopnia naukowego lub tytułu. Zwrócić należy uwagę, że zidentyfikowanie i wyznaczenie indywidualnego wkładu w stan wiedzy współcześnie nie zawsze jest zadaniem prostym do wykonania. Prowadzenie badań naukowych wymaga korzystania z osiągnięć i ustaleń naukowych innych badaczy. Stopień skomplikowania problemów badawczych powoduje, że naukowiec rzadko pracuje w pojedynkę czy jako członek małej grupy badawczej. W konsekwencji w postępowaniach awansowych osiągnięcia naukowe często są dokumentowane za pomocą wieloautorskich artykułów i wynalazków. Ustalenie, komu przysługiwać powinno autorstwo osiągnięcia naukowego, uzyskanego w wyniku zespołowo prowadzonych badań i na podstawie dorobku poprzedników, niewątpliwe wymaga niezwykłej jasności umysłu, obiektywizmu oraz wiedzy specjalistycznej z badanych zagadnień naukowych.

Poszukiwanie odpowiedzi na te pytania zobligowało autorów do podjęcia analiz o charakterze interdyscyplinarnym. Konieczne stało się zbadanie nie tylko ram prawnych autorstwa naukowego i prawa do bycia autorem, lecz także etycznych. W konsekwencji rozważania prowadzone są w książce z perspektywy nauk prawnych, w tym prawa własności intelektualnej i prawoznawstwa, oraz naukoznawstwa. Tak określony problem badawczy i ambitne cele autorów zdeterminowały również strukturę niniejszej pracy. Została ona podzielona na dwie części. Pierwsza część, autorstwa Anny Chorążewskiej, jest poświęcona analizie wolności badań naukowych jako kategorii chronionej konstytucyjnie oraz problematyce podstaw prawnych do ochrony autorstwa twórczości naukowej na gruncie prawa polskiego z uwzględnieniem tła prawno-porównawczego. Rozważania są oparte na tezie naukowej głoszącej, że autor samodzielnego, twórczego (oryginalnego) i istotnego wkładu w zespołowo realizowany projekt badawczy posiada prawo do uzyskania statusu współautora utworu naukowego, ogłaszającego wyniki wspólnie otrzymanych wyników badań.

Druga część książki, współautorstwa Anny Chorążewskiej i Adama Pronia, prawniczki i przedstawiciela nauk ścisłych o znacznym doświadczeniu badawczym i recenzenckim, analizuje uwarunkowania prawne i etyczne prowadzenia zespołowych badań naukowych w obszarze nauk ścisłych i przyrodniczych z perspektywy refleksji właściwej dla naukoznawstwa z uwzględnieniem tła historycznego rozwoju systemu nauki i oceny naukowców. Punktem wyjścia dla tych rozważań oraz ich pryzmatem są poglądy prekursora naukoznawstwa profesora Józefa Pietera (1904–1989), polskiego psychologa, filozofa i pedagoga, a także nauczyciela akademickiego kilku śląskich uczelni. Wybitne monografie Pietera, w których analizuje on pracę naukową jako przejaw pracy twórczej człowieka, stają się dla autorów przyczynkiem do podjęcia badań nad takimi zagadnieniami jak: rodzaje pracy naukowej, metoda naukowa, zjawisko mentoringu w nauce, przedmiot i charakter wkładu do badań, prawne i etyczne przesłanki atrybucji autorstwa utworów naukowych oraz autorstwa osiągnięcia naukowego.

Przeprowadzone analizy prowadzą autorów do dwóch zasadniczych ustaleń. Po pierwsze wyznaczenia wiążących zasad etycznych atrybucji autorstwa utworów naukowych. Uwzględniając kontekst prawny i etyczny, autorzy udzielają również odpowiedzi na pytanie, kto ma prawo do autorstwa utworu naukowego, a kto powinien zostać jedynie wspomniany w artykule w sekcji Podziękowania. Po drugie, w granicach ram prawnych, etycznych i z uwzględnieniem tła porównawczego, określono zasady efektywnego wykazywania przez osoby ubiegające się o nadanie stopnia lub tytułu naukowego w postępowaniach awansowych autorstwa osiągnięcia naukowego, czyli autorstwa samodzielnego i zindywidualizowanego wkładu w stan wiedzy. Podejmowane jest również zagadnienie właściwego udokumentowania w polskich postępowaniach awansowych autorstwa takich osiągnięć, które nie zostały ogłoszone w formie monoautorskiej monografii, lecz opublikowanego jednego cyklu powiązanych tematycznie wieloautorskich artykułów naukowych. Lektura książki ma zachęcać do podjęcia w środowisku naukowym dyskusji o granicach nauki i systemie premiowania wkładu indywidualnych naukowców w stan wiedzy zarówno przy atrybucji autorstwa artykułów naukowych, jak i w postępowaniach awansowych.

Słowa klucze: wolność nauki, prawa własności intelektualnej, autorstwo naukowe, zasady etyczne przypisywania autorstwa prac badawczych, odpowiedzialność za treść publikacji, twórca nauki, tryb nadawania stopni i tytułów naukowych

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The Creator of Science

A quotation from Percy W. Bridgman
(Nobel Prize in Physics, 1946):

From the point of view of society, the justification for the favored position of the scientist is that the scientist cannot make his contribution unless he is free, and that the value of his contribution is worth the price society pays for it.

A quotation from Linus Pauling
(Nobel Prize in Chemistry, 1954;
Nobel Peace Prize, 1967):

A scientist should try to understand the world, and should not be content to tabulate the results of experiments.

Authors

Anna Chorążewska (Ph.D., D.Sc.), was practising as an attorney at law for 13 years, at present, a judge at the Civil Division of the Sosnowiec District Court, the university professor at the Institute of Legal Studies of the Faculty of Law and Administration of the University of Silesia in Katowice. Author of works dedicated to the issues of the system of governance, particularly focusing on the systemic role of the President of Poland and the constitutional status of local self-government. Currently, the author is interested in matters concerning the constitutional status of an individual and the protection of their freedoms and rights serving that individual, with special emphasis on intellectual property rights.

Adam Proń (Professor, Ph.D., Eng.) specialises in physical chemistry and chemistry of materials. Graduate of the AGH University of Science and Technology. He earned his Ph.D. from the University of Pennsylvania in Philadelphia in 1980, his habilitation from the Warsaw University of Technology in 1988, and his professorship in 1994. He has worked continuously at the Warsaw University of Technology since 1974. He was also an employee of the AGH University of Science and Technology from 1989 to 1996, and of the Commission for Atomic Energy and Alternative Energies in Grenoble (France) from 1998 to 2012. In 2002, he received the Foundation for Polish Science award for his research on electroactive organic materials.

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