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LEIBNIZ'S SCIENTIFIC COLLABORATION WITH ADAM KOCHAŃSKI, S.J.

INTRODUCTION

The life and intellectual activity of the German philosopher and scientist Gottfried Wilhelm Leibniz coincides with the transformation of scientific communities in Europe. This phenomenon manifests itself, above all, in the rise of organizations uniting people concerned with science—viz. scientific societies. Considerable contributions to this process of transformation ought to be ascribed to Leibniz himself.

Correspondence—the exchange of letters between men of science—becomes at that time an important aspect of scientific collaboration and the German philosopher from Hanover actively participates in this way of exchanging information. This exchange of letters helped to evolve a singular international structure uniting European scientists of that age, the so-called "republic of scientists," in which letters containing matters of scientific interests, disseminated in copies, fulfilled the function of scientific publications. Among Leibniz's many correspondents, special attention deserves to be paid to the Polish mathematician and Jesuit, Father Adam Adamandy Kochański (1631–1700). Like the philosopher of Hanover, Kochański exchanged letters with many contemporary scholars and this exchange both illustrates his personal interests and achievements, and forms a valuable source for our study of the philosophy and science of the epoch of the Baroque. The breadth of contacts reveals similarities between the personalities and styles of research of both the correspondents; another common feature is

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their extensive philosophical and scientific interests and the wealth of problems they discussed. Leibniz highly appreciated the competence of the Jesuit scientist and he often expressed his esteem in the letters he wrote to him.

1. THE STRUCTURE OF THE LEIBNIZ–KOCHAŃSKI CORRESPONDENCE AND THE PROBLEMS DISCUSSED

Kochański and Leibniz corresponded in the Latin language. Samuel Dickstein has published a considerable part of their exchange of letters. The whole body of their correspondence can be divided into two parts. The first part (the letters from the years 1670–1671) comprises 25 letters by the Jesuit mathematician and 12 responses by Leibniz. This collection opens with the letter sent from Prague by Kochański on the 7th of June 1670; however, the content of that letter implies that it was preceded by a letter dispatched by Leibniz from Mainz in the early months of 1670. Unfortunately, this letter is lost. Nevertheless, we can conclude from what is said in Kochański's letter that the initiative to begin the exchange came from Leibniz. Kochański's letter dated the 8th of December 1671 closes the first stage of the correspondence between the two scholars.

The exchange reopened after twenty years and this new phase produced the second part of the Leibniz-Kochański correspondence, which comprises 20 letters by the latter with 12 responses from the former correspondent. The Polish scholar's contacts by letters with Leibniz eventually came to an end in 1698.

The scope of problems discussed by both scientists is very large and includes, to quote Samuel Dickstein, such items as: "questions of the new higher calculus and geometry of Descartes, theory of series, the fundamental concepts of mechanics, perpetual motion, cosmosophic hypotheses, theory of gravity and calculating machines;" and "beyond the domain of science in the strict sense, questions concerning politics, history, philosophy of language, ethnography, etc." These latter, as discussed in the correspondence, "bear the characteristic stamp of the epoch."

This quote from Dickstein not only highlights the diversity of topics discussed in their correspondence, but also throws light on the features of the intellectual makeup of both the correspondents. Leibniz is generally recognized as a universal scientist, a philosopher of wide intellectual horizons, an erudite conversant with the whole of the scientific knowledge of his time. Certainly Adam Kochański was not his equal in terms of achievements in the

domains of philosophy and mathematics; still, because of his interests and erudition, he was able to be a valuable partner for the German philosopher in research and exchange of ideas.

2. CONNECTING MATHEMATICS AND PHILOSOPHY

In the Leibniz–Kochański correspondence, the kinds of problems that very frequently come under consideration are mathematical problems. This should only be expected, for both Kochański and Leibniz were distinguished mathematicians. The importance of the German philosopher for the development of mathematics is universally recognized. Although less known, the achievements of his Polish correspondent were valuable for the mathematical sciences as well. For instance, it is worth mentioning his proposed solution to the classical problem of squaring the circle. This problem has been discussed since antiquity. His solution, because of its simplicity, met with general recognition and made him well known in mathematical circles, so that his name was mentioned in the works of some historians of mathematics.

In the time of Leibniz and Kochański, as is generally known, mathematics fulfilled an important role in the development of philosophy; for many of the leading contemporary thinkers, most notably René Descartes, took mathematics as the model for the method of doing philosophy. The author of the *Discourse on Method* began this style of doing philosophy; he hoped to construct a system of philosophical knowledge whose every thesis would be as secure and indubitable as a demonstrated mathematical theorem. The ideal model for a philosophical treatise was found in the famous opus of the ancient Greek mathematician, Euclid, known as the *Elements.* Many philosophers of the seventeenth and early eighteenth centuries, filled with admiration for the precision of Euclid's method in geometry, attempted to develop a *more geometric* or, more generally, a *more mathematic* philosophy. Leibniz also took mathematics for a model for doing philosophy; he even asserted that his philosophical works are a kind of mathematical treatises. The procedures of solving mathematical problems represented for the author of the *Monadology* the model for treating philosophical problems. Thus, for Leibniz, doing mathematics itself is not just preparation for doing philosophy, it is already philosophizing in the full meaning of the word. This is all the more so, for according to Leibniz, the world itself is a rationally arranged structure of beings mutually related, and mathematics is precisely

about discovering these rational structures even where they are not readily noticeable.

Also for Kochański, mathematics is the source of information about the real world (not just a formal structure) and thus, it serves the same purposes as philosophy. The Jesuit mathematician presented this view of the function of mathematics in his letter to Leibniz dated November 9th, 1691. In this letter the Jesuit scholar exhorts the German philosopher to seek the glory of God and, by the same token, the true wisdom and knowledge, not only in natural philosophy, but also in mathematical sciences. In the same letter the Polish Jesuit scientist makes known his interest in the novel method of mathematical analysis newly worked out by Leibniz; he also shows an interest in the second edition of Leibniz's *Ars combinatoria*, which he would like to purchase for his associates. Furthermore, he asks about the publication of Leibniz's work on geometry that had previously been announced in *Acta Eruditorum*. Kochański's interest in Leibniz's studies in geometry was prompted by the research he conducted on polygons inscribed into a circle. The Polish mathematician sought a general rule for calculating the length of the edges of any polygon inscribed into a circle. In his letter of the 9th of November 1691, he mentioned the method given by the Dutch mathematician Ludolf van Ceulen that enabled the calculation of the length of the edge of an inscribed polygon of 80 sides. Using van Ceulen's method, the Polish mathematician worked out the calculus for the lengths of the edges of polygons having up to 100 edges; however, he remained uncertain about his calculations for polygons with 83, 89 and 97 edges. Later in his letter, Kochański mentions his project of compiling mathematical tables that would facilitate practical calculations of the lengths of the edges of inscribed polygons.

In a response letter dated the same year, Leibniz gave Kochański exhaustive answers to his questions. With reference to Kochański's efforts on the mathematical tables facilitating the calculation of the lengths of the edges of inscribed polygons, Leibniz advised his correspondent to entrust this work, as consuming much effort, to a younger person while limiting himself to supervising the work's progress, and to focus on problems which require acumen rather than labor. Above all, the great mathematician communicated to the Polish Jesuit a general formula for calculating the length of a section of a given circle, when a tangent line to that section and the radius of the circle are given; he adds that this formula has been discovered by himself and was ignored both by Descartes and the French mathematician François Viète. He also points to the possibility of applying the new geometry to the treatment of

problems in physics and mechanics. In the same body of letters, he indicates the usefulness of the newly discovered differential and integral calculus for making further progress in both mathematics and philosophy of nature.

Leibniz discussed this last issue in his letter to Kochański dated the 20th of June 1694, where he expounded the principles of the differential and integral calculus; among other things, there is a definition of the differential and formulas for the differential of a sum, product, quotient and root of a function. There Leibniz also explained to Kochański the essence of the operation of integration with a diagram of a curve. Also mentioned in this letter is the second order differential. In the letter of July 26th he updates Kochański on the usefulness of the new calculus discovered by him in geometry and explains the essence of the higher order differentials, adding information about the successful results achieved by Christiaan Huygens due to an application of differential and integral calculus.

Adam Kochański fully appreciated the importance of the new division of mathematics discovered by Leibniz as well as the advantages that can be obtained by putting Leibniz's new theory to use in scientific research. He presented his own position on this subject in his succeeding letter to the philosopher of Hanover. Actually, Kochański had already been acquainted with the principles of the new calculus before starting his letter exchange with Leibniz, through reading the latter's articles on the subject published in *Acta eruditorum,* the scientific periodical whose collaborator was Kochański himself. As a matter of fact, Kochański was the first Polish scientist to familiarize himself with Leibniz's new infinitesimal calculus and to understand its importance for the further development of science. However, his advanced age, poor health and the lack of interest in his research, on the part of those close to him, resulted in the fact that the opportunity for the Polish scientific community of the 17th century to familiarize itself with the discovery, made by the polymath of Hanover, that set a new direction for the development of the new experimental physics, was lost.

3. THE CALCULATING MACHINE

Among the mathematical problems mentioned in the correspondence between these two scientists, there appears a very special issue concerning the interface between mathematics and engineering, namely the problem of constructing a machine that would be capable of performing basic arithmetic

operations. Adam Kochański worked for many years on the construction of a calculating machine; he was particularly busy with this task between the years of 1692–1698. His exchange of letters with Leibniz was an opportunity to share his ideas as well as discuss the difficulties and seek new solutions.

In May of 1692, the Polish mathematician learnt from the German polymath's letter about his work on a calculating machine; in response he informed his correspondent of his own undertaking concerning a similar project. Kochański envisioned a calculating machine capable of performing the complicated operations of division and multiplication. The machine contemplated by the Polish scientist was to be a perfected version of a device described by John Napier (1550–1617). Applying the so called Napier's bones to an appropriate cylinder or a prism in the expected device should—according to Kochański—enable the performance of complex operations not reducible to mere addition and multiplication. However, the mechanism, thus devised, did not yield satisfactory results for more complicated calculations. Leibniz referred to this problem in a letter of July 1692 in which he explained that his own calculating machine was substantially different from the construction using Napier's bones; he had presented his invention in 1680 in Paris and London, where it provoked Christiaan Huygens' interest. Kochański, in his response letter, also showed himself to be interested in the details of the construction of Leibniz's calculating device and from the remarks and suggestions he made, it shows that his own work on an arithmetical machine were very much advanced.

From that time on, the problem of the construction of the arithmetic machine was a subject often touched upon in their correspondence. In particular, in his letter of August 1695, Kochański urged Leibniz to publish a description of the construction of his calculating machine. In a letter dated the 26th March 1696, the German scientist informed Kochański of the completion of the second specimen of his calculating device and invited his correspondent to visit him in order to study its construction. Leibniz emphasized the differences between his machine and other devices of that kind, adding that the construction and the operation of his invention were so simple that even a child could use it. The contemplated meeting between the two men, no matter how desired by both of them, never came to be.

As is made evident by their further exchange of letters, Kochański continued to work on his project of making an arithmetic machine using Napier's bones. He updated Leibniz on the progress of his work in a letter in March 1697; from what he says therein, it follows that the problems he

struggled with were mostly of a technical nature. The progress of his undertaking was also delayed by his preoccupation with other projects, such as building a perpetual motion machine, a *perpetuum mobile*, and pursuit of research in the domain of alchemy. It is worth mentioning that during the time of the second stage of his correspondence with the German philosopher, Kochański was already seriously ill and permanently stayed in Teplitz-Schönau in Bohemia. All these factors combined to prevent him from bringing his project of a calculating machine to a successful conclusion. In the letter dated June 25th 1697, one of his last addressed to Leibniz, he expressed his joy at Leibniz's achievements related to his new calculus and the mathematical analysis it enabled; yet he added that owing to the grave condition of his health and decreasing physical and intellectual strength, he was no longer able to fully grasp the conceptions contained in his correspondent's mathematical works.

4. PHILOSOPHY'S CONNECTION WITH THE EXPERIMENT AND TECHNOLOGY

One very curious aspect of Kochański's attitude as a scientific researcher was his fondness for constructing new devices, machines that might be useful in research work as well as in everyday life. His effort to build a machine capable of performing calculating operations, a subject on which he consulted and exchanged ideas with Leibniz, is just one instance of this passion. Another subject frequently discussed in the correspondence between both men was Kochański's attempts to build a perpetual motion machine—a *perpetuum mobile.* While occupied with the construction of new machines and research instruments, the Jesuit mathematician busied himself by studying the works of experts in relevant domains of science and technology, including philosophical treatises. Thus, his work on the manufacture of elliptical and hyperbolical lenses led him to study the works of René Descartes. A side effect of this study was Kochański's thorough acquaintance with the philosophy of the author of the *Discourse on Method*; yet what Kochański principally achieved with his study of Descartes' doctrine was forming a theoretical conception of a manufacturing device for making lenses. Kochański reported this achievement in a letter to Leibniz dated the 18th of November 1671.

Kochański's occupation with constructing machines met with interest and support on the part of Leibniz; in fact they represented a confirmation of

some of the philosophical conceptions of the German polymath, who held that the pursuit of philosophy should take into account the practical aspect of knowledge. Thus, it was only natural for Leibniz to approve of the Polish mathematician's activity in constructing new apparatuses and instruments useful for scientific research. One of the fundamental principles of the philosophy of the author of the *Monadology* concerned the connection between theory and practice; it was the principle *theoria cum praxi,* where by *praxis* he meant productive technical activity. Reciprocal interaction between philosophy and science on one hand, and practical (which here means technical) activity on the other hand is, according to Leibniz, a necessity. Philosophy, when severed from its links with technology, degenerates and becomes an ivory tower occupation, yet the same is true for technology when pursued without contact with theoretical science. Leibniz envisaged the future of philosophy and science as a collaboration of theorists and practitioners of technical activity, including among the latter, the experimental scientists occupied with empirical verification of the conceptions arrived at by means of theory alone.

Thus, if we consider Kochański's involvement in the task of constructing new machines, including the arithmetic machine, from the point of view of Leibniz's *theoria cum praxi* principle, the interest of Leibniz in the Polish mathematician's work is easily comprehensible. He could not fail to see in the Polish Jesuit someone whose attitude and activity realized one of the essential ideas of his philosophy. By the same token, he must have construed Kochański's technical pursuits as a kind of philosophizing.

Yet, it has to be observed that not all of the strenuous efforts of the Polish scientist met with enthusiastic appreciation on the part of Leibniz. For example, Leibniz's was resolutely pessimistic about the possibility of success of Kochański's efforts to construct a perpetual motion device—a *perpetuum mobile*—a position he expressed in his letter of 1680 to the Jesuit mathematician. Leibniz's arguments rested upon the incompatibility of the assumption of the reality of perpetual motion with some theses of his dynamics. In particular it was incompatible with the fundamental principle stating that in a given instance of causal action "the total effect of a cause is always equal to the total input of action by that cause: 'effectum integrum semper causae plenae aeequalem esse'." Far from being discouraged by his correspondent's reaction, Kochański never gave up his efforts to produce ever new and, in his opinion, more perfect versions of his perpetual motion machine; some of these he communicated to Leibniz in his letter dated the 18th of April 1689. Kochański

was gifted enough as a constructor; as to his *perpetuum mobile* project he kept undertaking his attempts at construction until the very end of his life.

Kochański had more luck and achieved recognition as a clockmaker. The crucial problem in constructing a time measuring device is the mechanism of motion. Kochański's clocks measured time with great precision, made possible by his working out an improved driving mechanism, free from outside disturbances. It is possible that his successes in the construction of new clockwork mechanisms inspired him with the idea that building a new machine that endlessly drives itself lies within the limits of possibility. Naturally, his efforts in this direction were doomed to yield no success, as construction of such a device would imply contradicting the principles of classical thermodynamics. The first principle of thermodynamics states that a machine that would function without some supply of energy from an outside source is not possible. The second principle of thermodynamics affirms that it is not possible to build a device that would draw thermal energy from the surroundings and convert this energy entirely into the performed work. Even though such transformation of energy would be in accordance with the law of the conservation of energy, it would still contradict the law affirming that entropy increases in all thermodynamic processes.

However, Kochański's attempts to build a perpetual motion machine can, to a large extent, be understood and even justified. In his time the principles of thermodynamics, which identify the grounds of the impossibility of that kind of device, were not yet formulated. The Polish Jesuit was not the only reputable scientist to attempt constructing a perpetual motion machine. Many other scientists, both in his days and in subsequent time, undertook similar attempts; only few, like Leibniz, questioned the fruitfulness of these attempts.

5. THE PROBLEM OF ARISTOTLE'S PHILOSOPHY

In the correspondence under discussion, we find Kochański's statement concerning the philosophy of Aristotle. Naturally, he was familiar with the Stagirite's doctrine, which he studied as the main subject of his philosophical curriculum in Jesuit schools. His judgment of the philosophical achievement of the Greek thinker appears in connection with Leibniz's request addressed to himself to help the German philosopher to come into contact with other Polish Jesuits. In the letter of July 18th, 1696 written in Teplitz-Schönau, the Jesuit mathematician acknowledges the difficulty of fulfilling

his correspondent's request; the reason being that those among the Polish Jesuits who enjoyed the reputation of being the best educated were those who exceled in Aristotelian philosophy and in scholastic theology. Yet this area of study is foreign to him, all the more so as, in his opinion, Aristotle's way of thinking is disapproved of amongst mathematicians. This statement is in accordance with the fact that Kochański's scientific interests concerned mostly mathematical problems.

Kochański's reservations about the Stagirite's philosophy were grounded in his own experience of it, which he had acquired when following the philosophical curriculum in Jesuit schools. This curriculum had been set down by the statute concerning schools which had been in force throughout the whole of the Jesuit order. This document determined with precision what kind of philosophy had to be taught to lay students and to the members of the order. The propaedeutic of philosophy consisted in the study of the Latin language as based on the works of the Roman orator and philosopher Cicero, while the further study comprised "philosophy (metaphysics and physics) based on the works of Aristotle and his commentators, and also mathematics which is useful in the study of philosophy and theology." One of the traces of Kochański's study of Aristotle was his acceptation of the designation and conception of mathematics as theoretical philosophy according to the famous dichotomy of all knowledge into theoretical and practical. The former comprises metaphysics and physics as well as mathematics, which were in turn understood as including astronomy and mechanics.

Kochański's appreciation of Aristotelianism is fairly critical; one can observe his tendency to distance himself intellectually from this kind of philosophy. However, in some other statements and scientific publications, he appears more appreciative of the achievements of that school of philosophy that are valuable for science. Kochański acknowledged the keenness of Aristotle's mind, although he thought that the Stagirite in his efforts to arrive at truth relied too much on reasoning alone, while disregarding the experimental approach to investigate reality. For, we find phenomena in nature that cannot be explained by reasoning alone, that is reasoning not supported by the experience of investigated reality. There are problems in natural philosophy to the treatment of which reason alone—according to Kochański—is not enough. The phenomenon of gravity provides him with an apt illustration of his point. He finds Aristotle's explanation of gravity unconvincing as it relies exclusively on concepts and ignores all the data that can be obtained by experiment.

Kochański refers to the philosophical views of Aristotle in a more positive fashion in his treatise on statics published in the work *Cursus mathematicus* edited by Gaspar Schott. In this work, Kochański defends the Aristotelian theory of statics, although he strives to bring the Stagirite's views into agreement with the positions of his contemporaries. According to Jan Kucharzewski, a historian of the mechanics of the so called Jesuit school, Kochański's treatise was written in the peripatetic manner, yet it was open to the new investigations of his own epoch: as Kucharzewski stated, "among all that medieval apparatus of the treatise, the fresh currents of Renaissance air are all but lacking."

Kochański's appreciation of Aristotelianism allows one to see what purpose he assigns to philosophy. Philosophy's objective is obtaining well grounded knowledge of the surrounding world. To achieve this, one ought to use reasoning, precise definitions of concepts and demonstrations to justify the affirmed theses. Yet all the efforts by the investigating human mind should be supported by experimental contact with the investigated phenomena.

6. LINGUISTIC PROBLEMS

The Baroque period was a time of dynamic development of research in the sphere of linguistics. Oriental languages were of particular interest to the intellectual communities of Europe, Protestant as well as Catholic, namely Chinese idioms as well as other tongues of the Far East. One of the objectives that inspired that development of modern linguistic was generating a universal language, which might function as a perfect tool in treating scientific problems and facilitating the solution of social and even religious problems. Adam Kochański joined in the current of investigations that occupied many of his illustrious contemporaries; he exchanged letters discussing linguistic subjects with many scholars, Leibniz included.

The problems related to languages first appeared in the letter exchange between Kochański and Leibniz in 1691 and kept returning nearly until the end of the life of the Polish Jesuit. In Leibniz's correspondence of that period, the Chinese language and the languages of peoples inhabiting Siberia under Muscovite rule are the focus of particular interest. His interest in Chinese was a result of the work he had undertaken on compiling a Chinese dictionary: *Clavis sinica*. The Polish King John III Sobieski played an important role in providing him with information on some of those eastern lan-

guages. Leibniz wrote with appreciation about the Polish king in his letter to Kochański in December 1691, extolling the king's generally admired education and erudition. The German philosopher wanted to enlist the king's help in obtaining the text of the Lord's Prayer in the languages of the peoples inhabiting Siberia as well as information concerning the languages of the nations living in the territories to the east of the Polish-Lithuanian Commonwealth. He needed this data for his comparative studies of the languages of the Tatars inhabiting Asia and Eastern Europe.

In his letter of the 18th of January 1692, Kochański informed his German friend that the languages of the Tatar nations living in Asia and Europe differ very much; he also characterized other non-typical languages, such as Lithuanian, Hungarian and Wallachian. He assured his correspondent of King John III's help, to whom a part of Leibniz's letter had been communicated. The following month, without waiting for Leibniz's response letter, Kochański sent another communication, which was dated the 9th of February 1692. In this message he passed on to his correspondent compliments from the king for the "estimable correspondent from Hanover" and as much information as the king possessed about languages spoken in the "land of the Scythians," as Leibniz used to call the lands north of the Black and Caspian Seas. The Polish monarch had no information whatsoever about the people speaking Hungarian who lived in these territories; instead he promised to obtain for Leibniz the text of the Lord's Prayer in the languages of people inhabiting Siberia. As far as the relationship between the languages spoken by Asian and European Tartars was concerned, Kochański held that they have no more than a few words in common.

Leibniz responded to Kochański's communication from the 9th of February with a letter dated the 21st of March 1692. He asked to pass his expressions of gratitude to King Sobieski for his assistance; he praised the Polish monarch for his contribution to the advancement of knowledge about the peoples of the East and Siberia and about their languages. He renewed his request for the text of the prayer *Our Father* in the languages of the Perekop, Astrakhan, and Kazan Tatars, and the Bashkirs, Circassians, Samoyedic peoples, in addition to the Mongols and other nations. He also shared with Kochański his observation that besides neighboring nations whose languages are alike and related, one finds peoples who, as far as their language is concerned, are like islands among other peoples, the adduced example being Hungarians in Europe.

In his following letter to Leibniz, dated the 30th of May 1692, Kochański asks his correspondent for patience in waiting for the requested various languages texts of the Lord's Prayer, in the meantime he shared with the Hanoverian his own linguistic observations, quoting examples of similarities between Asian and European languages. He pointed to the need for a dictionary of terms current in European languages providing the pronunciation in diverse tongues in a universal phonetic script.

In a letter from July 1692 to the Polish Jesuit, Leibniz mentioned the problem of the universal language that he was then working on, he also mentioned other projects of his, such as the exploration of languages spoken by the inhabitants of the Russian empire, his project of tachygraphy (a kind of stenography, the art of quick notation) and the project of examining the text of the prayer *Our Father* in oriental languages.

Leibniz also took a lively interest in Slavonic languages and he expressed regret to his Polish friend that knowledge concerning these languages is weak. He expressed a wish to obtain a Polish dictionary in order to be able to study the roots of words common to Polish and other languages. He believed that studying Slavonic languages would be useful in the research on the origins of Germanic states and other nations. In his letter from January 1693 he voiced the view that in the past Germanic, Slavonic and other families of European languages were much closer to one another.

The problem of obtaining the text of the Lord's Prayer in the languages of various oriental people recurred constantly in the correspondence between the two learned men of the years 1694–1697. Kochański made considerable efforts to obtain these texts for his friend, despite the death of King Sobieski in 1696. The linguistic issues continued to be discussed in the correspondence between Kochański and Leibniz until 1698. This scholarly exchange was finally broken by the death of Kochański in Teplice-Schönau in 1700. Leibniz went on with his linguistic investigations, and he is credited with laying the foundations for our contemporary linguistics; a contribution to this achievement was the assistance he obtained from the Jesuit scholar and the Polish king, John III Sobieski.

7. THE PROBLEMS CONCERNING ALCHEMY

Interest in alchemy was widespread among Baroque intellectuals, scientists, and philosophers. Their occupation with alchemy was regarded in the

17th century with all the seriousness due to scientific activity in the proper sense of the term, even though critical opinions were not lacking. The problem of alchemy and alchemy's value as a means to discover truth is present in the scientific work of Adam Kochański; it is occasionally brought up for discussion in his correspondence with Leibniz.

Already during his stay in Germany, Kochański took interest in the works of the alchemist Johan Joachim Becher (1635–1685), whose name appears a number of times in his correspondences. Becher's alchemical investigations concerned the structure of minerals and other substances; the results of his work were presented in his published treatises *Physica Subterranea* (Frankfurt 1669) and *Tripus hermeticus pandens oracula chemica* (Frankfurt 1689). In his letter from the 18th of November 1671, the Polish Jesuit posed his correspondent a number of questions concerning alchemy, noting that these problems come from Becher's works. References to the German alchemist appear once again after almost twenty years, in Kochański's letter from the 18th of January 1692, in which the Jesuit mathematician writes with some pride about his friendly relations with Becher. In the same letter, he added that it was a long time since he had been studying the writings of alchemists to find out whether there was truth or falsehood in them; he would willingly discuss some interesting problems related to the topic with his Hanoverian friend. He also asked for Leibniz's assistance in procuring a well-known alchemical treatise, Raymond Lullus's *Potestas divinorum*. Leibniz on his part in his response of the 11th of March 1692 would refer to Becher as a famous personage, yet with unstable mind and lacking solid knowledge.

In a following letter of May 30th, 1692 the Jesuit scholar asks Leibniz for help in ascertaining the properties of a mineral named in German Besteig, *Leiste* or *Saalband*, which was of use in producing medicine. The theme of alchemy's use for compounding various medicines recurs in Kochański's other letters to Leibniz; the Jesuit mathematician's keen interest in iatrochemistry (or medical alchemy) was caused by his failing health which kept deteriorating with time. Moreover, he was troubled by the awareness of health problems rife in his family; all his relatives only lived briefly. The fear of losing his health and with it the independent life and possibility to occupy himself with science made him search for a panacea for his health problems through his personal investigations and, perhaps, his own experiments. This passion for alchemical and medical matters grew stronger after Kochański's departure in 1695 for Teplitz-Schönau, to cure himself of his ailments. In a letter dated March 14th 1696 Kochański explained to Leibniz

that the interest he took in alchemy was not prompted by a desire of profit but by a wish to find a universal medicine, a panacea for all illnesses and ailments troubling humanity, including his own health problems.

In his missive of the 5th of April 1696 Leibniz expounded his own position on alchemy. He, too, took an interest in alchemy in the past, yet with time he came to doubt its value as a knowledge. This skepticism, growing in time, induced him entirely to give up his interest in alchemy. This skeptical view of alchemy was, Leibniz added, shared by Franciscus Mercurius Helmontius, with whom Leibniz had long discussions of the problem. Nevertheless, despite this declared skepticism, he regarded sympathetically Kochański's alchemical investigation. The search for a universal cure was, in his opinion, a very weighty matter deserving one's dedication. In his next letter to Kochański, dated the 16th of May 1696 he communicated to the Jesuit a prescription for a treatment based on antimony.

The issue of the curative powers of antimony came back in Leibniz's letter of May 17th 1698, for he learned during his stay in Paris that antimony was efficacious in curing animals. So, the learned man of Hanover concluded, it might be worthwhile to try its therapeutic powers in curing humans. Leibniz deplored the condition of medical science in his days, with which Kochański agreed in his response of the 11th of June 1698, blaming this sad state of affairs on political authorities, which in many countries neglected the advancement of the medical arts. Kochański mentioned once more the use of antimony as a cure and expressed hope that the search for a universal cure, although beset with difficulties, would continue; these difficulties being the necessary price one has to take into account when undertaking serious work for the good of science and improvement of human health.

Kochański's letter from the 11th of June 1698 closes the exchange between the Jesuit and Leibniz. It follows from the above quoted references to alchemy in the Kochański-Leibniz correspondence, that the Polish mathematician's interest in alchemy had practical orientation; his purpose was finding prescriptions for new cures, and, if possible, the universal medicament, the panacea for human illnesses. It should be added that Adam Kochański was by no means uncritically fascinated with alchemy; he treated it with a certain reserve. A case proving it is the fact that he definitely rejected the possibility of obtaining gold from other metals and mineral substances, as he assured his Hanoverian correspondent in one of his letters.

CONCLUSION

The exchange of thoughts between Adam Kochański and Leibniz presented in this paper points to a very large spectrum of scientific interests shared by both scientists. The scope of their research included, above all, mathematics, philosophy, linguistics, the construction of a calculating device, a *perpetuum mobile*, other mechanics, and alchemy. Both men became close to each other through their passion for mathematics in which they searched for a universal method of scientific investigation, a method that would be of use not only in solving typically mathematical puzzles, but would also serve to solve problems in physics and other technical sciences. The ideas they exchanged, in particular those concerning the calculating machine, a *perpetuum mobile* and the universal cure, the *panaceum*, indicate a very special aspect of their scientific activity, namely their openness to the technical problems discussed in their time. Both Kochański and Leibniz regarded seriously the practical dimension of human life as it manifested itself in the technical problems that occupied the minds of their contemporaries. They both treated the scientific treatment of these problems as an important area of scientific and technical activity. Kochański, like Leibniz, firmly believed that science should be concerned with practical activity, the attitude captured by one of the principles of his philosophy, *Theoria cum praxi.* This principle, shared by both learned men, forms one of their principal philosophical ideas.

Adam Kochański and Leibniz were scientists and philosophers living in a time of revolutionary changes in both European philosophy and science; they keenly appreciated the value of new currents in intellectual life, yet they did not lose sight of philosophical tradition, especially the tradition of Aristotelian philosophy, which they both regarded as an important vehicle of truth. Thus, in their style of doing philosophy and science, one finds certain peripatetic traits, for example the acceptance of the Aristotelian conception of philosophy as science.

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WSPÓŁPRACA NAUKOWA LEIBNIZA Z ADAMEM KOCHAŃSKIM SJ

Streszczenie

W artykule zostały omówione kontakty naukowe polskiego matematyka i uczonego z zakonu jezuitów Adama Kochańskiego SJ (1631–1700) z Gottfriedem Wilhelmem Leibnizem. Jezuicki uczony i niemiecki filozof prowadzili rozległą korespondencję, w której omawiali szereg interesujących ich zagadnień naukowych i filozoficznych. Kochański był jednym z najwybitniejszych polskich uczonych XVII wieku i jako matematyk znany jest przede wszystkim z rozwiązania problemu kwadratury koła. W wymianie listowej między Kochańskim a Leibnizem dominują zagadnienia matematyczne. Uczeni omawiają problemy ówczesnej geometrii, szczególnie Kartezjusza, teorii szeregów, a zwłaszcza nowego rachunku różniczkowego odkrytego przez Leibniza. Ostatnie zagadnienie stanowi niezmiernie cenny aspekt współpracy między polskim matematykiem i niemieckim filozofem, albowiem jest to pierwsza wzmianka w polskim środowisku naukowym o odkryciu przez Leibniza (niezależnie od Izaaka Newtona) rachunku różniczkowego, który był przełomem w rozwoju nowożytnej matematyki i nowej fizyki. W korespondencji omawiane są także problemy mechaniki i grawitacji. Ważnym zagadnieniem jest dyskutowana w korespondencji kwestia maszyny liczącej do wykonywania podstawowych działań arytmetycznych, nad której konstrukcją samodzielnie pracowali Leibniz i Kochański. Polski uczony omawiał ze swoim korespondentem z Hanoweru konstrukcje różnych maszyn i urządzeń, w tym także *perpetuum mobile*. W listach obydwu uczonych obecne są też zagadnienia językoznawcze w kontekście prac Leibniza na językiem uniwersalnym. Stąd jego zainteresowanie językami ludów wschodnich zamieszkujących ziemie Rzeczypospolitej Obojga Narodów i państwa moskiewskiego. Kochański interesował się także alchemią, zwłaszcza możliwością wynalezienia nowych leków, szczególnie panaceum. Kwestię naukowej wartości alchemii omawiał ze swoim znakomitym korespondentem z Hanoweru. Kochański przedstawił w korespondencji swoje stanowisko w kwestii filozofii Arystotelesa. Jego opinia o niej jest dość krytyczna, albowiem ceni on Arystotelesa za precyzję w rozumowaniu i subtelność logiki, lecz zarzuca jego doktrynie brak kontaktu z rzeczywistością poprzez eksperyment i ograniczanie się w odkrywaniu prawdy jedynie do wykonywania operacji na pojęciach.

LEIBNIZ'S SCIENTIFIC COLLABORATION WITH ADAM KOCHAŃSKI, S.J.

Summary

The exchange of thoughts between Adam Kochański and Leibniz presented in this paper points to a very large spectrum of scientific interests shared by both scientists. The scope of their research included, above all, mathematics, philosophy, linguistics, the construction of a calculating device, a perpetuum mobile, other mechanics, and alchemy. Both men became close to each other through their passion for mathematics in which they searched for a universal method of sci-

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Słowa kluczowe: korespondencja; matematyka; filozofia; maszyna liczącą; językoznawstwo; *perpetuum mobile*; alchemia.

Key words: correspondence; mathematics; linguistics; *perpetuum mobile*; alchemy.

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