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Obituary

Stanisław Gołąb — life and work

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Professor Stanisław Gołąb died on 26 April 1980 at the age of 78. He was one of the greatest Polish geometricians, a distinguished scientist, magnificent educator and excellent organizer.

Professor Gołąb was a versatile mathematician. His publications covered various domains of mathematics as well as its applications. However, his main field was geometry and, in particular, the theory of geometric objects. In this domain Professor Gołąb's results are of the greatest importance. He also obtained a great many results in classical differential geometry under weak regularity assumptions; this was a continuation of the work of his teacher, Professor Antoni Hoborski. Apart from geometry, his other characteristic field of interest was the theory of functional equations. It became one of his main tools of investigation allowing him to obtain significant and very general results under minimal regularity assumptions. This method turned out to be particularly fruitful in the theory of geometric objects.

Professor Gołąb deserves great credit for educating a large number of followers interested in geometry who are now successfully carrying on his work. I have the honour to be one of them.

In order to realize the great work done by Professor Gołąb let us note that there were only a few persons interested in geometry in Poland before him, the main two being Professors Antoni Hoborski and Władysław Ślebodziński.

Professor Gołąb was a very active scientist. His scientific output comprises over 250 items including 15 textbooks and lecture-notes as well as the monograph *Funktionalgleichungen der Theorie der geometrischen Objekte*, written jointly with J.

Aczél in 1960. The third, English edition of Gołąb's textbook *Tensor Calculus* appeared in 1974, the two earlier editions having been published in 1956 and 1966, respectively.

Professor Gołąb participated in many local and international conferences, and delivered lectures and talks in almost all European countries as well as in the United States and in Canada. He was a member of the editorial boards of seven publishing houses and journals, two of them being foreign journals, namely "Aequationes Mathematicae" (since 1968) — edited in Waterloo, Ont. (Canada) and "Tensor" (since 1957) — edited in Japan.

In spite of so many different jobs and duties, Professor Gołąb worked with great devotion at educating the young generations of mathematicians. The number of Ph.D. theses supervised by him totals approximately 30. Moreover, he refereed 45 habilitation theses and about 80 Ph.D. dissertations. He organized several conferences on geometry in Poland and abroad, playing the main and leading role at them. About 20 such conferences were held in Poland. Due to his personal influence, the atmosphere at all these meetings was cordial and friendly. He was a great man and also warm-hearted and well-disposed to everybody. He would assist everyone who asked for his help, and such an attitude gained people's hearts and enlarged the circle of his pupils.

Before presenting those of his scientific achievements which are, in my opinion, the most important, I would like to recall some details of his life.

Stanisław Gołąb was born on 26 July 1902 at Travnik, a village now in Yugoslavia. In 1910 his parents moved with him to Kraków where he finished elementary and high school. During the period from 1920 to 1924 Gołąb studied mathematics at the Faculty of Mathematics and Physics of the Jagiellonian University. He graduated with an M.Sc. in 1924 and in 1926 he obtained a high school teacher's certificate. From 1928 to 1931 he studied with Professor J. A. Schouten in Delft (Holland) and with Levi-Civita and E. Bompiani in Italy, and also with L. Berwald in Czechoslovakia as well as in Göttingen, Germany.

The mathematical interests of Stanisław Gołąb were already manifested at high school. His mathematical abilities were recognized by his high school teacher of mathematics, Antoni Hoborski (later professor at the Mining Academy in Kraków), who watched his progress and implanted in him his interest in geometry.

As a young mathematician, Gołąb published his first research paper entitled *Quelques propriétés des courbes régulières* in 1925 [1].

S. Gołąb's Ph.D. thesis *Über verallgemeinerte projektive Geometrie* (Prace Mat.-Fiz., Warszawa, 1930 ([2])) was written under the supervision of J. A. Schouten in 1928. The defence of his dissertation took place at the Jagiellonian University in 1931. Because of the contemporary administrative rules, Professor Stanisław Zaremba had acted formally as supervisor.

The habilitation of S. Gołąb was also at the Jagiellonian University in 1932, based on his paper *Quelques problèmes métriques de la géometrie de Minkowski* (1932 ([3])).

Gołąb began his professional work already as a student in 1922. He obtained the position of teaching assistant at the Chair of Mathematics of the Mining Academy in Kraków. Except for the Second World War period, he worked there until 1955. Subsequently be occupied several positions. In 1939 he received the position of associate professor. After the war, in 1946, he obtained the title of extra-ordinary professor and in 1948 the title of ordinary (full) professor.

Professor Gołąb fulfilled a number of administrative duties at the Mining Academy. He was the Head of the Chair of Mathematics, Associate-Dean and Dean. In 1955 he was officially transferred to the Jagiellonian University where, as a full professor, he assumed the duties of the Head of the newly instituted Chair of Geometry. However, the Academy remained his second place of work until 1962. Moreover he collaborated fruitfully with it up to the end of his life. In appreciation of his merits the Academy conferred on him the honorary degree of Doctor Honoris Causa in 1969.

Professor Gołąb began his work at the Jagiellonian University before the war by giving contract lectures on mathematics for chemists and natural scientists (1930–1939). After habilitation he was giving lectures on various topics for mathematicians. He remained at the Jagiellonian University until his retirement in 1972.

In 1949 Professor Gołąb was appointed an associate member and Head of the Department of Differential Geometry in the State Mathematical Institute (in 1952 the name was changed to Institute of Mathematics of the Polish Academy of Sciences). The seminar on selected topics of differential geometry conducted by Professor Gołąb in the framework of the Institute of Mathematics always enjoyed high attendance and had a decisive influence on the development of differential geometry in Poland. He worked continuously at the Institute until 1968.

From 1950 to 1955, Professor Gołąb was also a contract professor at the Pedagogical University of Kraków where his abilities and interests in didactics were fully manifested.

It was the war that interrupted, in 1939, Gołąb's scientific as well as didactic and educational activity. In November 1939 he was arrested together with a group of Kraków professors and subsequently taken to a prison in Wrocław and to the concentration camps of Dachau and Sachsenhausen. He was released in December 1940 and, until the liberation in 1945, worked as a bookkeeper in the administration of forestry. Simultaneously, he took part in secret teaching at the Mining Academy and the Jagiellonian University.

Professor Gołąb dealt with different fields of mathematics such as geometry, topology, algebra, analysis, logic, functional and differential equations, the theory of numerical methods and various applications of mathematics. He wrote several didactic papers (13), popular-science papers (3), historical essays (8) and biographical notes (8). However, the most important results he obtained were in the field of geometry. More than half of the total number of his publications (130) belong to that domain. One can divide them into three almost equal parts: papers on the theory of geometric objects (40), papers on classical differential geometry under weak regularity assumptions (43) and papers belonging to various other domains in geometry (50) mainly connected with some special spaces such as spaces with linear or projective connection, Riemann, Minkowski and Finsler spaces, general metric spaces, etc.

His main results in the theory of geometric objects are:

a) exact definitions for the notions of pseudogroup, transformations of concomitants and equivalence (similarity) of objects;

b) determination and classification of certain geometric objects and determination of some concomitants and their applications to the investigation of various geometrical notions.

Some intuitive ideas connected with the notion of an object may already be found in the works of G. Ricci and F. Klein. Within the period of 1928–1934 several prominent geometers (e.g., O. Veblen (1928), J. A. Schouten and E. R. van Kampen (1930), O. Veblen and J. H. C. Whitehead (1932)) tried to define the notion of a geometric object. The first exact definition was given by A. Wundheiler at a meeting in Moscow in 1934. Afterwards, the theory of geometric objects was developed by J. A. Schouten and J. Haantjes (1936), whereupon S. Gołąb started to deal with this theory. In 1938–1939 he published four papers on that topic (1938, [1], [5], [10]; 1939, [1]).

In 1939, Gołąb defined exactly the notion of a pseudogroup of transformations [1]. Since F. Klein's Erlangen programme (1872) it has been known that the notion of a group of transformations plays a fundamental role in geometry. In the theory of geometric objects, where one considers mainly problems of a local character, the notion of a group of transformations turned out to be too narrow, and some geometers (O. Veblen, J. H. C. Whitehead, J. A. Schouten, and J. Haantjes) had used the notion of pseudogroup intuitively. The first precise definition of this notion was given by Gołąb in 1939. After him, the notion of a pseudogroup of transformations was developed and generalized by many authors, among others by L. Dubikajtis and W. Waliszewski. A similar notion was independently introduced later by C. Ehresmann who said, after acquainting himself with Professor Gołąb's paper, "it's a pity that I did not know this paper earlier". B.L. van der Waerden, the editor of "Mathematische Annalen", expressed his satisfaction, after receiving the manuscript of Gołąb's paper, that finally someone has cleared up the matter.

In another paper, written also in 1938, Gołąb defined the so-called J-objects and determined all the J-objects with one component under the C_1 assumption. These are the objects defined by the following transformation law:

$$\omega' = F(\omega, J) \tag{1}$$

where

$$F : M \times R_* \to M, \qquad M \subset R, \qquad J = \operatorname{Det} A^{i'}_{k}, \qquad R_* = R \setminus \{0\};$$

$A^{i'}_{k} = \partial \xi^{i'} / \partial \xi^{k}$ denote here the partial derivatives of the transformation $\xi^{i'} = \phi^{i'}(\xi^{k})$, which expresses the coordinates of a point in a new system U' from the coordinates of that point given in the system U. The method consisted practically in solving the following functional equation:

$$\bigwedge_{\omega \in M \subset R} \ \bigwedge_{u, v \in R_*} F(F(\omega, u), v) = F(\omega, vu) \tag{2}$$

with the condition

$$\bigwedge_{\omega \in M} F(\omega, 1) = \omega \tag{3}$$

under the assumption that F is a C_1-map. Equation (2) was solved for the first time under such weak assumptions. Usually, equation (2) has been investigated in the class of analytic functions.

These results aroused the interest of many mathematicians. Functional equations were definitely introduced into the theory of geometric objects. The substantial meaning of equation (2) was manifested fully. Those results were, in particular, held in high esteem by J. A. Schouten who stated in a letter to Professor Gołąb that they explained many points that had been unclear to him previously.

Equation (2) is usually called the translation (or fundamental) equation. Afterwards, it was developed further and generalized by many authors, among them J. Aczél, L. Kalmár, J. Mikusiński, S. Łojasiewicz, Z. Moszner and his pupils. It has been solved under various regularity assumptions. One of the strongest results was obtained by J. Aczél in 1956, who solved equation (2) assuming only the continuity of F with respect to some variables. Z. Moszner gave a method of construction of a solution of this equation on very general structures. Simultaneously it turned out that the translation equation plays a substantial role in many branches of mathematics and has a number of important applications.

Continuing his investigations in the theory of geometric objects after the war, Professor Gołąb essentially determined, in 1946 ([1]), all purely differential objects of class 2 and 3 with one component in one-dimensional space, i.e., the so-called objects of type (1, 1, 2) and (1, 1, 3) in the J. A. Schouten and J. Haantjes terminology; C_1 was again the regularity assumption. This time the problem reduced itself to the question of solving equation (2) on a slightly more complicated group, namely on the so-called differential group of order 2 or 3 in one-dimensional space; these groups have later been denoted by $\mathscr{L}_2^1$ or $\mathscr{L}_3^1$, respectively. In 1949 ([3]), Gołąb showed that there exists no such object of the class higher than 3. Under analyticity assumption this fact results immediately from a theorem of E. Cartan (1904) stating that in one-dimensional space there exists no group of transformations consisting of more than three parameters. An example of T. Ważewski (1949) shows that the analyticity assumption in Cartan's theorem is essential, i.e., that there exists a C_∞ four-parameter group of transformations in one-dimensional space. Consequently, Gołąb's proof of non-existence of C_1 objects of the class higher than 3 is essential. In the same year Gołąb determined all the non-differential objects with one component without any regularity assumptions [2]. Again, the point is to solve equation (2) but this time instead of the multiplicative group of real numbers one has to consider this equation on a certain simple Brandt-groupoid.

Finally, in 1947 ([1]) and 1950 ([2]), Professor Gołąb determined all purely differential objects of the first class with one component in n-dimensional space under C_1-assumption, i.e., the objects of type $(n, 1, 1)$. It turned out that for $n \geq 3$ every such object is a J-object. However, for $n = 2$, in addition to J-objects, there are also the so-called Piencow objects, determined earlier (in 1946) by that author using different methods under analyticity assumption. Moreover, Piencow's results were incomplete.

The last paper from this cycle was that written in 1963 ([4]) in which Gołąb showed that there exists no one-component purely differential object of the second class in a space of dimension greater than 1 ($(n, 1, 2)$, $n \geq 2$). The result was obtained under C_1-assumption. A. Nijenhuis later obtained the same result under the assumption of continuity of the function defining the transformation law and showed that without any regularity assumption this is no longer true.

In 1938 ([1]), Gołąb made the notion of concomitant exact and then determined concomitants of certain geometric objects and examined their properties. He introduced the notions of macro- and microconcomitants which nowadays are called algebraic and differential concomitants, respectively.

The determination of concomitants reduces itself to the question of finding solutions h of the functional equation

$$\bigwedge_{w \in M} \bigwedge_{u \in \mathscr{G}} h(f_1(\omega, u)) = f_2(h(\omega), u) \qquad (4)$$

with given functions f_1 and f_2 satisfying some conditions. The notion of an algebraic concomitant was used when investigating the algebras of geometric objects. Differential concomitants were used by Gołąb in his considerations of covariant derivatives and Lie derivatives. These are the basic differential concomitants playing an important role in the field of differential geometry.

A beautiful application of the theory of concomitants was presented by Gołąb in one of his last papers written in 1972 ([6]). A method of applying concomitants to the basic problem of classification of spaces was presented in that paper. He formulated general principles of such a classification and illustrated this idea on the example of classification of Riemannian spaces. This method was then used in one of the next papers to introduce the notion of an almost Euclidean space (1972 ([2])).

It may happen that in spite of the fact that some transformation laws differ considerably, they still represent the same geometric notion. An organizing principle for transformation laws was therefore needed, introducing some equivalence relations for them which would allow them to be classified and identified. For this purpose Gołąb introduced in 1950 ([3]) the notion of similarity (equivalence) of objects. It turned out that this notion had been identical with that given earlier (1945) by W. W. Wagner and he has priority in introducing this notion. It is of great importance in investigations concerning the classification of objects. The determination of equivalent objects also reduces to the problem of finding the solutions of equation (4). In this case the question is to find all bijective solutions of (4).

This shows that results on the theory of geometric objects contained simultaneously some results on functional equations, since the crucial point was just to solve the above-mentioned equations. In addition to them, Professor Gołąb obtained a number of other interesting and important results within the field of functional equations. Let us mention only one more.

Denote by $M(2, R)$ the set of all square matrices of order 2 whose elements are real numbers. Let $f: M(2, R) \to R$ denote a real-valued function defined on that set. Consider the following equation:

$$\bigwedge_{x,y \in M(2,R)} f(x \cdot y) = f(x) \cdot f(y). \tag{5}$$

In 1959 ([1]) Professor Gołąb showed for the first time that the general solution of (5) is of the form

$$f(x) = \phi(\det x),$$

where $\phi: R \to R$ is an arbitrary multiplicative function. This result was obtained without any regularity assumption. This important paper was followed by a long series of papers by M. Hosszú, M. Kucharzewski, M. Kuczma, S. Kurepa, O. Taussky-Todd, A. Zajtz and others, dealing with its various generalizations. Moreover, this result has found numerous applications.

Concerning Professor Gołąb's influence on the development of functional equations in Poland, Professor M. Kuczma has written (M. Kuczma, *Activity of Professor Stanisław Gołąb in the Theory of Functional Equations*. Demonstratio Math. *6* (1) (1973), 39–44): "(Professor Gołąb) ... may be considered as the father figure of the Polish school of functional equations. All Polish mathematicians working in the theory of functional equations are — directly or indirectly — pupils of Professor Gołąb."

Professor Gołąb had also obtained numerous results in applied mathematics. These results were concerned mainly with the following topics:

1. Movements of rock masses influenced by mining exploitation (1961–1964).
2. Computation methods in geodesy (1959–1960).
3. Mine ventilation (1967).
4. Granulometry and granulometric classification of friable bodies (1959–1961).

He collaborated with different Institutes of the Academy of Mining and Metallurgy as well as with the Main Institute of Mining at Katowice, and maintained close scientific contact with Professor H. Bystron from that Institute. In 1973, J. Bodziony expressed, among others, the following opinion concerning Professor Gołąb's activity in this domain: "... at least a few dozen, perhaps even hundreds, of engineers not only had the opportunity of discussing their projects or results with Professor Gołąb, but also as a result of this discussion could enrich and improve their research work." (J. Bodziony, *Activity of Professor Stanisław Gołąb in the Field of Applied Mathematics*, Demonstratio Math. *6* (1) (1973), 45–49.)

One may distinguish three characteristic features of Professor Gołąb's scientific output:

1. The highest possible generality and precision in the formulation of problems. This gave rise to his interests in topology, logic, algebra and functional equations.
2. Linking mathematics with applications.
3. Lucid presentation and great clarity of results. Undoubtedly, this was a consequence of Professor Gołąb's interest in didactics at every level.

He will always be remembered by his pupils as a conscientious researcher, great teacher and invariably helpful man.

It would be impossible to present all of Professor Gołąb's results even in short. I have mentioned just a few results which are, in my opinion, important and characteristic.

In appreciation of his versatile activity Professor Stanisław Gołąb was given several prestigious awards:

1) Gold Badge of the Student Association of the Academy of Mining (1946);
2) Medal of Victory and Freedom (1949);
3) Medal for the Decennial of the Polish People's Republic (1955);
4) Cavalier Cross of "Polonia Restituta" (1956);

5) Gold Badge of the Union of Polish Teachers (1959);

6) Medal of the Millenium of Mining and of the Millenium of the Polish State (1962);

7) Officer Cross of "Polonia Restituta" (1967);

8) Gold Badge of the City of Kraków (1969);

and, finally, the first-degree award of the Ministry of Education and Universities (twice, in 1965 and in 1971).

One should realize that the present state of differential geometry in Poland is not quite satisfactory. However, nowadays we have well educated, talented young people who are able to achieve interesting and important results at the international level. Clearly, this requires much further work and solid endeavours. However, I do hope that in the not too distant future Polish geometry will return to the forefront of international geometric research. It is hard to say when this hope will come true. Those who will live long enough to see this achieved, should remember that the rudiments of this success were due to the impressive efforts of the life-long work of Professor Gołąb — our Master and Teacher.

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BIBLIOGRAPHY OF PROFESSOR STANISŁAW GOŁĄB

(except popular, didactic and historical notes)

A. *Scientific Papers*

1925

[1] *O pewnych wianościach krzywych regularnych. Quelques propriétés des courbes régulières.* Prace Akademii Górniczej w Krakowie *4* (1925), 3–13.

1928

[1] *Un théorème sur le balayage.* Fund. Math. *12* (1928), 4–19.

[2] *Sur quelques points de la théorie de la longueur.* Ann. Soc. Polon. Math. 7 (1928), 227–241.

[3] *Sur un théorème rentrant dans le calcul fonctionnel et son application géométrique.* Atti del Congresso Internazionale dei Matematici, Bologna, 3–10 settembre 1928. Vol. VI, 165–166.

1929

[1] *Sur les transformations des ensembles rectifiables.* Ann. Soc. Polon. Math. *8* (1929), 302–307.

[2] *Über ausgezeichnete Tangenten einer regulären Kurve.* Math. Z. *30* (1929), 754–760.

[3] *Einige projektive Eigenschaften der affinen Geometrie.* Comptes-Rendus du Premier Congrès des Mathématiciens des Pays Slaves. Warszawa, 1929, 339–340.

1930

[1] *Über projektive Übertragungen und Ableitungen* (joint with J.A. Schouten). Math. Z. *32* (1930), 192–214.

[2] *Über verallgemeinerte projektive Geometrie.* Prace Mat.-Fiz. (Warsaw) *37* (1930), 91–153.
[3] *Über projektive Übertragungen und Ableitungen II* (joint with J.A. Schouten). Ann. Mat. Pura Appl. *8* (1930–31), 141–157.
[4] *Sopra le connessioni lineari generali. Estensione d'un teorema di Bompiani nel caso più generale.* Ann. Mat. Pura Appl. *8* (1930–31), 283–291.

1931
[1] *Minkowskische Geometrie. I and II* (joint with H. Härlen). Monatsh. Math.-Phys. (Leipzig) *38* (1931), 387–398.

1932
[1] *Einige Bemerkungen über Winkelmetrik in Finslerschen Räumen.* Internationaler Mathematikerkongress, Zürich, Vol. 2, 1932, 178–179.
[2] *Über die Möglichkeit einer absoluten Auszeichnung der Gruppe von Koordinatensystemen in verschiedenen Räumen.* Internationaler Mathematikerkongress. Zürich, Vol. 2, 1932, 183–184.
[3] *Zagadnienia metryczne geometrii Minkowskiego. Quelques problèmes métriques de la géométrie de Minkowski.* Prace Akademii Górniczej w Krakowie *6* (1932), 1–79.
[4] *Zur Theorie der Vektor- und Punktkonnexion* (joint with V. Hlavatý). Prace Mat.-Fiz. (Warsaw) *39* (1939), 119–130.
[5] *O funkcjach jednorodnych I. Rownanie Eulera. Sur les fonctions homogènes I. Equation d'Euler.* C.R. des Séances de la Société des Sciences et de Lettres de Varsovie *25* (1932), Classe III, 105–110.
[6] *Sopra certe classi di connessioni lineari.* Ann. Mat. Pura Appl. *11* (1932–33), 283–293.

1933
[1] *Sur les coordonnées polaires sur une surface.* Ann. Soc. Polon. Math. *12* (1933), 87–107.
[2] *Sur une propriété des fonctions harmoniques dans les espaces de Riemann.* Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Natur. *17* (1933), 377–380.
[3] *Sur un unvariant intégral relatif aux espaces métriques généralisés.* Atti. Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Natur. *17* (1933), 515–518.
[4] *Sur la représentation conforme de l'espace de Finsler sur l'espace euclidien.* C.R. Acad. Sci. Paris *196* (1933), 25–27.
[5] *Sur la représentation conforme de deux espaces de Finsler.* C.R. Acad. Sci. Paris *196* (1933), 986–988.
[6] *Aufgabe 151.* [Lösung der Aufgabe 151 von G. Lochs und J. Radon. Jber. Deutsch. Math.-Verein. *44* (1934), 19–22.] Jber. Deutsch. Math.-Verein. *43* (1933), 1.
[7] *Contribution à un théorème de M.S. Knebelman.* Prace Mat.-Fiz. (Warsaw) *41* (1933), 97–100.
[8] *Contribution à la théorie des équations de Frenet dans l'espace riemannien à n dimensions* (joint with A. Hoborski). Prace Mat.-Fiz. (Warsaw) *41* (1933), 101–104.
[9] *O metryce katowej ogolnych przestrzeni. I. Zasada Chasles'a. Sur la métrique angulaire des espaces généraux. I. Le principe de Chasles.* Wiadom. Math. *38* (1933), 1–12.

1934
[1] *Ein Beitrag zur konformen Abbildung von zwei Riemannschen Räumen aufeinander.* Ann. Soc. Polon. Math. *13* (1934), 13–19.
[2] *Ein Beitrag zur Theorie der sukzessiven Approximationen von Picard-Lindelöf.* Ann. Soc. Polon. Math. *13* (1934), 100–105.
[3] *Sur l'invariance des courbures des courbes réelles dans les espaces à n-dimensions par rapport à l'orientation de ces courbes.* Vestnik Král. Čes. Spol. Nauk *2* (1934), 1–8.
[4] *Sur l'ordre de planéité des espaces plongés.* Ann, Mat. Pura Appl. *13* (1934–1935), 119–125.

1935
[1] *Sur une condition nécessaire et suffisante afin qu'un espace de Finsler soit un espace riemannien.* Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Natur. *21* (1935), 133–137.

[2] *Sur la rectifiabilité des courbes dans la géométrie centro-affine plane.* Bull. Acad. Roy. de Belgique *21* (1935), 699–702.
[3] *Sur la mesure des aires dans les espaces de Finsler.* C.R. Acad. Sci. Paris *200* (1935), 197–199.
[4] *Les transformations par polaires reciproques dans la géométrie de Finsler.* C.R. Math. Sci. Paris *200* (1935), 1462–1464.
[5] *Sur le rapport entre les notions des mesures des angles et des aires dans les espaces de Finsler.* C.R. Math. Sci. Paris *201* (1935), 250–251.

1936
[1] *Über das Anholonomitätsobjekt von Schouten und van Dantzig.* Congrès International des Mathematiciens, Oslo 1936, Vol. II, 153–155.
[2] *Über einen Satz von O. Toeplitz.* Ann. Soc. Polon. Math. *15* (1936), 128–134.

1937
[1] *Über eine Art der Geometrie von Kawaguchi-Hokari.* Ann. Soc. Polon. Math. *16* (1937), 25–30.
[2] *Sur une condition nécessaire et suffisante pour l'existence d'une différentielle totale.* Ann. Soc. Polon. Math. *16* (1937), 31–40.
[3] *Sur une définition axiomatique des nombres conjugués pour les nombres complexes ordinaires.* Opuscula Math. (Kraków) *1* (1937), 1–11.
[4] *Sur la possibilité de la détermination de "coniugium" dans le corps des nombres hypercomplexes à deux unités.* Rev. Ci. (Lima) *40* (1937), 21–30.
[5] *Über die affinen Invarianten einer Kurve der* X_p, *die in einem* L_n *eingebettet ist.* Trudy Sem. Vektor. Tenzor. Anal. *4* (1937), 360–365.

1938
[1] *Sur quelques points concernant la notion du comitant.* Ann. Soc. Polon. Math. *17* (1938), 177–192.
[2] *Sur quelques points de géometrie des ensembles.* Bull. Acad. Roy. de Belgique *24* (1938), 632–640.
[3] *Sur la fonction représentant la distance d'un point variable à un ensemble fixe.* C.R. Acad. Sci. Paris *206* (1938), 406–408.
[4] *Ein Beitrag zum Mengerschen Begriff des fastmetrischen Raumes.* Fund. Math. *31* (1938), 67–73.
[5] *Über die Klassifikation der geometrischen Objekte.* Math. Z. *44* (1938), 104–114.
[6] *Ein Satz über Regelflächen und seine Verallgemeinerung auf Riemannsche Räume.* Opuscula Mat. (Kraków) *2* (1938), 1–6.
[7] *Zur Theorie des affinen Zusammenhanges im eindimensionalen Raume.* Opuscula Math. (Kraków) *2* (1938), 7–9.
[8] *A propos de la métrique angulaire des espaces de Finsler.* Opuscula Math. (Kraków) *2* (1938), 13–15.
[9] *La discussion de l'équation générale du mouvement dans un milieu résistant.* Prace Mat.-Fiz. (Warsaw) *46* (1938), 237–244.
[10] *Über eine Funktionalgleichung der Theorie der geometrischen Objekte.* Wiadom. Mat. *45* (1938), 97–137.
[11] *O pewnym warunku koniecznym skończoności całki niewłaściwej.* Wiadom. Mat. *46* (1938), 1–6.

1939
[1] *Über den Begriff der "Pseudogruppe von Transformationen".* Math. Ann. *116* (1939), 768–780.

1940
[1] *Un théorème de la théorie des équations différentielles approchées.* Mathematica (Cluj) *16* (1940), 61–65.

1945
[1] *Sur la généralisation d'une formule de Lancret concernant l'uniformisation des équations de Frenet.* Ann. Soc. Polon. Math. *18* (1945), 129–133.

[2] *Sur un problème de la métrique angulaire dans les espaces de Finsler* (joint with A. Bielecki). Ann. Soc. Polon. Math. *18* (1945), 134–144.

1946

[1] *Sur la théorie des objets géométriques* (*Les objets différentiels purs de deuxième et de troisième classe*). Ann. Soc. Polon. Math. *19* (1946), 7–35.

1947

[1] *Sur la théorie des objets géométriques* (*Reduction des objets géométriques spéciaux de première classe aux objets du type Δ*). Ann. Soc. Polon. Math. *20* (1947), 10–27.

1948

[1] *Espace pourvu d'une métrique définie au moyen de l'écart triangulaire et les métriques généralisés.* Ann. Soc. Polon. Math. *21* (1948), 226–235.

[2] *Alcuni teoremi della teoria degli oggetti geometrici.* Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Natur. *5* (1948), 120–122.

[3] *Sur la notion de la derivée covariante.* C.R. du Congr. Polon. Math. Wrocław 1946. Colloq. Math. *1* (1948), 160.

1949

[1] *Généralisation des équations de Bonnet-Kowalewski dans l'espace à un nombre arbitraire de dimensions.* Ann. Soc. Polon. Math. *22* (1949), 97–156.

[2] *O objektach geometrycznych nieróżniczkowych. Sur les objets géométriques non différentiels.* Bull. Acad. Polon. Sci. Lettr. Cl. Sci. Math. Natur. Ser. *A* (1949), 67–72.

[3] *Contribution à la theorie des objets géométriques. Przyczynek do teorii obiektów geometrycznych.* Prace Mat.-Fiz. (Warsaw) *47* (1949), 1–15.

[4] *Sur les lignes de courbure spéciales. O liniach kryzywiznowych specjalnych* (joint with A. Hoborski). Prace Mat.-Fiz. (Warsaw) *47* (1949), 17–20.

[5] *O znaczeniu geometrycznym krzywizny i torsji geodezyjnej dla krzywych położonych na wielowymiarowych hiperpowierzchniach. Sur quelques interprétation géométriques de la courbure géodésique et de la torsion géodésique pour les courbes situées dans une hypersurface plongée dans un espace euclidien à n-dimensions* (joint with T. Wrobel). Časopis pro pěstováni matematiky a fiziky (Praha) *74* (1949), 252–254.

1950

[1] *O pewnym warunku istnienia asymptoty krzywej plaskiej, VI Zjazd Matematyków Polskich.* Ann. Soc. Polon. Math. (Supplement) *22* (1950), 53–54.

[2] *Sur les objets géométriques à une composante.* Ann. Soc. Polon. Math. *23* (1950), 79–89.

[3] *O pojeciu podobieństwa obiektów geometrycznych. La notion de similitude parmi les objets géométriques.* Bull. Acad. Polon. Sci. Lettr. Cl. Sci. Math. Natur. Sér. *A* (1950), 1–7.

1951

[1] *Courbure et torsion géodésique pour les courbes situés sur les hypersurfaces à $n-1$ dimensions plongées dans l'espace à n dimensions* (joint with T. Wróbel). Ann. Soc. Polon. Math. *24* (1951), 25–51.

[2] *On Finsler's measurement of an angle.* Ann. Soc. Polon. Math. *24* (1951), 78–84.

1952

[1] *Sur une condition nécessaire et suffisante d'ombilicité d'un point de surface.* Ann. Soc. Polon. Math. *25* (1952), 140–144.

[2] *Kilka własności krzywych płaskich wraz z zastosowaniem do przybliżonych kwadratur. Quelques propositions de la théorie des courbes planes et leurs applications aux quadratures approchées.* Bull. Acad. Polon. Sci. Lettr. Cl. Sci. Math. Natur. Sér. *A*. Suppl. *1* (1952), 349–358.

[3] *Przybliżone kwadratury za pomoca paraboli wyższego stopnia. Les quadratures approchées à l'aide des paraboles du troisième et du quatrième degré* (joint with K. Tryuk). Bull. Acad. Polon. Sci. Lettr. Cl. Sci. Math. Natur. Sér. *A*. Suppl. *1* (1952), 411–415.

1954

[1] *Les courbes (ordinaires) d'une courbe située sur une hypersurface et les courbures géodésiques et normales ainsi que la torsion géodésique de cette courbe.* Ann. Polon. Math. *1* (1954), 81–88.
[2] *Sur quelques propriétés des courbes planes.* Ann. Polon. Math. *1* (1954), 91–106.
[3] *Sur la dérivée covariante des objets géométriques de deuxième classe.* Ann. Polon. Math. *1* (1954), 107–113.
[4] *Contribution à la formule simpsonienne de quadrature approchée.* Ann. Polon. Math. *1* (1954), 166–175.
[5] *Contribution à la théorie de la formule simpsonienne des quadratures approchées* (joint with C. Olech). Ann. Polon. Math. *1* (1954), 176–183.
[6] *Über den Begriff der kovarianten Ableitung.* Nieuw Arch. Wisk. *(3) II* (1954), 90–96.
[7] *Przyczynek do algebry działań w ciele liczb rzeczywistych.* Wyższ. Szkoła Ped. Krakow. Rocznik Nauk-Dydakt. Prace Mat. *1* (1954), 3–10.
[8] *Przyczynek do określenia stozkowych przez danych 5 elementów.* Wyzsz. Szkoła Ped. Krakow. Rocznik Nauk.-Dydakt. Prace Mat. *1* (1954), 209–214.

1955

[1] *On the geometrical significance of curvatures of higher orders for curves lying in n-dimensional spaces.* Ann. Polon. Math. *2* (1955), 209–214.
[2] *On the concept of the centre of the second curvature and on a generalization of a certain geometrical meaning of v. Lilienthal.* Ann. Polon. Math. *2* (1955), 215–218.
[3] *Zur Theorie der geometrischen Objekte* (joint with M. Kucharzewski). Ann. Polon. Math. *2* (1955), 250–253.

1956

[1] *Un théorème sur la valeur moyenne θ dans la formule des accroissements finis* (joint with S. Lojasiewicz). Ann. Polon. Math. *3* (1956), 118–125.
[2] *Géométrie différentielle vis-à-vis des hypothèses d'une faible régularité.* Rev. Roumaine Math. Pures Appl. *1* (1956), 99–112.
[3] *Zum distributiven Gesetz der reellen Zahlen.* Studia Math. *15* (1956), 353–358.
[4] *O trojkatach apłaszczonych. On flattened triangles.* Zeszyty Nauk. Akad. Gorn.-Hutniczej, Geodezja (1956), 13–17.

1957

[1] *Sur l'équation fonctionnelle $f(X).f(Y) = f(X.Y)$.* Colloq. Math. *4* (1957), 265.
[2] *O tzw. iteracji przyspieszonej przy rozwiazywaniu ukladow rownan liczbowych* (joint with J. Birzynski). Dziesiecioleeie Wyz. Szkol. Ped. Krakow (1957), 421–434.
[3] *Zur Theorie de Übertragungen. Der Begriff des Raumes in der Geometrie.* Bericht von der Riemann Tagung. Schriftenreihe d. Forschungsinstitut f. Math. Deutsch. Akad. d. Wiss. Berlin *1* (1957), 162–177.

1958

[1] *Sur l'algèbre des objets géométriques de première classe à une composante* (joint with H. Pidek-Lopuszańska). Ann. Polon. Math. *4* (1958), 226–241.
[2] *La courbure d'une courbe plane et l'existence d'une asymptote* (joint with M. Kuczma, Z. Opial). Ann. Polon. Math. *5* (1958), 275–283.
[3] *O formule Gaussa-Bonneta.* Wyzsz. Szkoła Ped. Krakow. Rocznik Nauk.-Dydakt. Prace Mat. *7* (1958), 3–4.

[4] *Über die Invarianz gewisser Eigenschaften von Affinoren bei Transformationen der entsprechenden Untergruppen der allgemeinen affinen Gruppe* (joint with M. Kucharzewski). Tensor *8* (1958), 1–7.
[5] *Über den Begriff der Pseudogrössen* (joint with M. Kucharzewski). Tensor *8* (1958), 79–89.

1959
[1] *Sur l'équation* $f(X)\cdot f(Y)=f(X\cdot Y)$. Ann. Polon. Math. *6* (1959), 1–13.
[2] *Differentialkomitanten und Liesche Ableitungen.* Mat. Lapok *10* (1959), 174–181.
[3] *Zagadnienia teorii obiektow geometrycznych.* Prace Mat. *3* (1959), 55–67.
[4] *O postaci wektorowej pewnych twierdzeń całkowych. On the vector form of certain integral theorems.* Prace Math. *3* (1959), 105–111.
[5] *O położeniu kul stycznych do powierzchni. On the position of spheres tangent to a surface* (joint with M. Kucharzewski). Prace Mat. *3* (1959), 167–184.
[6] *Sur l'équation fonctionnelle* $f[x+y\cdot f(x)]=f(x)\cdot f(y)$ (joint with A. Schnizel). Publ. Math. Debrecen *6* (1959), 113–125.
[7] *Über die Metrisierbarkeit der affin-zusammenhangenden Räume.* Tensor *9* (1959), 1–7.
[8] *Jednostajna zbieżność a ciagłość funkcji granicznej.* Wiadom. Mat. *2* (1959), 287–288.
[9] *O uproszczonym sposobie obliczania poprawki dla przyspieszenia ziemskiego pochodzacej od uwzglednienia nierówności terenu. A simple method of computing the correction for the acceleration of gravity resulting from ground relief.* Zeszyty Nauk. Akad. Górn.-Hutniczej, Geodezja *2* (1959), 15–33.
[10] *O pewnym wzorze Budryka w teorii pobierania prob. One of the formulae in Budryk's theory of sampling.* Zeszyty Nauk. Akad. Górn.-Hutniczej, Górnictwo *6* (1959), 21–26.

1960
[1] *Ein Beitrag zur Komitantentheorie* (joint with M. Kucharzewski). Acta Math. Acad. Sci. Hungar. *11* (1960), 173–174.
[2] *On some new geometrical interpretations of the torsion of a skew curve* (joint with J. Kordylewski, M. Kuczma). Ann. Polon. Math. *7* (1960), 269–278.
[3] *On the notion of gradient. I. Essentiality of regularity suppositions.* Ann. Polon. Math. *8* (1960), 1–4.
[4] *On the notion of gradient. II. A certain extremal property of direction of the gradient vector* (joint with M. Kucharzewski). Ann. Polon. Math. *8* (1960), 5–12.
[5] *On the notion of gradient. III. Gradient as a limit value of a surface integral* (joint with A. Plis). Ann. Polon. Math. *8* (1960), 13–22.
[6] *Sur quelques propriétés des lignes géodésiques.* Ann. Polon. Math. *8* (1960), 91–103.
[7] *Sur les comitants algébriques des tenseurs.* Ann. Polon. Math. *9* (1960), 113–118.
[8] *Das Doppelverhältnis als Lösung einer Funktionalgleichung* (joint with J. Aczél, M. Kuczma, E. Siwek). Ann. Polon. Math. *9* (1960), 183–187.
[9] *Le trièdre de Frenet aux points d'inflexion d'une courbe.* Ann. Polon. Math. *9* (1960), 201–209.
[10] *Sur les comitants scalaires du premier ordre des champs de scalaires.* Mathematica (Cluj) *2* (1960), 253–255.
[11] *Eine Kennzeichnung der euklidischen Ebene unter den Minkowskischen Ebenen* (joint with L. Tamássy). Publ. Math. Debrecen *7* (1960), 187–193.
[12] *O metodzie najmniejszych kwadratow Gaussa. Über die Gauss'sche Methode der kleinsten Quadrate.* Zeszyty Nauk. Akad. Górn.-Hutniczej, Geodezja *3* (1960), 5–21.

1961
[1] *Sur les comitants algébriques d'un objet de la connexion linéaire tensorielle.* Ann. Mat. Pura Appl. *54* (1961), 13–21.
[2] *Sur les domaines de transitivité d'un groupe de transformations* (joint with E. Siwek). Ann. Polon. Math. *10* (1961), 209–216.
[3] *On an integro-differential equation of the theory of screening of granular bodies* (joint with J. Bodziony). Arch. Mech. Stos. *4, 13* (1961), 529–554.

[4] *Sur l'litération au sens de Seidel dans la resolution des systèmes des équations numériques* (joint with J. Burzyński). C.R. du I. Symposium Intern. sur les calculs géodésiques. Cracovie (1961), 159–162.

[5] *Sur l'équivalence des objets géométriques de deuxième classe dont le nombre de composantes est égal à la dimension de l'espace.* Czechoslovak Math. J. *11* (1961), 475–479.

[6] *O pewnej klasie odwzorowan izopowierzchniowych.* Geodezja i Kartografia (Warsaw) *10* (1961), 221–227.

[7] *Les derniers résultats dans la théorie des objets géométriques.* Zeszyty Nauk. Akad. Górn.-Hutniczej, Rozprawy *6* (1961), 5–21.

1962

[1] *Sur un théorème de la géométrie différentielle globale.* Ann. Polon. Math. *12* (1962), 39–47.

[2] *Contribution à la théorie des mouvements dans les espaces de Riemann.* Bul. Inst. Politehn. Iaşi *8* (1962), 31–36.

[3] *A remark on the curvature of non-plane curves* (joint with A. Pliś). Colloq. Math. *9* (1962), 127–130.

[4] *Sur les travaux de Mieczyslaw Biernacki en géométrie.* Colloq. Math. *9* (1962), 375–377.

[5] *La rélation d'équivalence et les objets géométriques.* Fund. Math. *50* (1962), 381–386.

[6] *Contribution à la théorie des équations de Killing dans les espaces de Riemann.* Glasnik Mat.-Fiz. Astr. (Zagreb) *17* (1962), 43–51.

[7] *Sur la notion du "champ traine"* (joint with A. Jakubowicz, P. Kucharczyk). Mathematica (Cluj) *4* (1962), 247–252.

[8] *Sur une méthode réductive de définition des courbures d'une courbe plongée dans un espace n-dimensionnel.* Wyższ. Szkola Ped. Krakow. Rocznik Nauk.-Dydakt. Prace Mat. *13* (1962), 5–15.

1963

[1] *Sur le contact des courbes dans les espaces métriques généraux* (joint with Z. Moszner). Colloq. Math. *10* (1963), 305–311.

[2] *Über den Begriff der Richtung in allgemeinen metrischen Räumen.* Bayer. Akad. Wiss. Math.-Natur. Kl.S.-B. (1963), 27–34.

[3] *Über ein Funktionalgleichungssystem von O.E. Gheorgiu,* Tagungsbericht "Funktionalgleichungen", 7–11 Okt. 1963, Mathem. Forschungsinstitut Oberwolfach, 9–10.

[4] *Contribution à la théorie des objets géométriques. Non-existence des objets de deuxième classe à une composante dans X_n pour $n \geq 2$.* Tensor *14* (1963), 122–131.

[5] *Sur une condition suffisante (et nécessaire) pour qu'un espace riemannien à trois dimensions soit euclidien.* Zeszyty Nauk. Uniw. Jagiello. Prace Mat. *9* (1963), 27–29.

1964

[1] *Sur l'objet géométrique représentant une direction munie d'un sens* (joint with A. Jakubowicz, M. Kucharzewski, M. Kuczma). Ann. Polon. Math. *15* (1964), 233–236.

[2] *Sur un comitant algébrique d'un objet de connexion affine.* Ann. Polon. Math. *16* (1964), 23–25.

[3] *Sur un problème concernant les approximations succéssives d'une équation intégro-différentielle.* Mathematica (Cluj) *6* (1964), 47–50.

[4] *O pewnym zagadnieniu nieklasycznym rachunku wariacyjnego. Sur un problème non classique du calcul des variations.* Zeszyty Nauk. Akad. Gorn.-Hutniczej, Geodezja *5* (1964), 5–19.

[5] *O ekstremum krzywizny dla krzywej Gaussa $y = C\exp(-\alpha x^2)$. Sur la valeur extrémale de courbure de la courbe de Gauss $y = C\exp(-\alpha x^2)$* (joint with Z. Strzelecka). Zeszyty Nauk. Akad. Górn.-Hutniczej, Geodezja *5* (1964), 39–59.

[6] *Sur quelques problèmes concernant la notion de pseudogroupe de transformations.* Lecture delivered in Rennes, 1964, 9 pp.

[7] *O pewnym obiekcie geometrycznym czysto różniczkowym typu $(m, n, 1)$, gdy $m = \binom{n+1}{2}$, $n \geq 2$ $(m < n^2)$. About a certain geometrical object pure differential of the $(m, n, 1)$ type when $m = \binom{n+1}{2}$, $n \geq 2$ $(m < n^2)$* (joint with A. Jakubowicz). Zeszyty Nauk. Politech. Szczecin. *57* (1964), 5–18.

1965

[1] *Sur les points singuliers des surfaces parallèles.* I. An. Stiint. Univ. "Al. I. Cuza" Iasi Sect. I a Mat. *11*b (1965), 465–472.

[2] *Einige grundlegende Fragen der Theorie der Funktionalgleichungen.* Glasnik Mat.-Fiz. Astr. (Zagreb) *20* (1965), 57–63.

[3] *Über die Funktionalgleichung der Funktion Arccosinus, I. Die lokalen Lösungen* (joint with L. Losonczi). Publ. Math. Debrecen *12* (1965), 159–174.

[4] *Sur la notion du pseudogroupe de transformations.* Revue Roumaine Math. Pures Appl. *10* (1965), 1081–1087.

[5] *Über eine Frage die der Theorie der Tensoren zugrunde liegt* (joint with A. Jakubowicz). Zeszyty Nauk. Uniw. Jagiello. Prace Mat. *10* (1965), 17–19.

[6] *Über eine Eigenschaft der Systeme von Transformationen* (joint with M. Kuczma). Zeszyty Nauk. Uniw. Jagiello. Prace Mat. *10* (1965), 21–24.

1966

[1] *Über ein System von Funktionalgleichungen* (joint with O.E. Gheorghiu). Ann. Polon. Math. *17* (1966), 223–243.

[2] *Sur la longueur de l'indicatrice dans la géométrie plane de Minkowski.* Colloq. Math. *17* (1966), 223–243.

[3] *La comparaison de la rapidité de convergence des approximations successives de la methode de Newton avec la méthode de "regula falsi".* Mathematica (Cluj) *8* (1966), 45–49.

[4] *Über die Funktionalgleichung der Funktion Arccosinus, II* (joint with L. Losonczi). Publ. Math. Debrecen *13* (1966), 183–185.

[5] *O pewnej przestrzeni metrycznej dwuwymiarowej. Sur un espace métrique à deux dimensions* (joint with Z. Moszner). Wyzsz. Szkoła Ped. Krakow. Rocznik Nauk.-Dydakt. Prace Mat. *25* (1966), 85–90.

1967

[1] *Über Differentialkomitanten erster Ordnung, I.* Colloq. Math. *16* (1967), 173–184.

[2] *Sur un type d'équations intégro-différentielles.* Colloq. Math. *18* (1967), 111–117.

[3] *O pewnych komitantach algebraicznych S-afinorów. About some algebraic comitants of S-affinors* (joint with A. Jakubowicz). Zeszyty Nauk. Politech. Szczecin. *80* (1967), 39–61.

1968

[1] *Über Differentialkomitanten erster Ordnung, II.* Ann. Polon. Math. *20* (1968), 81–89.

[2] *Ein Beitrag zur Dreiecksgeometrie.* Math. Nachr. *37* (1968), 109–117.

[3] *Przestrzeń metryczna dwuwektorów. Metric space of bivectors* (joint with A. Jakubowicz, S. Wegrzynowski). Zeszyty Nauk. Politech. Szczecin. *103* (1968), 61–78.

[4] *O S-afinorach pierwszego i drugiego rodzaju i pewnych ich komitantach algebraicznych. About S-affinors of the first and second kind and their certain algebraical concomitants* (joint with A. Jakubowicz). Zeszyty Nauk. Politech. Szczecin. *103* (1968), 79–85.

[5] *Metody geometrii różniczkowej w teorii potencjalu.* In the book *Metody geometryczne w fizyce i technice*, Warszawa, 1968, 1–13.

1969

[1] *Remarks on one-parameter subsemigroups of the affine group and their homo- and isomorphism* (joint with J. Aczél). Aequationes Math. *3* (1969), 194–196.

[2] *Die affin-zusammenhängenden Räume mit verunstalteter rekurrenter Krümmung* (joint with A. Jakubowicz). Ann. Polon. Math. *21* (1969), 161–165.

[3] *Über die Grundlagen der affinen Geometrie.* Jber. Deutsch. Math.-Verein. *71* (1969), 138–155.

[4] *Ein Beitrag zur Theorie des Zusammenhanges für Bivektoren* (joint with A. Jakubowicz). Tensor *20* (1969), 29–34.

[5] *Functional equations in Geometry*. Zeszyty Nauk. Uniw. Jagiello. Prace Mat. *14* (1969), 13–19.

1970

[1] *Über die Induzierbarkeit des affin-zusammenhängenden Raumes der Bivektoren* (joint with I. Gawrylczyk, A. Jakubowicz, M. Pudelewicz). Acta Math. Acad. Sci. Hungar. *21* (1970), 183–187.

[2] *Remarks on one-parameter subsemigroups of the affine group and their homo- and isomorphisms* (joint with J. Aczél). Aequationes Math. *4* (1970), 1–10.

[3] *Sulle connessioni tensoriali.* Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Natur. *48* (1970), 309–310.

[4] *Über das Flächenmass in Vektorräumen* (joint with M. Kucharzewski). Prace Mat. *14* (1970), 51–57.

[5] *O pewnym zagadnieniu geometrii Minkowskiego. Sur un problème de la géométrie de Minkowski.* Prace Nauk. Inst. Mat. i Fiz. Politech. Wrocław. *2* (1970), 3–5.

[6] *Über ein Funktionalgleichungssystem aus dem Gebiete der Geometrie.* I. Intern. Kolloquium über Funktionalgleichungen und ihre Anwendungen. Publ. of the Technical University. Miskolc, 1970, 237–242.

[7] *Les équations fonctionnelles et la théorie des groupes* (joint with Z. Krzeszowiak). Rev. Roumaine Math. Pures Appl. *15* (1970), 1395–1406.

1971

[1] *Sur un problème de la métrique angulaire dans la géométrie de Minkowski.* Aequationes Math. *6* (1971), 121–129.

[2] *Sur l'équation fonctionnelle des brigades.* In the book *Functional Equations and Inequalities.* C.I.M.E. 1970. Roma, 1971, 143–151.

[3] *Quelques généralisations des espaces vectoriels* (joint with R. Miron). Rev. Roumaine Math. Pures Appl. *16* (1971), 1477–1496.

1972

[1] *Note on inner product in vector spaces* (joint with H. Świątak). Aequationes Math. *8* (1972), 74–75.

[2] *Sur la notion de l'espace presque euclidien.* Ann. Polon. Math. *26* (1972), 205–210.

[3] *Sur la notion de la dérivée covariante et de la dérivée de Lie.* Colloq. Math. *26* (1972), 39–47.

[4] *The scientific work of Professor J.A. Schouten.* Demonstratio Math. *4* (1972), 63–85.

[5] *Une contribution à la trigonométrie du plan de Lobatchewski.* Glasnik Mat. *7* (1972), 87–91.

[6] *On some new principles of classifying geometries.* Reports on Mathematical Physics (Amsterdam, Warsaw) *3* (1972), 21–31.

[7] *Sur quelques conditions suffisantes pour que l'espace de Minkowski à deux dimensions soit euclidien. I. Le rôle de l'axiome de L. Dubikajtis.* Tensor *24* (1972), 383–388.

1973

[1] *On the homogeneity of the Carnotian scalar product in vector-spaces.* Aequationes Math. *13* (1975), 9–13.

[2] *Sur un système d'équations fonctionnelles lié avec le rapport anharmonique.* Ann. Polon. Math. *29* (1974), 273–280.

[3] *Über einen algebraischen Satz, welcher in der Theorie der geometrischen Objekte auftritt.* Beiträge zur Algebra und Geometrie. Wiss. Beiträge Martin-Luther-Univ. Halle-Wittenberg Reihe M Math. *4* (1973), 7–10.

[4] *Ein Beitrag zur Axiomatisierung des Begriffs des Skalarproduktes.* Demonstratio Math. *5* (1973), 273–288.

1974

[1] *Über eine Verallgemeinerung der Schwarzschen Ungleichung*. Publ. Math. Debrecen *21* (1974), 155–158.

[2] *Sur la régularité des espaces métriques généraux*. Ann. Mat. Pura Appl. *98* (1974), 319–325.

B. *Monographs, textbooks, lecture notes*

[B.1] *Zbiór zadań z Wyższej Matematyki* (joint with A. Hoborski, A. Jakubowski). Kraków, 1928, z.1, 110 pp.

[B.2] *Zbiór zadań z Wyższej Matematyki* (joint with A. Hoborski, A. Jakubowski). Kraków, 1928, z.2, 210 pp.

[B.3] *Graficzne różniczkowanie i całkowanie*. Wydawnictwo Zakładu Matematyki Akademji Górniczej. Kraków, 1930, 9 pp.

[B.4] *Wskazówki do cwiczeń z integrafem Abdank-Abakanowicza*. Wydawnictwo Zakładu Matematyki Akademii Górniczej. Kraków, 1933, 17 pp., 5 fig.

[B.5] *O konstrukcjach geometrycznych w szkole średniej*. Poradnik *V*, *3*, Warszawa, 1933, 1–10.

[B.6] *Matematyka dla Chemikow i Przyrodnikow*. Kraków, 1934, 321 pp.

[B.7] *Geometria analityczna*. Kraków, 1935, 123 pp.

[B.8] *Równania rózniczkowe*. Kraków, 1946, 77 pp.

[B.9] *Elementy matematyki wyższej* (joint with R. Wilkowski). Warszawa, 1947, 294 pp.

[B.10] *Zarys matematyki wyzszej*. Warszawa, 1948, 318 pp.

[B.11] *Matematyka Wyższa, Cz. I*. Kraków, 1952, 322 pp., second ed. 1962.

[B.12] *Matematyka Wyższa, Cz.II*. Kraków, 1952, 354 pp., second ed. 1963.

[B.13] *Logika Matematyczna* (joint with Z. Krygowska, J. Lesniak). Warszawa, 1955, 196 pp., second ed. Elementy logiki matematycznej, Kraków, 1958, 223 pp., third ed. Kraków, 1965, 224 pp.

[B.14] *Rachunek tensorowy*. *Bibl. Mat. 11*, Warszawa, 1956, 309 pp., second ed. 1966, 359 pp.

[B.15] *Funktionalgleichungen der Theorie der geometrischen Objekte* (joint with J. Aczél). Monografie Mat. 39. Warszawa, 1960, 172 pp.

[B.16] *Dlaczego możliwe sa rozne geometrie*? Nauka dla wszystkich. No. 170, Warszawa, 1972, 38 pp.

[B.17] *Tensor Calculus*. Translation of the second edition of *Rachunek tensorowy* [B.14]. Elsevier Scientific Publishing Co., Amsterdam–London–New York. PWN-Polish Scientific Publishers, Warsaw, 1974, 371 pp.