MATHEMATICS IN POLAND TODAY[*]

K. Kuratowski

Polish Academy of Sciences

I am supposed to speak on mathematics in Poland today. Allow me, however, to say a few words on mathematics in Poland yesterday. The reason for that is the fact that just a year ago the fiftieth volume of the Fundamenta Mathematicae went off the press.

The publication of its fiftieth volume is for any scientific journal an important event, stimulating reflection as to how much those volumes contributed to the advancement of world science. In the present case, however, the publication of the fiftieth volume is more than a mere anniversary of a journal. The historical perspective now shows that the inauguration of the Fundamenta Mathematicae was a visible evidence of the appearance of a new school in Mathematics, a school which soon was to be called the Polish Mathematical School.

It is impossible, of course, to define precisely the date of a creation of a new school in science. However, if a group of mathematicians working on problems in the same field start to publish a journal entirely devoted to these problems, it seems reasonable to consider the date of the publication of its first volume as the moment of the appearance of the school. That moment was in 1920.

This does not imply that prior to that date there were no important achievements accomplished by Polish mathematicians. That would not be true. But there did not exist at that time

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anything which could deserve the name of a Polish school in Mathematics. At the very beginning of the 20th century, there were in Poland three prominent mathematicians: W. Sierpiński, whose achievements were in number theory and, later, in theory of sets; S. Zaremba, working very actively in partial differential equations and potential theory, in close connection with the French mathematicians; and, finally, K. Żorawski, former pupil of Sophus Lie, working in differential geometry, and publishing his papers mostly in Polish, which was the main reason why they were not widely known outside of Poland. These three mathematicians were working in different fields of mathematics, and the chance of getting a group of younger people to work together was rather small.

The essential change came during the years 1915-1918, and just after the end of World War I, when Poland regained its national independence after an enslavement lasting for more than a century. In 1915 the Russian army left Warsaw, and a Polish University was established. Among the newly appointed professors of mathematics were two young brilliant scientists, Z. Janiszewski and S. Mazurkiewicz, who studied partially with Sierpinski, and also in Paris and Göttingen. Janiszewski, the younger of them, published in 1918 an article entitled "On the Needs of Mathematics in Poland". It had an historical importance for the further development of Mathematics in Poland, by giving really a delineation of the future of Polish Mathematics. He emphasized that the creation of a Polish Mathematical School can be achieved only by concentrating the main talents of the Polish mathematicians in one field of mathematics. "This is now happening by itself, and we only need assist that process" - he wrote. "Undoubtedly" - he went on - "founding of a specialized periodical serving that single field of mathematics will attract many scientists to it. But there is still a further way in which the journal, published in the most widespread foreign languages, would help in establishing such a workshop in this country: we should become the technical centre of mathematical publication in this one field. We should receive the manuscripts of new papers and we should be approached for help in establishing contacts. If we want to get our own place in the world of science we have to show our own initiative". Thus, the idea was to establish an international journal devoted to Set Theory, Foundations of Mathematics, Topology, and related topics.

Such was the origin of the journal Fundamenta Mathematicae, and of the Polish Mathematical School. Janiszewski's ideas were brought into being. Unfortunately, Janiszewski himself did not live to see his ideas materialized. He did not even see the first volume of the Fundamenta Mathematicae of which he was the first editor-in-chief. Janiszewski died in 1920.

From the present perspective of half a century, the boldness of Janiszewski's conception becomes all the more striking, especially two of his ambitions: to publish the journal only in internationally known languages, and - as already indicated - to make it a strictly specialist journal.

To print the Fundamenta in languages widely known in other countries meant to make our findings available to scientists the world over, which in turn was a prerequisite for foreign mathematicians to print their papers in the journal, with obvious effect on its international standing. And yet it was by no means easy to overcome the widespread belief, or rather prejudice, that a Pole ought to publish his papers in Polish, no matter how little chance he stood of bringing them to the attention of world scientists.

Even more revolutionary was the other ambition - to restrict the field covered by the Fundamenta to selected branches of mathematics. By contrast with the common practice, involving numerous strictly specialized journals, this venture constituted a novelty at the time and as such was received by many mathematicians with manifest scepticism. In particular, a leading mathematician of the period, Lebesgue, addressing a letter to Professor Sierpiński in connection with the publication of the first volume of the Fundamenta, expressed - together with praise for the papers contained in the volume - his strong doubt as to the possibility of obtaining enough material to maintain such a highly specialized journal as a going concern. But future developments proved Lebesgue wrong. The amount of material received by the editors increased steadily, making it possible to publish the journal more frequently, and at the same time to select the material more carefully.

The group of mathematicians concentrated in branches of mathematics to which the Fundamenta Mathematicae were devoted grew stronger year by year, and in the early 1920's it was mainly connected with the University in Warsaw.

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However, the Polish Mathematical School was not restricted to Warsaw only. Within a few years, the mathematicians in Lwów, grouped around Banach and Steinhaus, achieved fundamental successes in Functional Analysis which combined the accomplishments in Set Theory and Topology with the modern mathematical analysis. Functional Analysis became the chief domain of the Lwów team of mathematicians. They also founded a new periodical, Studia Mathematica, which also specialized in one field, and also published in foreign languages only.

This thriving development of mathematics in Poland could not be achieved without concentration of manpower. It had also certain disadvantages rooted in Janiszewski's very conception. Although Topology, Functional Analysis, Foundations of Mathematics, the main fields of the Polish Mathematical School, grew in importance in mathematics as a whole, their development without appropriate advancement of other fields, like Analysis and Algebra, were doubtlessly one of the weaknesses of mathematics in Poland at that time.

This circumstance began to cause concern among the Polish mathematicians in the years 1936-1939. At that time Polish Mathematics seemed to have had - to some extent - an established position in the world of science, and its scientific potential appeared to be adequate for expanding into new fields, hitherto neglected or completely ignored, e.g. Applied Mathematics. The plan was ready in 1939.

Then the disastrous World War II broke out. Polish mathematics emerged from the war terribly mutilated. More than 50 per cent of the Polish mathematicians lost their lives. Almost all the university buildings and libraries were destroyed. The resurrection of Polish mathematics under such conditions called for a tremendous effort. We understood that this goal far exceeded the possibilities of our universities. It was indispensable to create a body which could cope on a national scale with the problems of organization and which would, at the same time, carry out its own scientific research on the largest possible scale by developing all branches of mathematics in order to meet the needs of the recovering nation. That was the idea of establishing the Polish Institute of Mathematics.

The Polish Mathematical Institute started its activity in

1948. Since 1952 it has been incorporated into the new Polish
Academy of Science established on the base of the two Academies
existing at that time, namely the Polish Academy of Sciences
and Letters in Cracow, and the Warsaw Scientific Society,
established in the beginning of the 19th century. The main
difference between the new Academy and the older ones con-
sists in the following. The new Academy is not merely an
association of distinguished scholars (like e. g. the Institut de
France, or the Royal Society in London) but it is a creative
scientific organization working through its institutes in practi-
cally all the field of Science, humanities, medicine, technology
and agriculture.

One of the first institutes of the Academy was the Mathe-
matical Institute. What is its organization, and how does it work?
The answer to this question will constitute one of the important
points in the picture of Mathematics in Poland today.

The Mathematical Institute is essentially a research
scientific body. The training and teaching of students has been
left to the Universities. This does not imply that the Universities
do not carry out their own research programs. On the contrary,
no advance and graduate teaching can exist without research.
But the main goal of the universities, which is of extreme
importance, is the teaching and the training of the new cadres
in order to meet the immense and ever increasing demand
for teachers and scientists at all levels. There is also some
training activity at the Institute, but it is confined to the highest
level. Thus, no regular courses for students are offered, but
there are various research seminars within each of the 14
sections of the Institute. The total number of these seminars
amounts to 40 at the present time.

The sections of the Institute are organized according to
the particular branch of mathematics in which they are working.
Almost all fields of contemporary mathematics are
represented in those sections: Topology, headed by K. Borsuk
in cooperation with Knaster (in Wrocław), Jaworowski and
myself; Foundations, A. Mostowski in cooperation with Mrs.
Rasiowa and others; Functional Analysis, headed by S. Mazur,
and in Poznań by W. Orlicz; Differential Equations, headed in
Cracow by T. Ważewski in cooperation with Krzyżański,
Lojasiewicz, Pliś, Szarski and others; General Analysis

headed by Mikusiński; Differential Geometry headed by
S. Gołab in Cracow; Analytic Functions headed by Z. Charzyński
in Lodz with collaboration of F. Leja in Cracow; Algebra headed
by J. Loś in Toruń; Real-valued Functions headed by
E. Marczewski in Wrocław with collaboration of H. Steinhaus,
R. Sikorski, Ryll-Nardzewski, Urbanik and Hartman;
Industrial Applications headed by J. Oderfeld; Applications
to Agriculture and Biology headed by Perkal in Wrocław;
Statistics headed by Sadowski in Warsaw; Numerical Analysis
headed by Altman; new organized Section of Number Theory
under the leadership of W. Sierpiński. Forty seminars, which
meet every week for several hours in various Polish cities and
which are attended also by out of town mathematicians, consti-
tute the most valuable and powerful instrument in advancing
scientific research.

A very close collaboration between specialists in different
fields is one of the features of Polish mathematics; thus e. g. ,
the section of Topology has a considerable cooperation with the
section of Differential Equations, as well as with that of
Foundations and of Functional Analysis; the section of Functional
Analysis, in its turn, influences that of Numerical Analysis etc.
In this way, Janiszewski's dream has come true.

There was also in the Mathematical Institute a Section of
Electronic Computers. About two years ago it grew into an
independent Institute itself within the Polish Academy of Sciences.
Besides those activities, the Mathematical Institute has also
been helping various technological institutes in carrying out their
research programs. To this end, numerous quite specialized
courses for engineers have been offered by the Mathematical
Institute, e. g. in Operational Research, Cybernetics, and
other modern subjects.

The Mathematical Institute works in close cooperation
with the Universities and Technological Academical Schools.
Many university professors are simultaneously on the staff at
the Institute, and a large number of university instructors as
well as graduate students participate in the Seminars conducted
at the Institute.

There are at present 7 Universities (5 before the war):
in Cracow (the oldest one, established 600 years ago),

in Warsaw, Poznań, Lublin, Wrocław, Toruń and Lodz. The total number of Technological Schools is greater; it is growing according to the development of the Polish industry.

There is also a strong cooperation between the Polish Mathematical Society and the Universities on one side and the Mathematical Institute of the Academy on the other. The meetings of the Mathematical Society are not as specialized as those of the Institute. They keep the mathematicians, working in their field, informed of what is going on in other fields. Also, the Mathematical Society assists the Universities and Polytechnical Institutes, and even the high schools, in working out their teaching programs in mathematical education. The Society organizes also mathematical competitions, called Mathematical Olympiads, among the high school students, in order to find at that level the talents which will constitute the body of the future generation's mathematicians.

A very important domain of activity of the Polish Mathematics, concentrated mainly in the Mathematical Institute in partial cooperation with the Polish Mathematical Society, is in the field of editorial work. We publish now 8 periodicals, 4 of them specialized and written in foreign languages exclusively. In this way we follow again the ideas of Janiszewski. These four journals are: Fundamenta Mathematicae, Studie Mathematica, Annales Polonici Mathematici, and Acta Arithmetica. I have also to mention Colloquium Mathematicum, chiefly devoted to new problems, and the Bulletin of the Polish Academy of Sciences, which publishes about 100 short mathematical papers (not exceeding 6 pages) within a short time (not exceeding 3 months) after they have been presented by one of the members of the Academy; a large proportion of those papers are by foreign authors.

Besides the above mentioned periodicals, we have the well-known Mathematical Monographs, published in foreign languages (French, English, German), started in 1932 and stemming from Fundamenta Mathematicae and Studia Mathematica; furthermore, the Mathematical Memoirs (Rozprawy Matematyczne) and textbooks edited by the Polish Scientific Publishers under the mathematical guidance of Docent M. Stark. Some of these books have been translated into English, and conversely, we translate into Polish the most outstanding books, to meet the needs of

our readers. For instance, the book by Professor Coxeter will soon appear in a Polish translation.

Before concluding I would like to summarize what constitutes, in my opinion, the main success in re-establishing Polish Mathematics after the war. I think one should attribute the priority to the following facts.

1. A considerable increase of the number and quality of young gifted mathematicians. Not only all our junior scientific staff but also the majority of our docents and quite a few of the present professors have graduated after the war. There are now in Poland about 400 active mathematicians doing research in various fields of mathematics, and that number is considerably higher than it was in the prewar times.

2. The number of mathematical scientific publications has doubled as compared with the prewar period. We publish now about 300 papers yearly. Let me point out that we started in the years 1945-49 with the annual average of 50 papers.

3. Polish Mathematics seems to have regained the position it occupied before the war in the field of Topology, Foundations and Functional Analysis. However, in addition to those fields, new scientific activities have been considerably expanded in directions previously neglected in Poland: Differential Equations, Algebra, Probability, and Applied Mathematics.

I would like to point out here that these successes could not be achieved without considerable cooperation with foreign mathematicians. This cooperation has been developing very well. Each year a large number of scholarships are granted to our young mathematicians for studies abroad, chiefly in U.S.A., Soviet Union, France, Italy, Canada, Great Britain, Hungary, etc. At the same time, the number of visitors from abroad to Poland increases considerably. Thus, for example, in 1962 we had 17 visitors in just one section of Topology at the Mathematical Institute.

I would like to pay special attention to the cooperation of the Canadian and Polish mathematicians. Two years ago, an arrangement was worked out between the National Research

Council of Canada and the Polish Academy of Sciences. The arrangement is aimed at the strengthening of the scientific contacts between our two countries, and I am most hopeful it will serve that cause successfully. I hope very much that the goal will also be achieved in the field of mathematics. My Polish colleagues and myself are looking forward to welcoming in Poland as many as possible representatives of the Canadian Mathematical Congress.

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