
STUDY OF THE SCIENTIFIC WORK
BY QUANTITATIVE METHODS: SOME RESULTS
ON ACADEMICIAN NIKOLA OBRESHKOFF'S WORKS

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Some results of studying the work of one of the most productive Bulgarian mathematician by quantitative methods are presented. The study is based on the data from the world-wide known review journals "Jahrbuch über die Fortschritte der Mathematik", "Zentralblatt für Mathematik und ihre Grenzgebiete" and others, representing most accurately the world scientific information flow, structuring it by domains of science and their areas. Graphically are shown: distribution of Obreshkoff's works over domains of mathematics according to divisions of mentioned review journals, distribution of scientific activity over years, domains of mathematics and their areas, etc.

This study is based on the so-called Reference Database (RDB) allowing flexible retrieving, systematizing, aggregation and generalizing data.

1. INTRODUCTION

Academician Nikola Obreshkoff is a Bulgarian scientist known not only to the Bulgarian mathematicians. He is respected by the whole Bulgarian scientific community for his over 40 years long scientific and publication activity. The goal of the present paper is to estimate by quantitative means his interference with the international scientific community.

Some results of using quantitative methods to explore his publication activity are presented in the paper. The notions of relevance criterion and the so-called Reference Database (RDB) are introduced. The data in the RDB on N. Obreshkoff are compared to the known bibliographies of his works. These bibliographies

are not used as sources to build a RDB, because they are lists of works, ordered chronologically or alphabetically. They are not organized according to the domains of scientific fields the scientist works in. No matter how complete they are, they do not give an adequate image of the interaction between the scientist and the international scientific community. This characteristic feature is the main reason to study the publication activity by RDB organized according to some classification of scientific domains.

2. WORLD-WIDE FLOW OF SCIENTIFIC INFORMATION AND RELEVANCE CRITERION

The mentioned interaction between scientists gives the so-called *world-wide flow of scientific information* built by an immense quantity of scientific works in different fields of science, published in numerous scientific journals, proceedings of conferences and workshops, monographs and so on. To manage that flow, the scientific community created the powerful tool of auxiliary reference editions — review (abstract) journals, bibliographies etc.

The consideration of the participation of a given scientific work in this information flow provides a useful bibliometric criterion — whether the paper has been or not reviewed in the world-widely known abstract journals. The use of that criterion when exploring the scientific work mirrors the publishing activity of given scientists and the dynamics of their scientific interests as the international scientific community looks at them.

Thus the idea is arisen of using the Reference Databases with published scientific works of one or more scientists — a computer database keeping data extracted from scientific reviews published in the abstract journals. Such a database can be explored by computer and quantitative tools from different points of view. This approach makes it possible to find some interesting and sometimes unexpected points in the entire work of a given scientist. The authors of the present paper are developing similar RDB, fulfilling the project “A quantitative study of the scientific production of lecturers of the Sofia University from 1889 to 1950”¹. This project continues the research of the authors published in [5].

In this study the selection of sources is done following the above mentioned criterion: published works are taken into consideration only if they are reviewed in world-widely known abstract journals. These journals assign the reviews to sections in accordance with the domains of different fields of science. This is a good reason to use such journals for purposes of building RDB.

In the field of Mathematics the following journals were selected to build a RDB: *Jahrbuch über die Fortschritte der Mathematik* (Fortsch. d. Math.), *Zentralblatt für Mathematik und ihre Grenzgebiete* (Zbl. Math.), *Mathematical Reviews* and *Referativny Zhurnal*. The first one was founded in 1868 and was issued regularly until 1938², the second was founded in 1931, the third — in 1940, and the last — in 1953.

¹ Contract No 97/1996 of the Sofia University Scientific Research Fund.

² It was stopped several years later.

3. USING RDB TO PROCESS THE DATA ON N. OBRESHKOFF

The data in RDB concerning the works before 1939 are extracted from two abstract journals: *Jahrbuch über die Fortschritte der Mathematik* and *Zentralblatt für Mathematik und ihre Grenzgebiete*, and concerning the works after 1939 — from three abstract journals: *Zentralblatt für Mathematik und ihre Grenzgebiete*, *Mathematical Reviews* and *Referativny Zhournal*. The search in the journals was conducted for a period starting several years before 1920 (the year of N. Obreshkoff's entrance in the lecturer community of Sofia University) and continuing up to 1970, Vol. 178 of *Zbl. Math.* The assignment of entries to the sections and subsections before 1939 is made according to these of the *Fortsch. d. Math.*, and concerning the works after 1939 — according only to the sections and subsections of the *Zbl. Math.* The way of assignment is changed because the issuing of the first journal is suspended after 1939. Conforming all RDB to the classification before 1939 is useless. Thus, there is a boundary dividing the entire work of N. Obreshkoff into two periods: the first one from 1920 till 1939 (44% of the whole duration) and the second one from 1940 till 1963. For this reason works, for instance, belonging to the domain of Analysis, may have entries in section II (if the work is published before 1939) or in section V (if the work is published after 1939) in the RDB.

The creation of the RDB on N. Obreshkoff's work is based on a modification of a first variant of RDB on lecturers in the Faculty of Mathematics and Physics, built by the authors. This makes the investigation much easier.

4. RESULTS

A. A QUANTITATIVE INFORMATION ON SCIENTIFIC ACTIVITY IN THE PERIOD 1920–1939

The RDB has 99 entries for this period, assigned to the following domains in the field of Mathematics: I. Arithmetics and Algebra (21 reviewed works); II. Analysis (76 reviewed works); III. Geometry (2 reviewed works).

Fig. 1 shows the publication activity (the number of all works from 1920 to 1939) distributed over different domains. The domains I and III contain entries assigned to one area in each domain. The most of entries are in the domain of Analysis, assigned to several areas. Fig. 2 shows the distribution of the works over areas. It allows ranking the activity of N. Obreshkoff in this period. Thus, his scientific interests are oriented in the first place to the areas of *Infinite Number Sequences Theory* and *General Theory of Real Functions* (50% of all works). Near 31% of them are in the areas of *General Theory of Functions with Complex Arguments* and *Functions of Complex Variables*.

The scientific activity is often represented by the number of published works per year. The distribution of works in different domains per year is given on Fig. 3 representing the dynamics of scientific interests. Being concentrated in the domain of Analysis, the number of works varies — there is an alternation of decreasing and

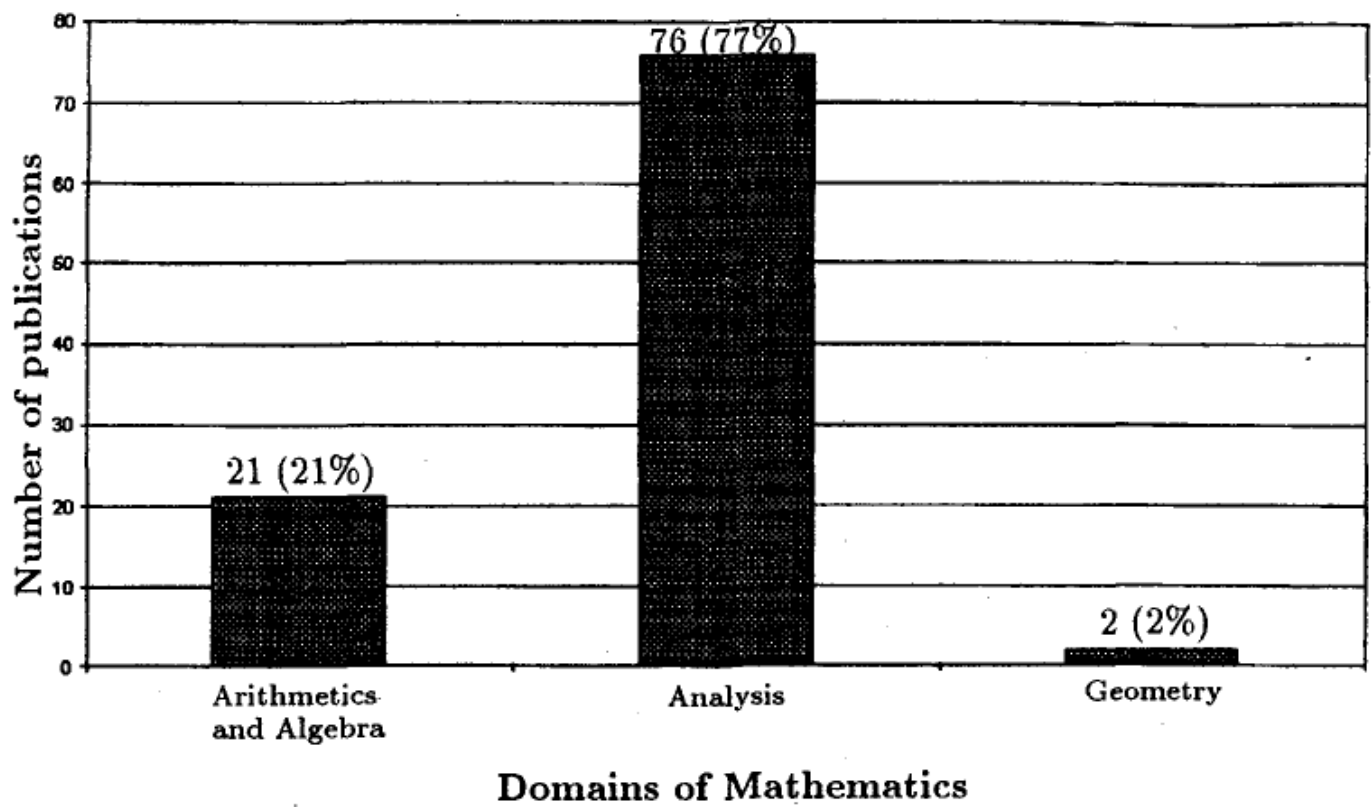


Fig. 1. Activity distribution (before 1939)

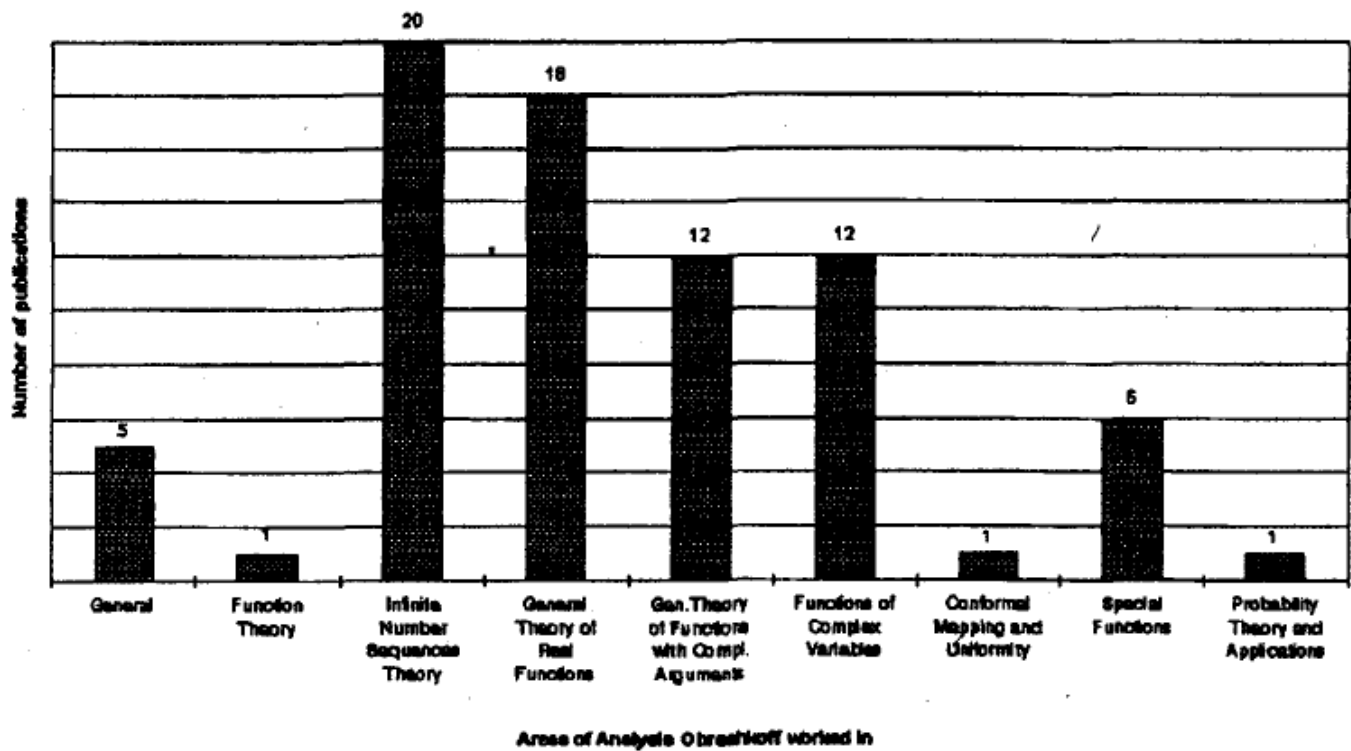


Fig. 2. Activity over areas of analysis (before 1939)

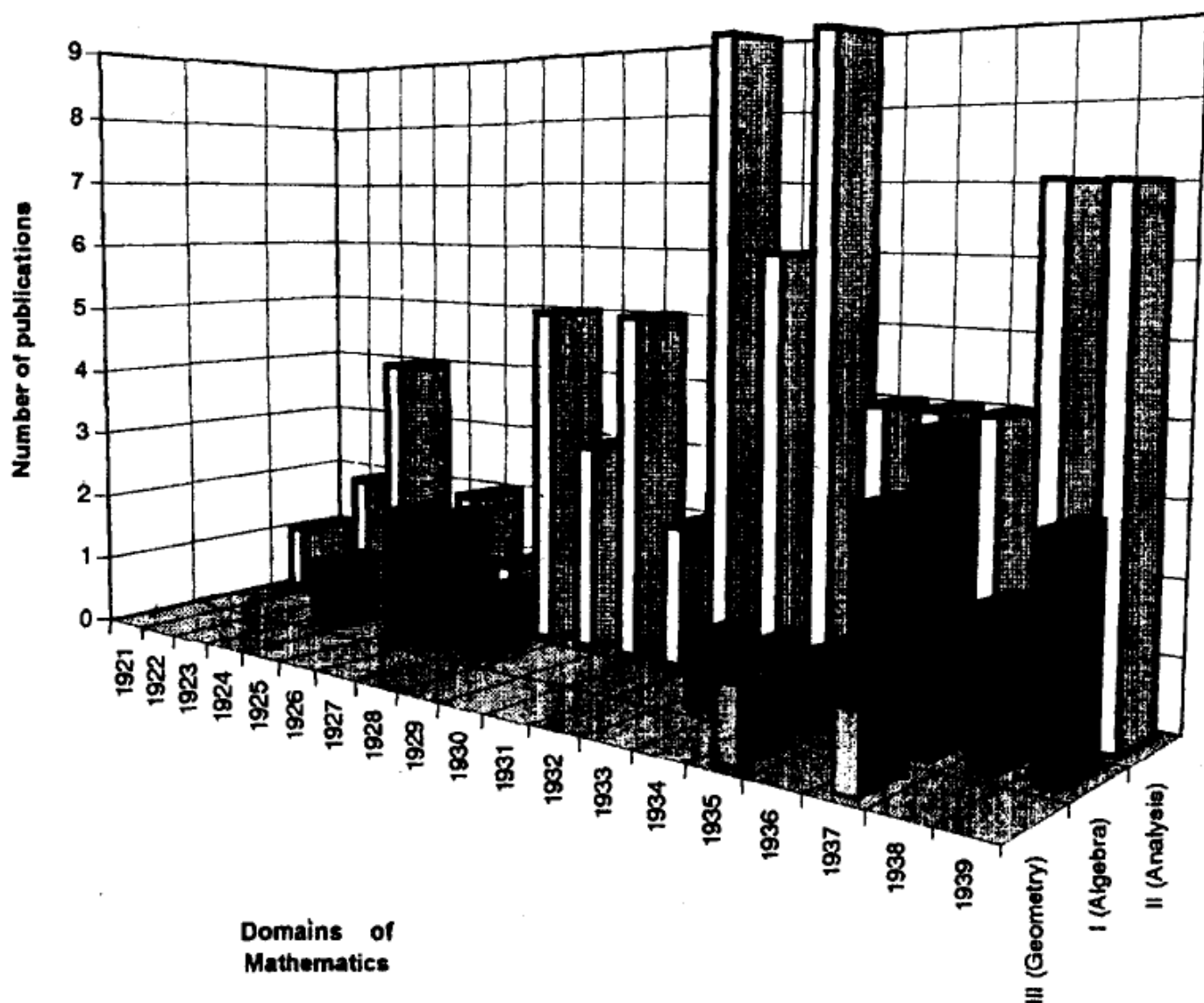


Fig. 3. Distribution of works over domains of mathematics per year (before 1939).

increasing in the activity in this domain; when the activity in the area of Analysis decreases, this one in the area of Algebra increases (a contre-tendance).

B. A QUANTITATIVE INFORMATION ON SCIENTIFIC ACTIVITY IN THE PERIOD 1940-1963

The RDB has 93 entries for this period assigned to the following domains in the field of Mathematics: IV. Algebra and Number Theory (34 reviewed works); V. Analysis (57 reviewed works); VI. Geometry (1 reviewed work), VII. Probability Theory. Statistics. Applications (4 reviewed works).

Fig. 4 shows the publication activity distribution over domains of Mathematics. It confirms the conclusion about concentration of interests in the domains of Algebra and Analysis.

Fig. 5 illustrates the activity over areas of analysis after 1939. In this period the classification is different compared with that of the first period. Nevertheless, Fig. 5 shows that the biggest part of published works is in the areas of *Real Function*

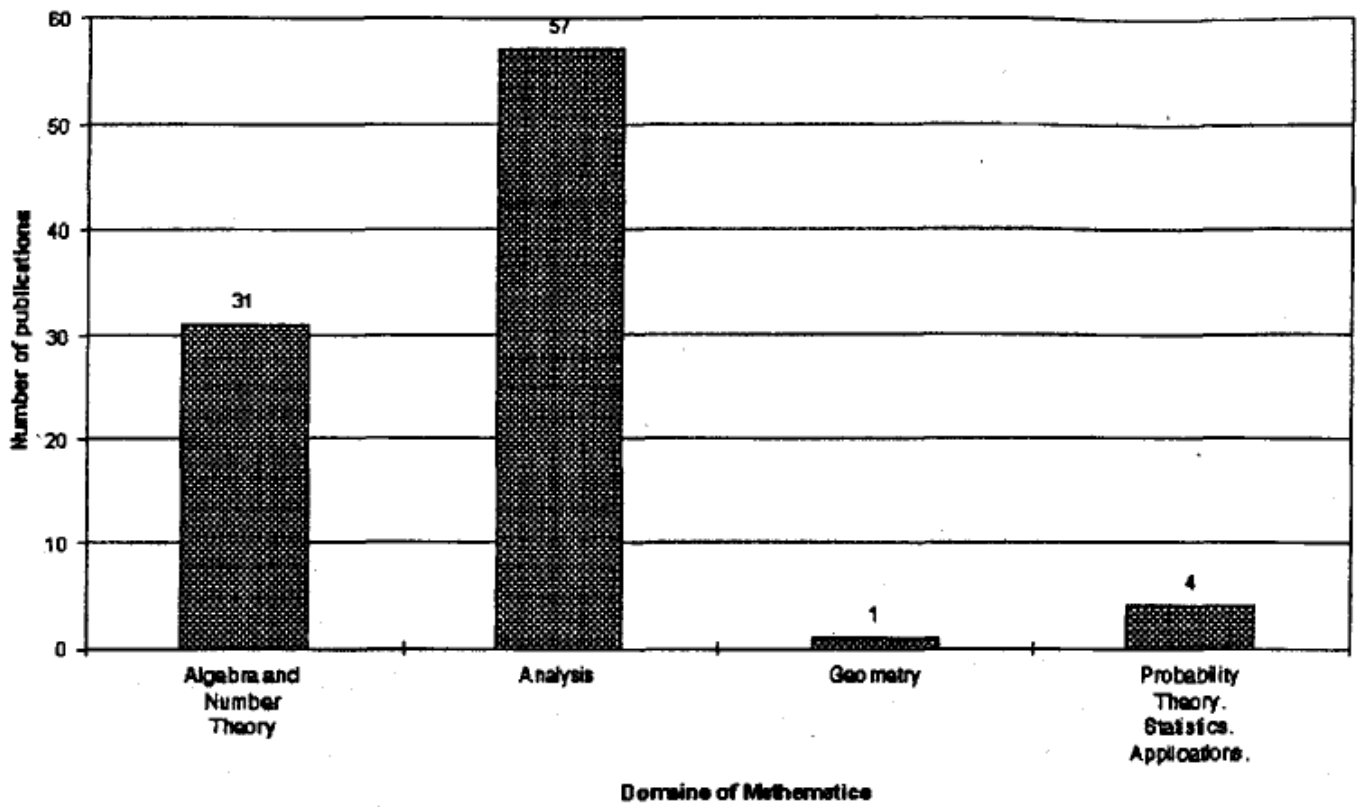


Fig. 4. Activity distribution (after 1939)

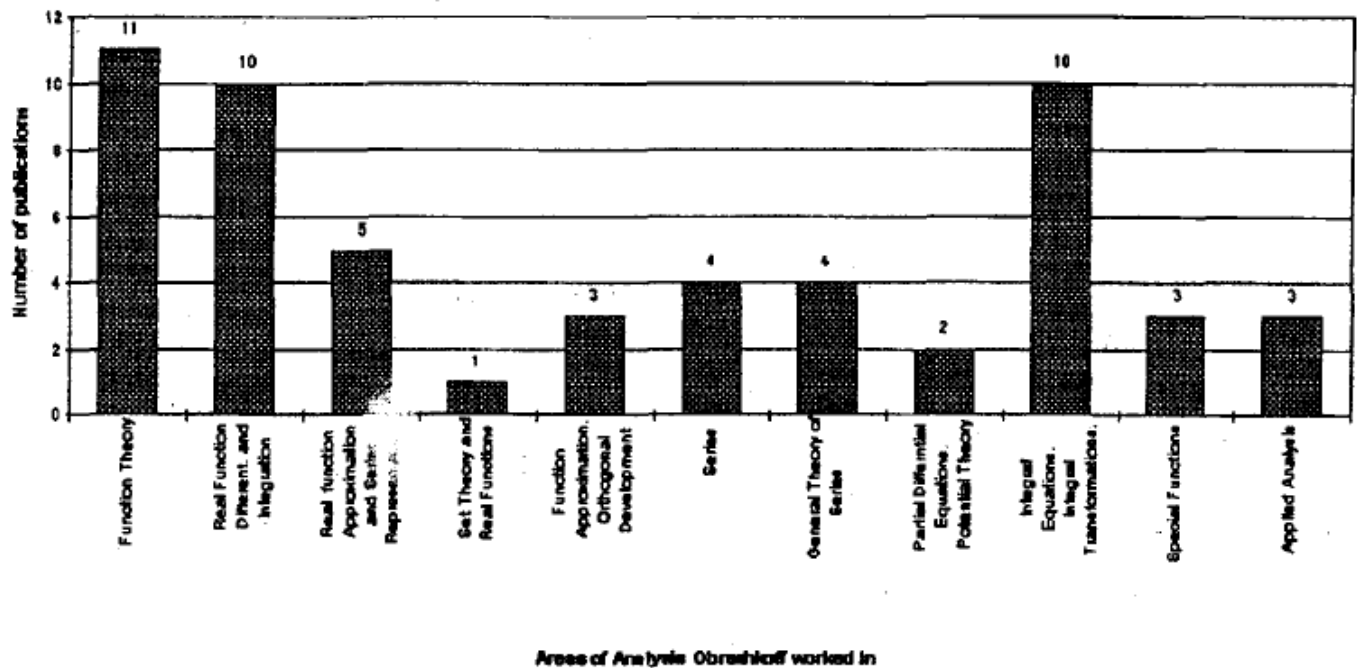


Fig. 5. Activity over areas of analysis (after 1939)

Differentiation and Integration and *Integral Equations, Integral Transformations*. There is a work not related to any area of Analysis, according to the subsections of *Zbl. Math.*, so the sum of the numbers in different areas is 56.

On Fig. 6 "Distribution of works over domains of Mathematics per year (after 1939)" the dynamics of N. Obreshkoff's works is shown. With concentration in the

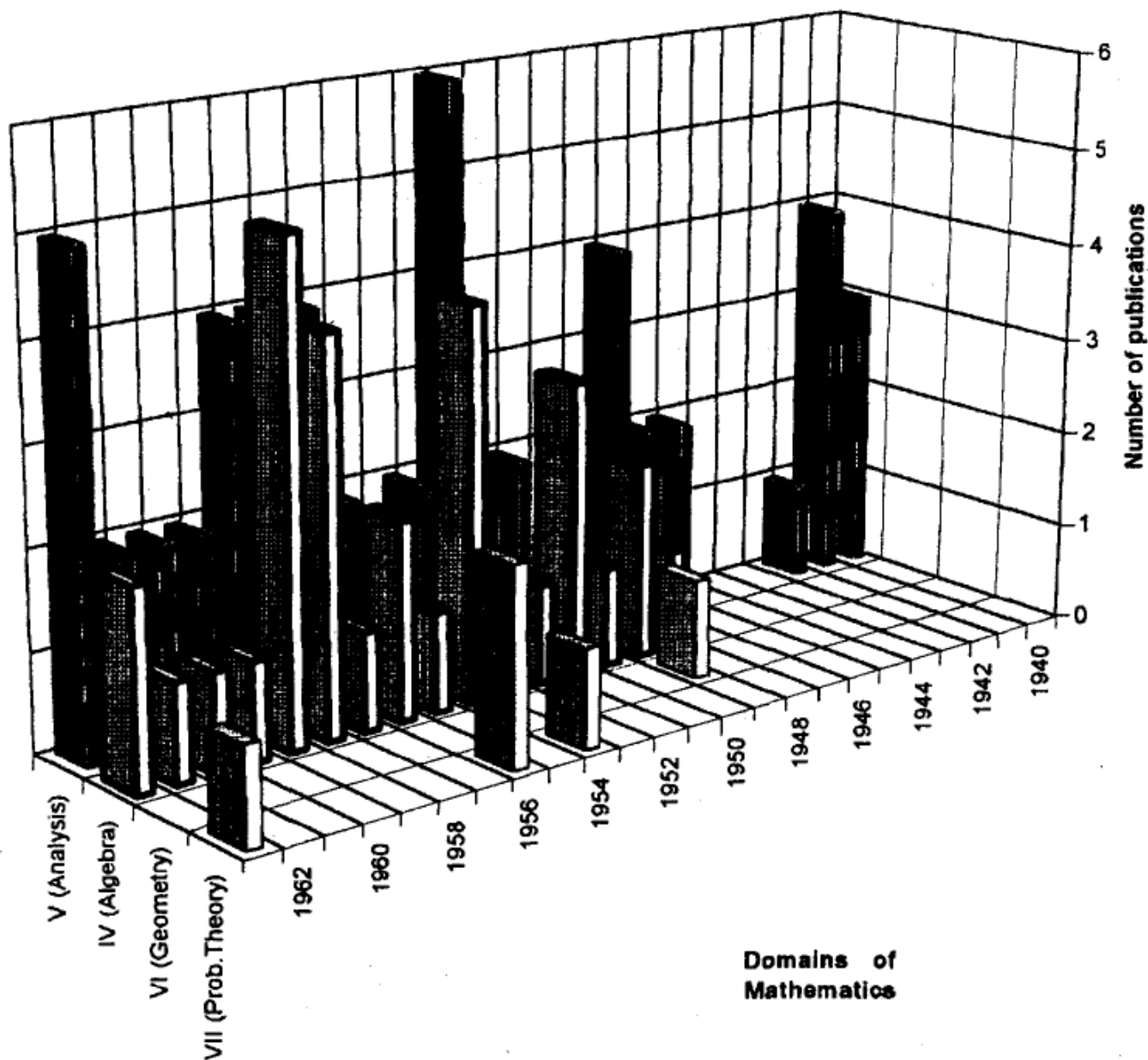


Fig. 6. Distribution of works over domains of mathematics per year (after 1939)

domains of Analysis and Algebra, similar to the first period, some equalising of tendencies near 1963 is observed. The number of works in the domain of Analysis prevails over the works in the area of Algebra near 1940. An interruption in the activity between 1943–1945 can be explained by the difficulties in publishing because of the World War II.

C. A GENERALIZED QUANTITATIVE INFORMATION ON THE ENTIRE SCIENTIFIC WORK IN THE PERIOD 1920–1963

The distribution of published works over the age of the scientist is given on Fig. 7. There is a period of extremely high activity starting in 1932 (when N. Obreshkoff was 36 years old) to 1939. The end of this period coincides with the beginning of the World War II. Here 67 published and reviewed works can be seen or 35% of all published and reviewed works. During this 7 year long period there are two absolutely maximal values of the activity (in 1934 and 1939). The second

Number of publications

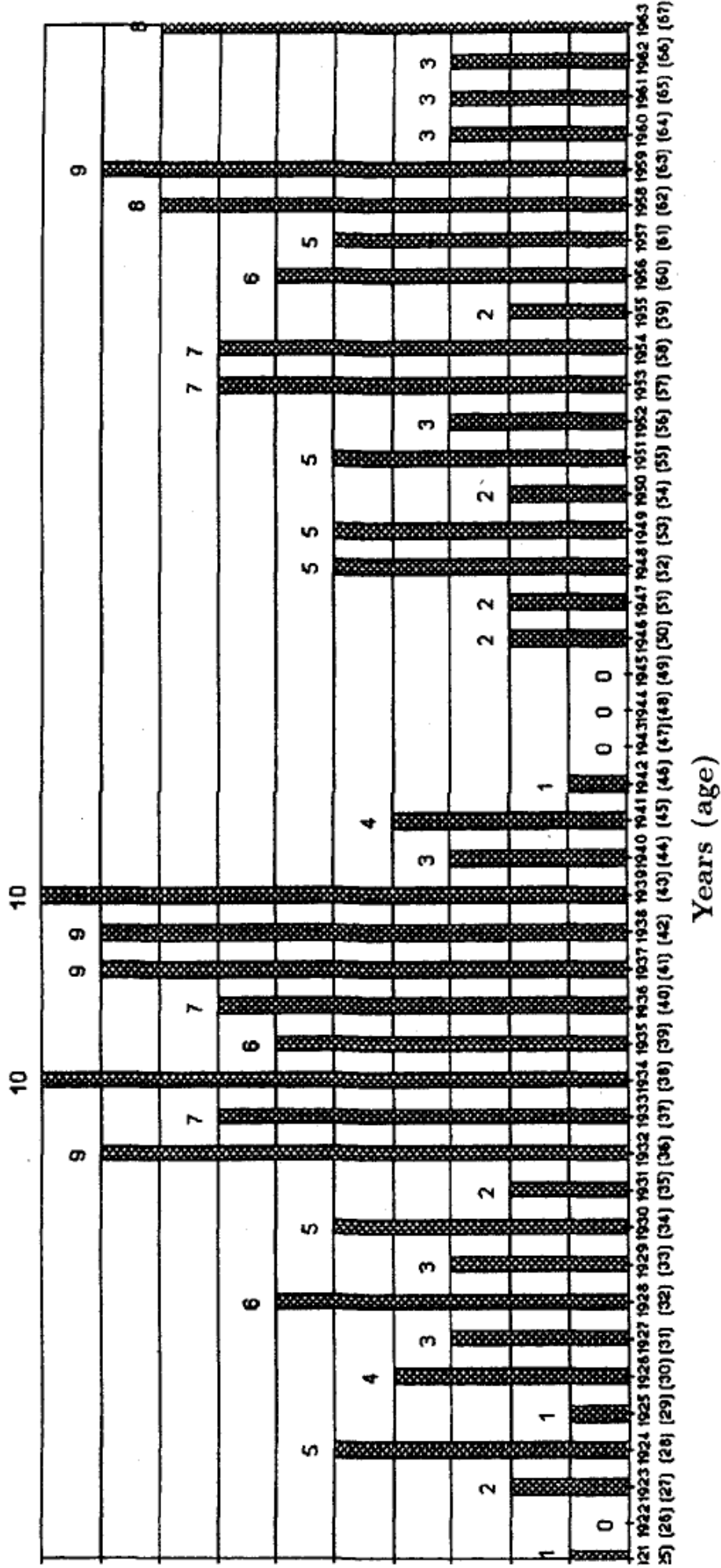


Fig. 7. Distribution of works of Nikola Obreshkoff

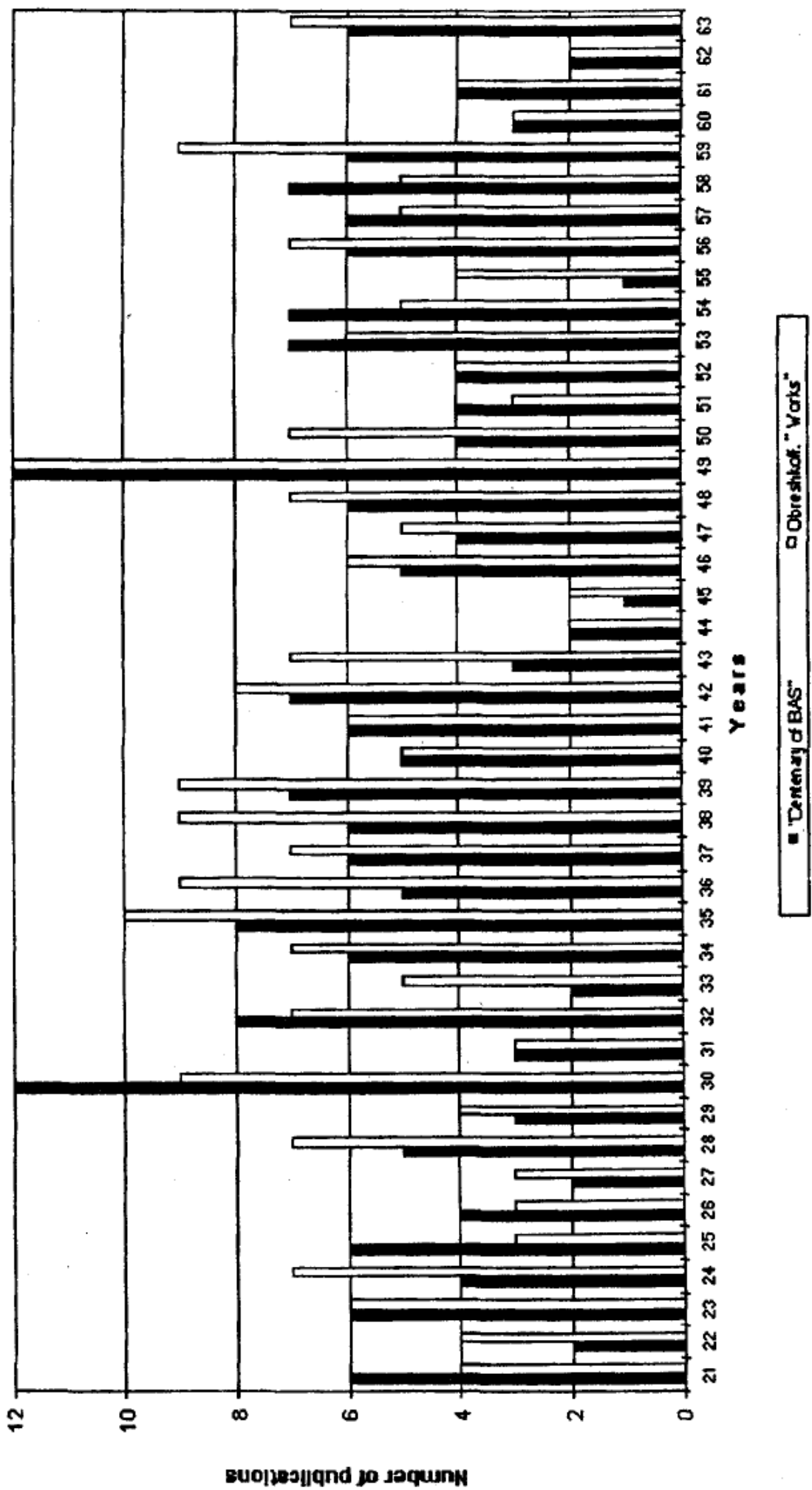


Fig. 8. Published works of Nikola Obreshkoff

maximum hints a new period of increase in the work of N. Obreshkoff, stopped by the beginning of the war.

It is interesting to compare our data with the known bibliographies of N. Obreshkoff's works. The most complete one has 247 entries [6]. The bibliography in [4] has 219 entries. The bibliography in [3] includes works from 1940 to 1963. All of them were compiled after N. Obreshkoff's death in 1963. Two previous bibliographies are given in the first Almanacs of Sofia University the first one in 1929 [1] and the second one in 1940 [2]. They were compiled by Nikola Obreshkoff himself. The bibliography of 1929 includes entries missing in the later bibliographies, the one of 1940 is selective and its worth is Obreshkoff's own classification of works into groups of "principal works", "other works" and "diverse". Fig. 8 shows the distribution of published works over the years according to the biggest bibliographies [4, 6] which include not only reviewed works. The noticeable difference in 1930 can be explained by the fact that the *Annuaire* of the Sofia University was not reviewed before 1930. Another difference in 1949 can be explained by the difficulties in the cultural relations in Europe in the end of the World War II and after it.

Each domain of mathematics has two corresponding sections in this implementation of RDB. For this reason, in order to retrieve a quantitative information relative to the entire period from 1920 to 1963, the data are grouped into four domains: **A.** Algebra and Number Theory; **B.** Analysis; **C.** Geometry; **D.** Probability Theory. Statistics. Applications. The distribution of works over these domains is presented on Fig. 9.

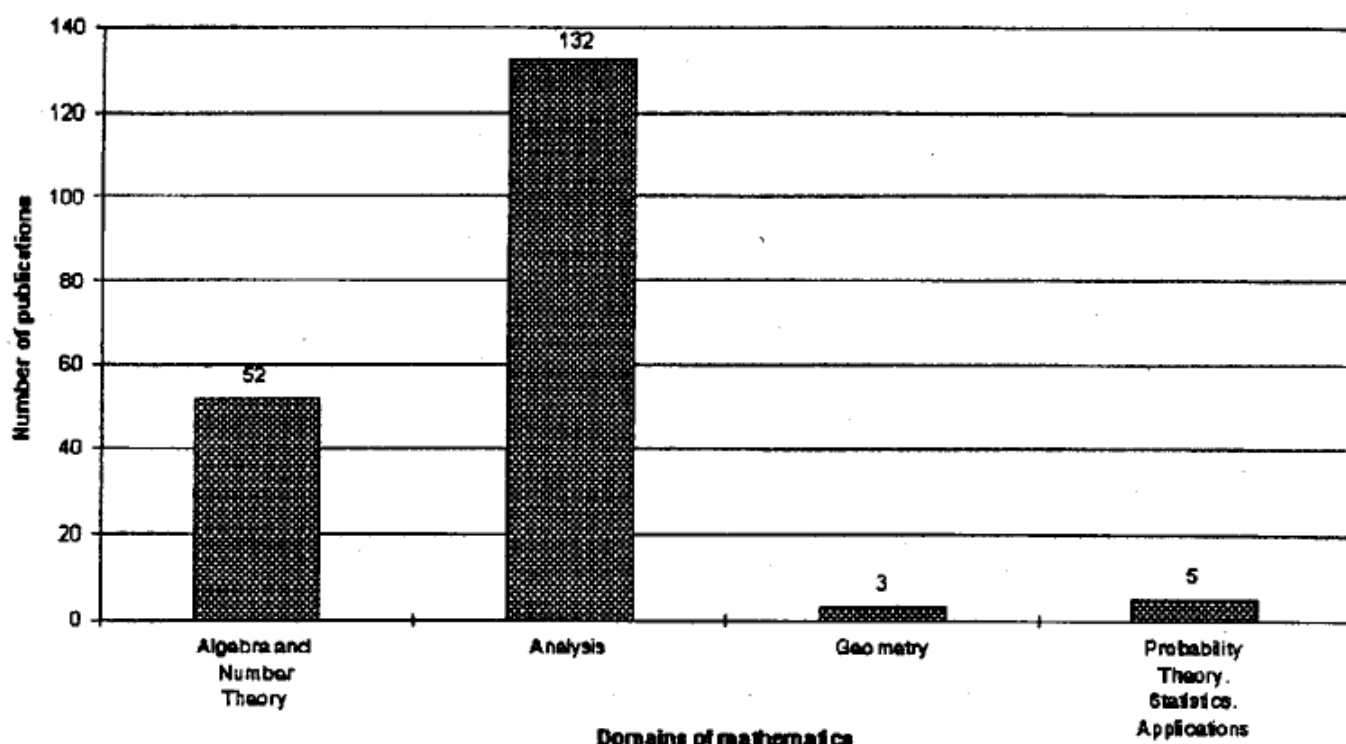


Fig. 9. Distribution of works over domains of mathematics

The reviewed works are published in nearly 50 journals, 3 monographs, 6 textbooks. Most of the papers are published in: *Comptes Rendues Acad. Sci., Paris* — 36 papers, *Annuaire Univ. Sofia, Fac. Phys.-Math., Livre 1* — 25 papers, *Comptes*

5. CONCLUSIONS

The results presented in the paper allow to make: (i) deductions about the publication activity of N. Obreshkoff, and (ii) quantitative evaluation of dynamics of his scientific interests. Specific features of the activity like the contra-tendencies in its alternation are demonstrated.

The predominant orientation of interests to the Analysis and Algebra, shown graphically, can be compared to Obreshkoff's own view on his principal works [2]. There are 22 works, 15 in the area of Analysis (over 2/3) and only 7 in the area of Algebra. Of these principal works 15 are reviewed: 3 on Algebra (20%) and 12 (80%) on Analysis.

The results obtained show that the application of RDB was useful in exploring the work of the scientist. The data on scientific publication activity were considered according to different points of view. They were represented in different ways, and numeric evaluation, dynamics and distributions were obtained. The method of RDB is outlined as a necessary foundation in research on a scientist's publication and other activity, on its significance for evaluating the development of the corresponding scientific domain in Bulgaria and comparing it with the general tendencies in the development of the science in the world.

Last but not least, the RDB allows to explore the abstract journals themselves — their scope, degree of discordance in their classification schemes etc. This is an important area in research, based on the use of abstract journals.

REFERENCES

1. Almanac of Sofia University (1888–1928), Printing house "Khudozhnik", Sofia, 1929 (in Bulgarian).
2. Almanac of Sofia University "St. Kliment Ohridski", Second ed., Court printing house (Phototype edition, Publishing House of Sofia University), Sofia, 1940 (in Bulgarian).
3. Almanac of Sofia University (1939–1988), Publishing House of Sofia University, 1995 (in Bulgarian).
4. Centenary of Bulgarian Academy of Sciences (1869–1969), Vol. 1, Publishing House of Bulgarian Academy of Sciences, Sofia (in Bulgarian).
5. K h r i s t o v, D. et als. New Information on the History of Sofia University "St. Kliment Ohridski" undertaken by Quantitative Methods and Computer. 1888–1939., Publishing House of Sofia University, Sofia, 1990 (in Bulgarian).
6. O b r e s h k o f f, N. Works. Vol. 1, Publishing House of Bulgarian Academy of Sciences, Sofia, 1977 (in Bulgarian).
7. O b r e s h k o f f, N. Works. Vol. 2, Publishing House of Bulgarian Academy of Sciences, Sofia, 1981 (in Bulgarian).

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