BioBibliometry

Statistics on life sciences publications

Bibliometry is changing how science is organized . The count and examination of published works and references in research journals seem to be a magic wand that enables us to embrace the boundless, allowing us to capture in figures, talent, success and place, both in the history of science and of humanity.

Irrespective of criticism, the number of advocates of the count of references and indices is steadily increasing. According to the project of the official Innovation Strategy of the Russian Federation, by the year 2020, 5% of all new articles in the Web of Science database should be written by Russian authors. This is an indicator of success in scientific reform that has been subscribed to by the Ministry of Economics. However, the current share is approximately 2.5%, while as recently as ten years ago it was 3.5%. It is no coincidence that experts remain skeptical regarding the figures quoted in the Strategy project.

The competition for "megagrants" announced by the Ministry of Education and Science had the same demonstrative force. The officials avow that applicants for the six-figure financial support need to have high Hirsh indices. It has been heard that even in more modest competitions held by the Ministry, participants will need to specify the number of citations of their published works.

This year, the assessment of the effectiveness of the state's civil science organizations is due to start, raising heated debate. This is largely due to the fact that it is quite possible that unsatisfactory bibliometric indices may result in the closure of a number of research institutes. The same indices have been widely used to measure the efficiency of the development of national research and federal universities.

At an organizational level, a number of programs for stimulating those researchers who actively publish their results in authoritative journals have also emerged. The type of incentive depends on the type of organization: in some organizations, the refined index of the effectiveness of scientific activity is forcefully used, while some organizations stipulate their own rules, according to which the salary of researchers who publish their results in *Nature* and *Science* may be five times greater in comparison with their less active colleagues.

It goes without saying that any bibliometrical indices should be interpreted with a great deal of caution. There are a number of factors preventing one from affirming the existence of an unequivocal link between the indices and the actual scientific merits of an individual researcher, organization, or even country. However, many scientists in the world put increasing importance on bibliometry in their careers, and they are guided by figures even in terms of self-rating and planning. Sometimes the situation can be absurd; such as the case when after having gotten married and changed their last names, western female researchers continue using their maiden names, which are already indexed in bibliometric databases, for scientific publications.

It is necessary to concede that biomedicine, molecular biology, bioinformatics, and other cutting-edge disciplines of life sciences better suit publication analysis as compared with mathematics or archaeology due to the large amount of publica-

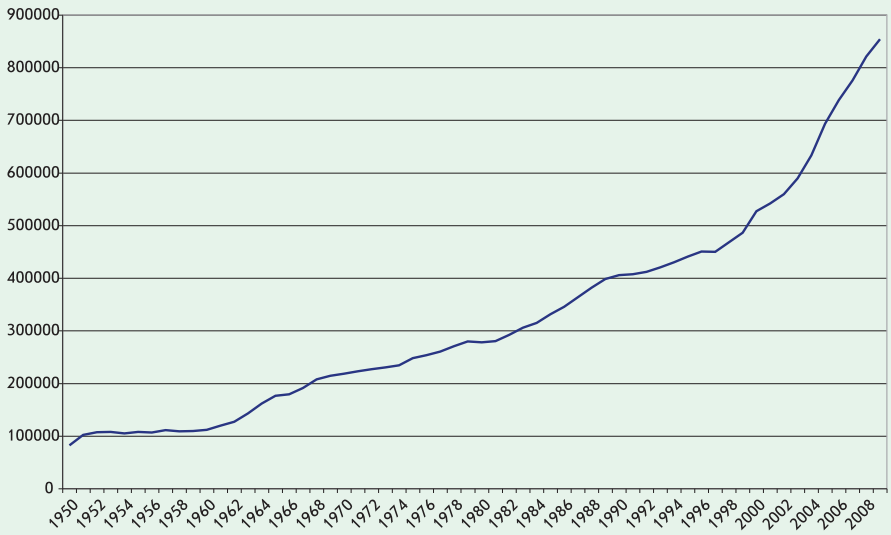

Fig. 1. Publications in MEDLINE database (arranged between the years of 1950 and2009).

tions in biology, the time it takes to publish these works, and the great quantity of citations. An average professor in molecular biology has more articles published than his mathematician colleague; these articles are cited more frequently.

Nevertheless, we consider the assessment of individual researchers and publication of their ratings as being insufficiently proper even in the field of biology. It is much more reliable to refer to the composite indicators with respect to countries and organizations, since large swathes of published data enable to capture actual changes in science. PubMed — the data search system in the MEDLINE database — is the main tool for everyday work

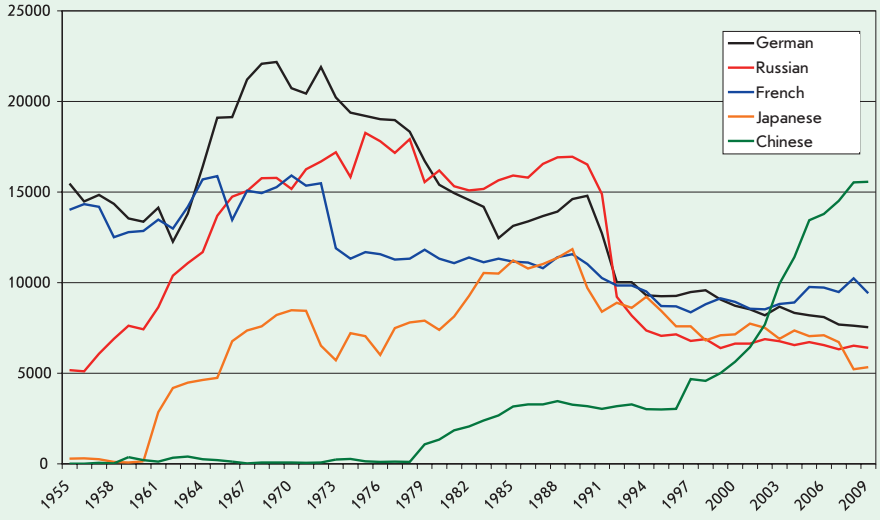

Fig. 2. The major subsidiary languages of science. The number of new publications in the MEDLINE database between the years of 1955 and 2009.

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The article presented should be interesting and extremely useful for the readers of *Acta Naturae* and, indeed, all scientists. Indeed, bibliometry has been assuming a bigger role recently, and this is very likely to continue in the future. I believe that this article will provide an objective and reasonable evaluation of the current state of affairs.

As can be seen from the article, the current state of Russian science is far from excellent; both objective and subjective factors are responsible for this situation. It can be said without fear of exaggeration that the objective reason is the culpable attitude of our authorities toward science over the course of the past two decades. Moreover, such excuses as the recent economic crisis, the tough times during the 1990s, are insufficient. The root cause is a lack of understanding (in the best-case scenario) and a deliberate ignorance (in the worst case) of the role of science in the development of modern economics. As a result, the second-major scientific power in the world became a mere supplier of raw materials to developed countries. I consider measures that were taken recently in an effort to improve the situation to be wholly inefficient (the analysis of the reasons lies beyond the scope of this comment). However, I consider it appropriate to mention that the thoughtless use of bibliometrical indices in order to divide Russian scientists into the categories of "proper" and "improper" may exacerbate this situation.

The subjective reasons for the decrease in the number of publications by Russian scientists in foreign journals is connected with the editorial policies of the journals and, to an increasing extent, with enthusiasm about the bibliometric indices. Indeed, a considerable number of editors of international journals confess in private conversations that Russian publications are not inferior to the corresponding western ones in terms of their quality. However, the endless pursuit of the 'impact factor' of the journal makes the editors reject a considerable number of the articles they receive. Unfortunately, in this case, Russian articles are rejected more frequently, since due to the objective reasons mentioned above, Russian science has not been well integrated into world science. Russian scientists (with several exceptions) are insufficiently acquainted with the international community. Unfortunately, this situation cannot be improved without substantial changes in the state policy towards science. Even provided the corresponding conditions are created, it will take much time to rectify. In this regard, I would like to emphasize , on one hand the absolute necessity for the use of bibliometric indices as the only criteria that objectively describes the situation and, on the other hand, that these indices should not be made a cornerstone. If we compare Russian science to an ill patient, radical treatment should lead to the patient's recovery and not make the problems disappear through his death.

with publications for medics or biologists. This database was created by the National Health Institute (United States) and contains data on published works from approximately 5,000 research journals for the past several decades. Presently, it contains approximately 20 million publications. An increase in the number of articles that are added to MEDLINE each year faithfully represents the general increase in interest in life sciences in our generation (*Fig. 1*).

In the course of the next 3–5 years, the number of new scientific and near-scientific papers in medicine and biology in MEDLINE will pass the threshold of 1 million per year. It is of importance that

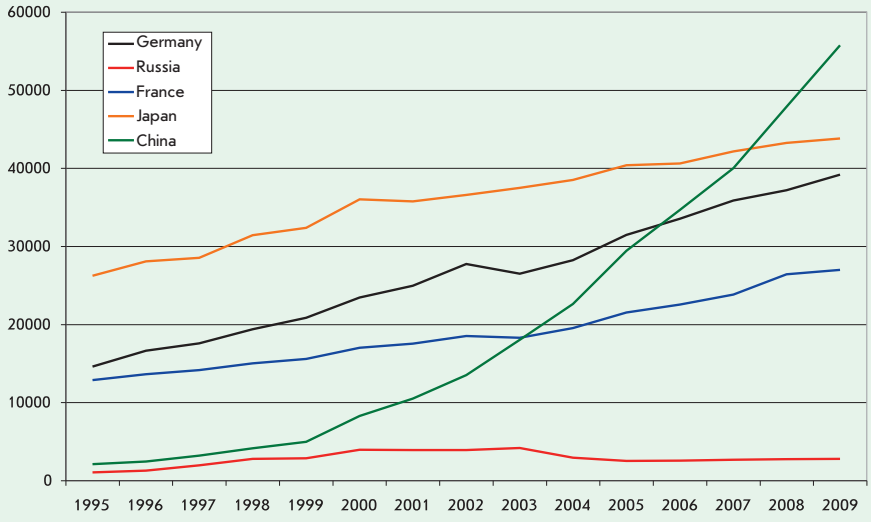

Fig. 3. Publication activity of certain countries. The number of new publications in the MEDLINE database between 1995 and 2009.

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The drive to assess the results of scientific labor using figures has produced and continues to produce the corresponding criteria. Among the most conspicuous and extensively used is the impact factor devised 50 years ago by Garfield, and a new science-meter indicator that was invented five years ago – the so-called Hirsh index; a quantitative characteristic of a scientist's productivity, based on the number of publications and citations. Each of the aforementioned criteria is less than ideal. Striking examples are available to illustrate that in terms of these formal indices even outstanding scientists can appear like outsiders. Nevertheless, accurate formalized bibliometric indices can and should serve as a basis for the evaluation of a scientist's labor. The subjectivity of such an evaluation for an individual scientist will always be higher than that for research institutions in general. Therefore, these indices are more useful when comparing research institutes and finding the leading ones amongst them. However, these formalized indicators should not be regarded as the one and only determining criteria. Each statistics-based evaluation system has its own drawbacks. Nothing can adequately substitute the expert evaluation given by colleagues. The examination carried out by independent and impartial experts from other departments (ideally, by foreign researchers) would be most efficient and objective. The *a priori* known criteria, transparency and publication of the decisions made as a result of such examinations, minimize errors and inspire respect within the scientific community. The program of the Presidium of the Russian Academy of Sciences "Molecular and Cell Biology" can be given as an example of successful examination organization.

There is an additional factor regarding bibliometry that is worthy of our attention. The difficulties that Russian scientists experience in publishing works in highly rated foreign journals have been widely discussed. The problems are real, valid, and have numerous causes. Therefore, the teams who manage to do it should be given more considerable evaluation. On the other hand, it is an oft-heard argument that Russian science should challenge the West, with a wide range of Russian scientific periodicals. The editors-in-chief and editorial board members make efforts on a heroic scale to enhance the prestige of Russian periodicals. However, the obsolete system of organization of publishing in most Russian journals, coupled with the lack of financial support and subsequent poor translation quality and delayed publication of the English versions of the journals, is a significantly negative factor which prevents the majority of Russian periodicals from having adequate values of impact factors. Unsurprisingly, the authors of the most interesting works strive for publication in foreign journals, thereby limiting the citation of Russian journals and in turn, affecting the impact factors of Russian periodicals.

the processing of texts is available not only for those written in English, but also other commonly used scientific languages. This unique array of data allows one to trace how these languages kept up with English, or how they were left behind (*Fig. 2*).

As we can see, the collapse of the socialist system has had an impact not only on Russian science, but on German science as well. In any case, the lion's share of all texts in MEDLINE is written in English. The percentage of publications written in English increased from 46 to 93% over the period from 1955 to 2009. Based on the increase in general publication activity, almost everyone is using English. We show the distribution of the texts published from 1995 to 2009 according to the authors' countries of origin (regretfully, a large number of articles in MEDLINE do not have the correct country affiliation of authors; therefore, the dynamic is more trustworthy, albeit not absolutely so) (*Fig. 3*).

A lot of interesting facts can be gleaned regarding the content of articles and the changeover of popular topics. We counted the number of articles containing a number of medical terms that are of great social and economic significance, for each year from a period spanning 1951 to 2009. A relative index was used (the number of articles containing this term per 100,000 articles) (*Fig. 4*).

The development of methods and investigation techniques can be traced in the same way (*Fig. 5*).

But let us return to Russian science. The major Russian bibliometric source is the Russian Science Citation Index (RSCI), found within the electronic library of science, eLIBRARY.ru. It was financially backed by the Ministry of Education and Science and comprises data on published works from several thousand Russian research journals. The information on publications by Russian authors in foreign journals from the Scopus database was recently integrated into the RSCI. The total number of publications encompassed with certainty by the index has exceeded 30,000.

Many scientists are critical of the RSCI, both for its focus on Russian journals and for numerous inaccuracies, trivia and errors. However, the number of errors is constantly decreasing, while the inclusion of Scopus data should solve the problem related to publications in foreign journals. Nevertheless, RSCI substantially differs from the most authoritative bibliometric database

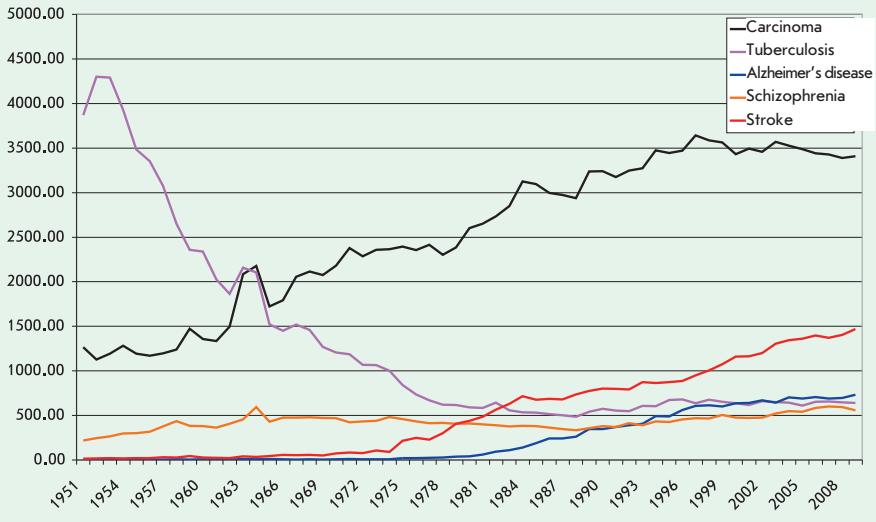

Fig. 4. The relative number of articles devoted to certain biomedical problems (1951–2009, MEDLINE).

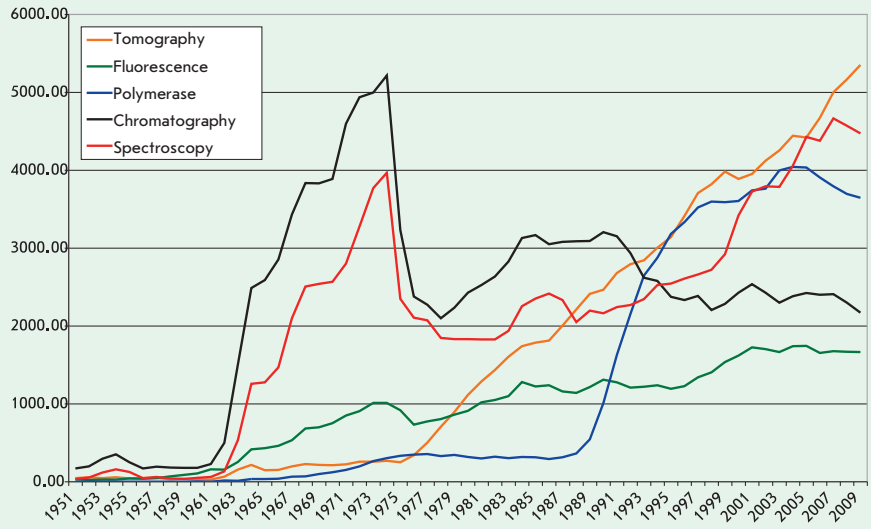

Fig. 5. The relative number of articles mentioning certain experimental and clinical methods (1951–2009, MEDLINE).

Table 1. Impact factors of Russian journals in the sphere of life sciences, 2009, Web of Science Journal Citation Reports

№	Journal	Impact factor
1	Biochemistry (Moscow)	1.327
2	Applied Biochemistry and Microbiology	0.67
3	Microbiology	0.638
4	Molecular Biology	0.57
5	Russian Journal of Genetics	0.501
6	Russian Journal of Plant Physiology	0.5
7	Russian Journal of Bioorganic Chemistry	0.473
8	Russian Journal of Ecology	0.414
9	Zhurnal Obshchei Biologii	0.377
10	Journal of Evolutionary Biochemistry and Physiology	0.267

Table 2. Impact factors of Russian journals in the sphere of life sciences, 2009, RSCI. The self-citation coefficient shows the share of citations from this journal in the total number of citations to the articles published in this journal

№	Journal	Impact factor	The total number of articles in RSCI	Self-citation coefficient, %
1	Microbiology	1.69	1953	No data
2	Biomedical Technologies and Radio Electronics (Biomeditsinskie tekhnologii i radio elektronika)	0.951	135	0
3	Geophysical Processes and Biosphere (Geofizicheskie protsessy i biosphera)	0.852	106	62.5
4	Human Physiology (Fiziologia cheloveka)	0.757	705	27.8
5	Molecular Biology (Molekulyarnaya biologiya)	0.67	1075	17
6	Russian Journal of Gastroentherology, Hepatology, Coloproctology (Rossijskiy zhurnal gastroenterologii, gepatologii, koloproktologii)	0.645	390	20
7	Information Technologies in Medicine (Vrach i informatsionnye tekhnologii)	0.644	376	17.2
8	Biochemistry (Biokhimia)	0.588	1785	27.4
9	Russian Journal of Nematology	0.538	106	н/д
10	Advances in Modern Biology (Uspekhi sovremennoi biologii)	0.514	295	17.6

Table 3. Biological Institutes of the Russian Academy of Sciences in the lead in terms of the citation of works published between 2005 and 2009, RSCI

Organization	Publications (A)	Citation (B)	Financing, thousand rubles (C)	B/A	C/A	C/B
Institute of Bioorganic Chemistry	1337	6103	315617	4.56	236.1	51.7
Institute of Molecular Biology	1078	4035	116096	3.74	107.7	28.8
Institute of Cytology and Genetics, Siberian Branch RAS	1488	3237	No data	2.18	No data	No data
Institute of General Genetics	696	3063	85421	4.4	122.7	27.9
Institute of Biological Instrument Engineering	138	2671	69773	19.4	505.6	26.1
Zoological Institute	1504	2548	117026	1.69	77.8	45.9
Institute of Microbiology	704	2143	51701	3.04	73.4	24.1
Institute of Molecular Genetics	530	1968	74457	3.71	140.5	37.8
Institute of Biochemistry	684	1950	103580	2.85	151.4	53.1
Institute of Ecology and Evolution	1419	2002	215157	1.41	151.6	107.5
Institute of Cytology	726	1871	105806	2.58	145.7	56.6
Institute of Theoretical and Experimental Biophysics	921	1945	127707	2.11	138.7	65.7
Institute of Biochemical Physics	1285	1812	138538	1.41	107.8	76.5
Institute of Protein Research	329	1592	67366	4.84	204.8	42.3
Institute of Chemical Biology and Fundamental Medicine, Siberian Branch RAS	559	1576	No data	2.82	No data	No data

in the world (the Web of Science). For the purpose of illustration, two versions of the top-10 biological journals are provided based on the value of the impact factor (*Tables 1 and 2*).

The projected assessment of the efficiency of the institutes of the Russian Academy of Sciences will be widely based on bibliometry. Even today, the RSCI permits to calculate a number of indices for certain organizations.

We selected 15 research institutes of the Russian Academy of Sciences with a biology profile that are in the lead in terms of the number of citations of articles published between 2005 and 2009 (*Table 3*). The amount of planned financing through the Russian Academy of Sciences is used as an indicator of the size of the organization. It should be noted that the areas of study encompassed by the Zoology Institute and the Institute of Ecology are on average cited less internationally, in comparison with molecular biology and bioinformatics, amongst others. There

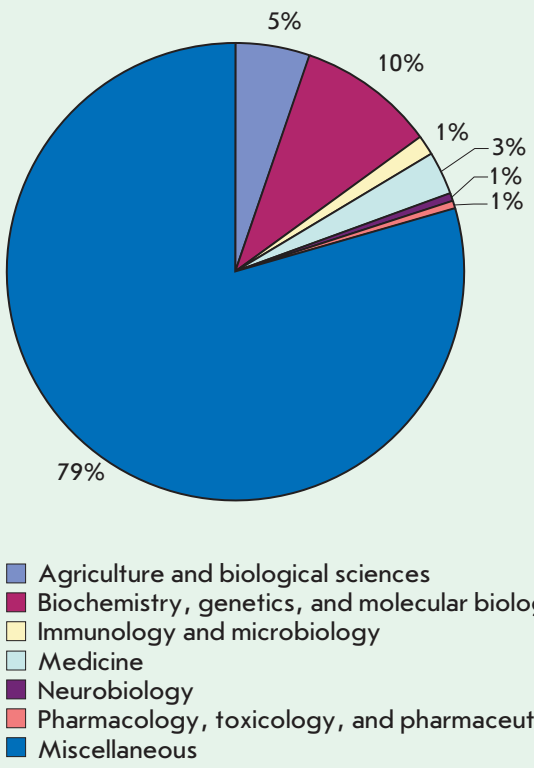

Fig. 6. The weight of the individual life science in the total amount of published works by Russian authors in 2009. Scopus. N = 33,690.

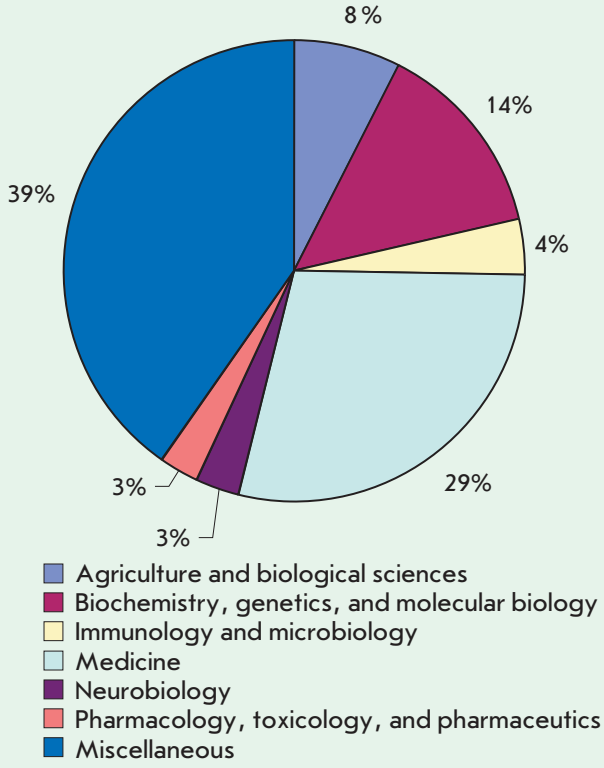

Fig. 7. The weight of the individual life science in the total amount of published works by U.S. authors in 2009. Scopus. N = 415,057.

are many biological and medical organizations in the Russian Federation; however, none of them can engage competitively in terms of citation with physics institutes. If one were to rate all organizations which make up the RSCI in terms of the number of citations, the leading biological institute (the Institute of Biological Chemistry) will only be ranked towards the end of the list of the top 20 organizations.

In order to demonstrate the place of life science in the general scheme of Russian publications, the Scopus database, which indexes 18,000 international journals, is an appropriate tool (*Fig. 6*).

It is enough to compare it with the United States to note a wide difference. As bibliometry attests, life sciences still play second fiddle in Russia (*Fig. 7*).

Taking into account the increased interest in bibliometry and its significance in managing science, we intend to publish the updated indices for life sciences on a regular basis. ●

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