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On the new edition of the collected works of M V Lomonosov

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Lomonosov M V *Complete Works* in 10 vols, 2nd ed. (Ed.-in-Chief Yu S Osipov) (Moscow–St. Petersburg: Nauka, 2011), ISBN 978-5-02-038154-4, vols 1–4 ''Works in physics, chemistry and astronomy.''

Nauka, the publishing house of the Russian Academy of Sciences, has published the latest (10th) volume of the 2nd edition of M V Lomonosov's *Complete Works* (*Polnoe Sobranie Sochinenii*, PSS). The new edition was undertaken in accordance with Order No. 951-p from the Government of the Russian Federation dated 19 July 2007 on preparing and conducting events to mark the 300th anniversary of Lomonosov's birth, which was widely celebrated in the country in November 2011. The PSS editor-in-chief was Yury Osipov, the President of the Russian Academy of Sciences, and the supervising editor (coordinating the joint effort of the contributors) was Nobel Prize winner Zhores Alferov.

The significance of Lomonosov's contribution to science in Russia is enormous, and its progressive comprehension has continued to be summed up in successive academic editions of Lomonosov's complete works. The first truly scientific six-volume edition (and the fifth in the order of appearance) of the Complete Works of the first Russian academician, comprising his work in natural sciences, was prepared by the Academy of Sciences on the initiative of Princess Dashkova and came out in 1784–1788 with a print run of 700; it was reprinted in 1794 and then in 1803–1804. It included the first scientific ''Biography of Lomonosov,'' which for a long time after that served as the only reliable source of information about him. Two volumes (III and IV) were devoted to his works in chemistry, physics, geology, astronomy, and navigation.

In the 19th century, the Academy of Sciences undertook the publication of a new version of Lomonosov's complete works (the second scientific and the ninth overall), in 8 volumes. The edition, initiated in 1891 by M I Sukhomlinov, was completed only in 1948 by L B Modzalevskii. Three volumes (V–VII) contained Lomonosov's work in the natural sciences. Extensive commentaries in that edition made a significant contribution to the studies of Lomonosov's biography and creative genius.

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In 1949, a new edition of Lomonosov's complete works in ten volumes was initiated by S I Vavilov, the president of the USSR Academy of Sciences, with himself as editor-in-chief; it was completed in 1957 and later, in 1983, appended with an additional (11th) reference volume [1]. That edition included Lomonosov's entire scientific, literary, and epistolary heritage known at the time. Volumes I–IV contained Lomonosov's works in physics, chemistry, astronomy, and instrument making (87 papers, almost 2800 pages in total, including commentaries). That edition, the most complete ever, differed drastically from the previous one and greatly advanced in-depth studies and popularization, both in the country and abroad, of the heritage of the great Russian polymath. The edition was accepted by Soviet physicists with enthusiasm [2–4]; many of them made fruitful contributions to the studies of the first Russian scientist.[1] In hindsight, we can say that the PSS-I edited by S I Vavilov and written by a team of highly qualified experts laid the foundation of modern Lomonosovology and largely shaped the positive perception of science in the society, at the same time reaffirming the everlasting significance of Lomonosov as ''the name of Russian science'' (Fig. 1). A contemporary reader of the PSS-I must be impressed by its thoughtful conclusions, the truly scientific approach, and the absence of political or rhetorical elements in the commentaries (for example, the first four volumes contain no obsessive references to 'Marx–Engels–Lenin–Stalin–CPSU'; there is only one instance mentioning ''reactionary metaphysics'' and only one assertion that ''the previously unseen bloom of sciences, technologies, and culture [in the country] occurred only with the coming of the Lenin–Stalin epoch,'' a statement one could either agree or disagree with [5]).[2]

The main objectives for the preparation of the new, 2nd revised and extended edition of the Complete Works (the PSS-II) marking Lomonosov's tercentennial were as follows:

(a) to publish a new edition: the PSS-I has become a rarity over the 50 years after its publication;

(b) the desire to incorporate new findings in Lomonosovology; to reflect the extensive corpus of contemporary Russian and foreign literature on the subject (the number of references in Russian that emerged only in the last two decades exceeded 1600);

(c) the need to correct outdated commentaries and footnotes and the accompanying articles to Lomonosov's papers and ''... to remove many of the evaluations enforced by

[1] See, e.g., the publications in collections of articles and materials ''Lomonosov'' or articles displayed at the *Physics–Uspekhi* portal ''Lomonosov-300'': http://ufn.ru/ru/events/lomonosov.html.

[2] The PSS-I is accessible in its entirety as a scientific electronic publication on the web pages of the Fundamental Digital Library at http://feb-web.ru/feb/lomonos/, and all volumes of the PSS-I in scanned format are easily accessible on the Internet.

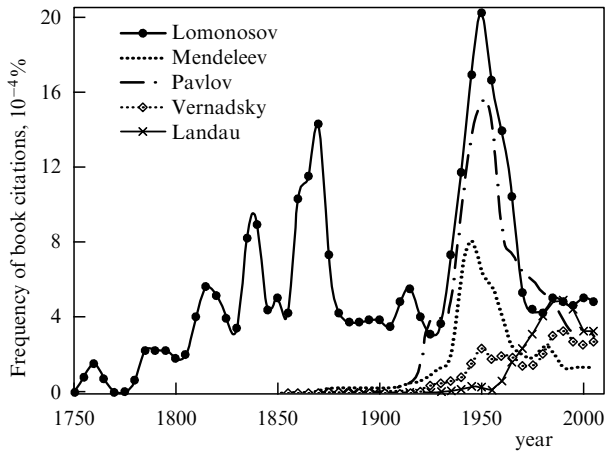

Figure 1. The frequency of appearances of five men's names as a fraction of the sum total of words published in Russian-language books in a given year: M V Lomonosov, D I Mendeleev, I P Pavlov, V I Vernadsky, and L D Landau. According to this indicator, calculated by Google's software Ngram Viewer [6], these names are mentioned most frequently among all Russian scientists, and this plot illustrates their unique paths to fame. Lomonosov (1711–1765) was 'somewhat forgotten' after his death, but the glory returned to him at the beginning of the 19th century, during the time of the spiritual rebirth of Russia (Pushkin being one of the cultural factors behind the trend). The peaks in the 1860s and in the 1950s coincide with information campaigns, of which the latter was launched in the USSR to popularize science and technology and to pay tribute to Russia's scientific heritage. It must be recognized that such campaigns are not a characteristic Russian or Soviet phenomenon; for example, it was shown in [14] that in England in the early 18th century and in Germany in the second half of the 19th century, respective periods of enthusiastic glorification of Newton and Leibniz were even more rapturous. On the whole, these bursts have not affected Lomonosov's generally very high level of popularity as "The First Russian scientist." It seems that the true value of a person has remained unchanged in the eyes of the nation for decades and even centuries.

the political and ideological situation of the time" (of the 1950s–1960s).

The result was successful, but only in part. First, the circulation of the PSS-II was merely 1000 copies,[3] and it is therefore very unlikely that it has reached anywhere beyond the major libraries in the country. It must be admitted that the number of references in editorials and commentaries at the end of each volume has indeed increased dramatically in comparison with the PSS-I, while the sizes of the volumes themselves did not grow but rather diminished, because the Latin originals of the articles were moved out of printed volumes to electronic disks. Numerous examples showed conclusively that Lomonosov's publications were better known in the West than was previously believed. However, most questions arise from the content of editorials and commentaries, as well as from the methodology used and the conclusions drawn.

After the publication of the PSS-I, Litinetskiy noted in his article in *Physics–Uspekhi* [4] that the scientific apparatus of the edition could be improved if more extensive indications were given on "the novelty, significance, and, most importantly, further evolution of a large number of inventions made by Lomonosov and of the ideas he advanced," and proposed doing so at the expense of "dropping a number of details of second- and third-order importance, of which many commentaries abound." Rather than following that advice, the editors and compilers of the PSS-II did the exact opposite — assessments of the novelty and short commentaries already existing in the PSS-I were mostly dropped, but information on how many copies of various papers were sent out, when, and to whom, and who mentioned those papers kept taking up more and more space (although generally useful, this information must not be detrimental to the analytic component of the content). As a result, the general impression was that the PSS-I was compiled by scientists for a broader community of scientists, but the PSS-II was done by contemporary Lomonosovologists for fellow Lomonosovologists. The reader is thus left baffled: what could it mean if the PSS-I stated that Lomonosov was the first to invent the vane anemometer and the refractometer, while the PSS-II does not contain a single word about it? There are many similar instances, and the reading scientific community, which is ready to accept any reasonable response, be it 'the first' or 'not the first', is confused by the absence of an answer. The authors of the PSS-II commentaries should have understood that they work in a field (Lomonosovology) in which dozens of prominent scientists and historians of science have expressed their opinions over more than a hundred years (see Table 1), and therefore ignoring their analysis is unacceptable and any conclusion differing from the previously achieved consensus requires a serious foundation. Any other approach can hardly be regarded as scientific.

In a few cases, the commentators dared to fundamentally reassess Lomonosov's achievements. For instance, his night-vision tube is declared to be inefficient because it "produced no appreciable effect and did not allow night vision" (PSS-II. Vol. 4. p. 348). Whence this conclusion? It totally contradicts the earlier investigations of Russian scientists, S I Vavilov among them, and denies what we read in Landsberg's fundamental textbook on optics [15]. By injecting unproven statements of such type, the editors of the PSS-II undermine the scientific value of that edition.

In another remarkable case, the commentators did come up with an explanation as to why they totally rejected such an important achievement of Lomonosov's as the mass conservation law in chemical reactions. We remind the reader that Lomonosov not only pondered this issue for a long time (in several of his articles between 1744 and 1760 and in a well-known letter to Leonhard Euler in 1748) but also conducted his famous experiments of 1756 with specimens heated in sealed retorts. Summarizing the logic of the commentators, Lomonosov cannot be regarded as the discoverer of this law because:

(1) neither Lomonosov nor anyone else at the time had the correct understanding of the concept of chemical reactions;

(2) Ya G Dorfman discussed a hypothetical result of another of Lomonosov's experiments with unsealed retorts and showed that it had to reveal a logical contradiction to the experiment of 1756;

(3) Lomonosov himself put no great score on that law and chose not to include it in his "Review of the most important discoveries with which Mikhail Lomonosov attempted to enrich natural sciences..." of 1764.

These arguments are unconvincing. First, Lomonosov's experimental result was a pioneering breakthrough in and of itself, regardless of the details of interpretation. Second, it is not clear why Dorfman's point of view [16] has chosen over, e.g., Kudryavtsev's [10] or that of P L Kapitza, who wrote: "...Lomonosov's most significant achievement was the

[3] To be compared with a circulation of 10,000 copies for the PSS-I.

Table 1. Evaluation of Lomonosov's achievements in the natural sciences according to a number of sources: '+' — recognition of priority, '–' — negation of priority, 'o' — mentioned; empty cell — not mentioned. Bold font is used to highlight papers which Lomonosov included in his "Review of the most important discoveries..." (1764, see PSS-I [1], vol. 10, pp. 404–411).

	1911, Lebedev [7]	1912, Smith [8]	1925, Lazarev [9]	1948, Kudryavtsev [10]	1950 – 1959, PSS-I [1]	1965, Kapitza [11]	1970, Leicester [12]	2011, *Priroda* [13], PSS-II	2012, Shiltsev [14]
Corpuscular theory of heat	+	+	+	+	+	+	+	+	+
Absolute cold		+		+	+	+	+	+	+
Conservation of mass in chemical reactions	+	+	+	+	+	+	×	–	+
Physical chemistry		+	+		+	+	+	–	+
Experiments on and theory of elasticity of gases		+	+	+	+	+		o	+
Experiments on and theory of electricity				+	+	+		o	+
Experiments on and theory of colors				+	+		+	+	+
Freezing of mercury (with I Braun)					+		+	+	+
Discovery of Venus's atmosphere		+		+	+	+		±	+
Nonequivalence of mass and weight				o	o	–	o	–	o
Invention of new type of reflector					+			+	+
Invention of night-vision tube					+			–	+
Working model of helicopter				+	+				+
Experiments on refraction of light and optics				+	+			o	
Advanced instrument making				+	+	+		o	+

experimental proof of the law of conservation of matter. Lomonosov's discovery of the law of conservation of matter has by now been well studied, and any doubt has been removed from the certainty that Lomonosov was the first to have discovered it" [11]. We know that P L Kapitza and S I Vavilov, who agreed with the former on that issue, treated all facets of the history of science with utmost seriousness and studied materials in the greatest detail. Dorfman's conclusions are based on the hypothesis of Lomonosov's second experiment and its hypothetical results, i.e., on what is not found in Lomonosov's works. Dorfman's methods, assumptions, and conclusions were subjected to criticism by Russian and foreign scientists (see, e.g., [12]); in fact, in the PSS-II, the commentators themselves disagreed with Dorfman on other matters. Finally, whether Lomonosov mentioned or chose not to mention a specific result in his "Review of the most important discoveries ..." cannot be considered an indicator of its importance or unimportance. First, Lomonosov had written several such reviews and lists, and one must understand their context (for what publication, for whom, and for what purpose they were compiled), and second, the perception of the importance of a result by the author and by the scientific community may vary depending on the progress in the specific field of knowledge. For example, Lomonosov chose not to include his discovery of the atmosphere of Venus in the same "Review of the most important discoveries...," even though the PSS-II commentators recognized it as Lomonosov's outstanding contribution to world science.

Even the commentaries in which Lomonosov's priority is not denied sometimes show insufficient knowledge of the subject. For instance, the opinion that reigned from the time of the PSS-I held that the type of tilted single-mirror telescope, usually referred to as the 'Herschelian telescope', has every right to be known as the 'Lomonosov–Herschel telescope'. Now, with the priority issue carefully studied and finalized by specialists, we know that already in 1616, Italian Jesuit Niccolo Zucchi came up with a reflector design in which the mirror was tilted such that the head of the observer did not block the entrance aperture; it seems, nevertheless, that with the mirror quality as poor as it was at the time and the large tilt angle, aberrations were strong, and the idea was abandoned as practically useless and was forgotten for more than a century. The tilted-mirror reflector design was realized and presented to the French Academy in 1728 by astronomer Jacques LeMaire, but did not become widespread due to technical reasons. Mikhail Lomonosov had independently invented and very successfully realized a tilted single-mirror reflector in 1762. He used a low-aperture mirror and a smaller

tilt angle, which gave significantly weaker aberrations. And finally, William Herschel reinvented and implemented the same type of reflector in 1789. He not only built several tilted-mirror telescopes but also applied them successfully. Therefore, it would be justifiable to refer to the reflector design with a tilted mirror as the 'Zucchi–LeMaire–Lomonosov–Herschel' telescope. Unfortunately, the reader would not find any such arguments in the commentaries in Vol. 4 of the PSS-II.

The story with the discovery of the atmosphere of Venus is very similar: the PSS-I commentators enthusiastically supported Lomonosov's priority, which seemed impeccable to them, because Soviet scientists studied it quite profoundly in the 1950s–1960s (mostly V V Sharonov and V L Chenakal, the PSS-I commentators). But the situation has changed significantly since then. First, a newspaper article was found in the archives of the GDR written by the German astronomer C Silberschlag on 13 June 1761 (a month before the publication of Lomonosov's paper), who reported (albeit briefly, in just three sentences) the observation of a luminous arc around Venus at the moment of its egress from the Sun's disk and also hypothesized the existence of the planet's atmosphere (although not attempting to explain the effect). Second, just before the 2012 transit of Venus across the Sun, controversy flared up on whether Lomonosov, in principle, could have observed such an arc of light outside the Sun's disk in 1761. For example, American observers J Pasachoff and W Sheehan expressed doubts based on their own experience of observing Venus's transit across the Sun's disk in 2004: they encountered difficulties in detecting such a subtle effect, even when using supposedly much finer tools than 18th-century telescopes. Third, it remained a mystery until very recently exactly what kind of telescope Lomonosov used on 25 May 1761. All these peripeteia failed to attract the attention of the editors of the PSS-II. Thanks to the enthusiasm and efforts of several researchers, the type of the telescope Lomonosov used was determined, and his observations were also successfully replicated during the transit of Venus on 5–6 June 2012 in four different locations on Earth using antique 18th-century achromatic refractors manufactured by English optician John Dollond; these were identical to the one used by Lomonosov. It thus proved possible to confirm that Lomonosov's telescope was completely adequate to the task of detecting an arc of light around Venus at the moments of its emergence on or exit from the solar disk, as long as the appropriate experimental methods were used; these were described by Lomonosov in his publication of 1761, including a weak solar filter [17].

As regards the reduced "evaluations dictated by the political and ideological situation of the time," we give one example here: the paragraph "...these Notes include several of Lomonosov's convincingly patriotic statements, which reflects the independence and originality of his convictions, his belief in his own intellectual powers, his relentless struggle to defend the honor and dignity of Russian national science" was dropped from the commentaries on "Notes on the System of Physics as a whole and on Micrology" (Vol. 3, paper 30). In the PSS-I, this comment referred to a note dated 1764, to show that "*...contrary to the opinion of some vagabonds, in the North too there are naturally gifted personalities who*," etc. Lomonosov aims the sobriquet 'vagabond' at one German academician who wandered all over Europe for many years until he settled in St. Petersburg. Lomonosov was greatly annoyed with the influx of mediocre scientists who dared to challenge and instruct the principal researcher of the Academy.

Perhaps because of numerous revisions regarding the importance of Lomonosov's works, an article by E P Karpeev and E A Tropp, "M V Lomonosov's physics and chemistry," was added to Vol. 1 in which the authors "...made an attempt to provide a modern description of the concepts of physics, chemistry, and astronomy in M V Lomonosov's works," to give a "philosophical reappraisal" of the work of the great scientist, and also to help the contemporary reader to "properly assess his works, the place he occupies [in the history of science] and the significance [of his contribution]." Karpeev and Tropp failed miserably in doing this, and therefore their article belongs in a magazine rather than in complete works: it is largely a discussion of the views of other Lomonosov scholars little known to the general public (like Dorfman or S I Romanovskii); we find there statements such as "...by today's standards, Lomonosov should have felt 'profound inner satisfaction': he would have a 'high citation index', he would launch an international scientific debate..." or, in another paragraph: "...this is remindful of Francis Crick's ironic phrases like 'But how plausible was that wrong idea!'." The same commentary offers a rejection without a single supporting argument: "Lomonosov did not discover the law of conservation of weight of substances in chemical reactions," and with a single unsupportive self-reference to an entry in a dictionary (edited by Karpeev himself [18]; see the discussion above) and ends with a benign recognition of only three of Lomonosov's papers as contributions to world science (which is quite baffling: numerous others were not analyzed at all). The patchiness and lack of arguments in this rather extensive article (33 pages) are especially stark if we compare it with the relevant chapter in the book by Kudryavtsev [10]. Another aspect may not be so important but is irritating in a scientific publication prepared to serve the reader, if not for centuries, at least for decades without any doubt: an unforgivably high number of 'blunders' — straightforward errors, slang words, neologisms used without justification, etc. We found more than a dozen of them in editorials and commentaries on the first four volumes of the PSS-II (to compare: no such issues were found in the PSS-I).

We nevertheless remark that the PSS-II commentaries were relatively modest compared to some articles written about Lomonosov in anticipation of his tercentennial (including those by members of the PSS-II editorial board and commentators). It cannot be expected that an appraisal of the achievements of such a titanic figure in Russian science and Russian history in general as Lomonosov should remain unchanged with time. Each generation has its own Lomonosov, and debates concerning him will always have the stamp of time. For example, 100 years ago Lebedev lamented in [7] that intolerable working conditions did not allow Lomonosov to express his potential in full (which was an obvious reference to the situation contemporary to Lebedev). Fifty years later, Kapitza expressed the highest opinion on the achievement of the genius, discussed with full respect his misconceptions (Lomonosov's rejection of action at a distance in Newton's gravitation), and used him as an example showing the need to build an advanced scientific community in Russia, to reform the management of science, and to expand international scientific exchanges [11]. The jubilee campaign of 2011 had new overtones: "Lomonosov as hero and martyr of Russian science," which left its imprint on articles that appeared in the journal *Priroda* [13] and, to a

lesser extent, in Shcherbakov's article in *Physics–Uspekhi* [19]. One can agree with this attitude or reject it (e.g., "the martyrdom of ...State Councilor of His Majesty the Emperor of All Russia, full member of the St. Petersburg Academy of Sciences, full professor of chemistry, honorary member of the Academy of Fine Arts established in the same academy, and of the Royal Academy of Stockholm and the Bologna Institute" is hard to believe to; also, frequent lamentations that Lomonosov could have done much more in science had he been relieved of petty worries and administration appear to reflect the lack of understanding by the authors of how large-scale experimental science worked in Lomonosov's times (and continues to this day). What is totally unacceptable is their overall rejection of Lomonosov's merits ("...it is easy to see that the list [of achievements] is far too modest for the status of the great chemist" — in the first article in [13]) and their fallacious comparison with numerous discoveries made by scientists of subsequent generations (in the second article of [13], such as K V Scheele and T Lowitz, who were respectively 37 years and 46 years younger than Lomonosov).

In summary, we conclude regretfully that the new edition of Lomonosov's complete works failed to constitute, in its natural-sciences volumes, an important new step in Lomonosovology. Furthermore, the corrections, revisions, and new commentaries in the PSS-II contain numerous methodological errors, are very often intolerably formalistic, and are biased toward insignificant details, while at the same time not offering an analysis of the facts and circumstances that could guide the modern reader to well-justified conclusions. It is difficult to recognize the work of the editors and commentators as successful, especially in terms of the overall scientific editing and the understanding of the place held by Lomonosov's works both in the natural sciences of the 18th century and in its impact on the science of subsequent centuries and on our times. The issues of priorities — so important for the prestige of Russian science — are inadequately addressed. Looking far into the future, we want to believe that a better edition of Lomonosov's complete works will appear, in which appendices and commentaries will be based on the results of truly scientific examinations, preferably accompanied by an analysis of the data of the corresponding experimental studies and reconstructions. It will also be necessary to include a detailed biography of the scientist, all of the known lifetime portraits of Lomonosov (Fig. 2), and subject indices for each volume.

As regards the tasks for Lomonosov scholars in the near future, we mention the urgent need of translating at least the most important of Lomonosov's articles into English (*de facto* the language of international science in our time). The interest in Lomonosov and his life and times is definitely very much alive. Readers of the rare articles about Lomonosov in English-language general scientific periodicals [14, 20, 21] admire Lomonosov, regret knowing so little about him, and complain that the sources are hard to find. At the moment, translations of only 14 of his papers on corpuscular theory appeared in monograph [12], in addition to the papers "The appearance of Venus on the Sun..." [22] and "On the strata of the Earth" [23]. Only about a dozen translations are missing for the publication of a comprehensive one-volume collection of Lomonosov's scientific works in English: the articles "Review of the most important discoveries with which Mikhail Lomonosov tried to enrich natural sciences," "A word on the birth of metals driven by earthquakes," "A word on aerial phenomena which originate from electric forces,"

Figure 2. Portrait of M V Lomonosov (unknown artist of the 18th century, oil on canvas, size: 55 × 38 cm. Russian National Library, St. Petersburg). This portrait of Lomonosov is in the Manuscript Department of the Russian National Library in St. Petersburg. It is quite different from the habitual image of the round-faced grandee in an ornate red coat known from copies of the portrait painted by G Prenner. Experts in Lomonosov's iconography were able to confirm in the late 1960s that this is indeed a portrait of Lomonosov, perhaps at the age of 30 — see the magazine cover and Kopaneva's article ("M V Lomonosov's museum in MAE RAS", St. Petersburg) in [24]. This portrait was not known to Kapitza, who in 1965 expressed his regret that there remained no decent, life-like, spiritual image of Lomonosov. Even today, this portrait remains virtually unknown outside a small circle of specialists; regretfully, the reader will not find it among the 10 portraits printed at the beginning of each volume of the PSS-II.

"Concise Russian chronicles with genealogies," "Letter to Leonhard Euler written on July 5, 1748," "Brief description of different voyages in the northern seas and a demonstration of the possibility of travel to eastern India across the Siberian Ocean," "Note on experiments on the freezing of mercury," and "On self-preservation and proliferation of the Russian people." Such a publication — as a printed book or even as an electronic edition — would help to convey the titanic figure of one of the cornerstones of our national culture, the great Russian scientist Mikhail Vasil'evich Lomonosov, to the wide international scientific community.

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