History of Medicine. 2017. Vol. 4. № 3.
DOI: 10.17772/2409-5834.v4.3.2017.03c

On the biography of P.P. Belousov: the role of Tula's first sanitary doctor in the construction of the city water supply system

Olga V. Tereshkina
Tula State University, Medical Institute, Tula
128, Boldina St., Tula 300028, Russia

In the second half of the 19th century, the provision of drinking water to Russian cities was a pressing need for social and hygiene reasons. In Tula, this had become a key issue for the development of the city and the provision of sanitation at the required level. The city's first sanitary doctor, P.P. Belousov, was tasked with dealing with this issue. The article attempts to clarify his role in organizing the construction of the Tula water pipeline, which was put into operation in 1893, although this issue had been discussed since the 1830s. On the basis of archival documents, as well as periodical publications, Belousov's and the city medical community's approach to the construction of the city water supply is reviewed. As a result of a conflict with his colleagues, Belousov left the Society of Tula Doctors in 1893. The Tula Doctors' Society sent a statement to the Medical Department of the provincial government stating that its members insisted on reviewing the results of studies conducted on urban water sources and the project adopted on their basis, submitted by the Water Commission and the City Council. Belousov repeatedly conducted studies of Tula water sources and was familiar with their results. All sources, including those chosen for the construction of the water pipe and approved by the Duma resolution, were suitable for use, and each had its own advantages and disadvantages. Considering the many preceding years of centralized city water supply management in Tula, Belousov tried to speed up finding a solution to the issue, since procrastination was extremely dangerous given the existing sanitary and epidemic situation. Belousov supported a project that was not popular in Tula society, and managed to achieve a positive solution to one of the city's major sanitary issues.

Keywords: *P.P. Belousov, water supply, tap water sources, Tula Doctors' Society.*

For quotation: *Tereshkina O.V. On the biography of P.P. Belousov: the role of Tula's first sanitary doctor in the construction of the city water supply system. History of Medicine. 2017. Vol. 4. № 3. P. 222–236.*

About the author

Olga Vladimirovna Tereshkina – Candidate of Biological Sciences, Associate Professor at the Department of Human Physiology of Medical Institute, Tula State University, Tula (Russian Federation). E-mail: tierieshkina2013@mail.ru

Brief history of the construction of the water supply system in Tula

In June 1870, a royal assent was granted in Russia to the municipal government regulations designed to introduce a "fundamental change" in providing for the needs of the "urban residential facilities". It was to be put into effect immediately in the governorate and provincial-level towns, including Tula. The "General Provisions" specified the measures aimed at the aesthetic improvement of the city: "administration of the arrangement and maintenance of streets, squares, pavements, sidewalks, municipal public gardens, boulevards, water supply systems, sewer pipes, canals, ponds, ditches and ducts, bridges, causeways, and passages, as well as the lighting in the city" [1, p. 823]. However, the implementation of sanitary measures was the right rather than the obligation of the local urban authorities. Therefore, the organization of municipal public health was a challenging task, and in some cases, the city officials could just ignore the problem [2].

At the end of the 19th century, Tula was a significant Russian industrial center, home to metallurgy, cast-iron, coal, ammunition, arms, copper, sugar, samovar, accordion, and other industries [3]. The industrial nature of the city determined its dissatisfactory sanitation condition [3, 4]. The issue of the installation of the public waterworks system began to be discussed in the

Received: 09.02.2017

1830s for the first time: "The hardships related to the water used both for food supplies and fire extinguishing made the governors take care of the installation of a water supply system in Tula as early as the 1830s, but for want of money, all attempts in this regard remained futile" [5, p. 3]. One of the reports presented in the Tula State Duma stated: "The case of water supply in our city was reinitiated by the Minister of the Interior on 27 June 1860 (No. 80, Case of the Governorate Construction and Road Commission No. 182, 1853), whereby a special committee was established at the municipal Duma. It was formed of the members of all classes, one from one hundred house owners. Having heard a commentary by the architect O.V. Gromov concerning the water supply system, this committee engaged the engineer, actual state councillor A. Stuckenberg" [5, p. 7].

Until the year 1865, due to a lack of money, the construction of a water supply system was under discussion only [6, p. 819]. On 19 February 1865, a directive was issued to transfer 270,000 rubles from the Governorate Construction and Road Commission to the Municipal Government for the construction of the city water supply system. The Municipal Government performed a number of studies to ascertain whether the sources which were traditionally used by citizens and considered to be of the best quality had enough water to supply the city. Then a number of water supply projects were introduced.

In the 19th century, Tula was divided into four sectors. There were also four sources of water traditionally used by citizens: Nadezhdinsky (in the fourth sector of the city), Nikolsky and Trostyansky (in the third sector), and Rogozhinsky (in the first sector). The results of measurements of the amount of water in the sources taken at varying times by various researchers were different [6, p. 819].[1] According to A.I. Stuckenberg, Nadezhdinsky was the only source which could supply enough water for the city. Yolkin proposed that water be delivered to the city from two sources, Rogozhinsky and Nikolsky. At the time of the study (the 1870s), the aggregate amount of water in them (180,000 buckets per day) could meet the demand of Tula.

The commission for the installation of the water supply system in Tula was established by the City Duma on 11 May 1871. The first documents concerning the installation of the water supply system in the city in the form of the reports of a special water supply commission at the Tula City Duma are dated 1873 and 1876 [5, 7].

The twenty-year delay between the examination of sources, analysis of waters, project planning, and the materialization of this idea (the construction of the water supply system in Tula was completed in December 1893) was caused by "a rather destructive trend which found support in the local administration, namely, to use the capital for other purposes having nothing in common with the water supply system" [6, p. 819]. As a result, by 1 January 1872, the remaining sum was 92,300 rubles, and by the beginning of 1888, it was approximately 62,000 rubles (the debt was 232,254 rubles). In February 1888, the Ministry of Internal Affairs demanded that the City Duma account for the diminishing "water supply capital". At the same time, the Ministry absolutely forbade new loans.

To implement the decree of the Duma (11 June 1891), on 6 July 1891 the Water Supply Commission was established again. Together with the Municipal Council, it was given instructions to perform all preliminary work on the arrangement of the water supply system. The Commission engaged the engineer M.I. Altukhov. In making a detailed draft of the water supply system, he had to choose a source with a capacity of no less than 300,000 liters of water per day and spend no more than 30,000 rubles. The research of the sources (springs) and their catchment areas (subsoil water) conducted after the 20-years' pause (M.I. Altukhov, 1891) showed that Nadezhdinsky was the only source capable of providing 300,000 buckets per day. The capacity of the others was much less. Therefore, to fulfill the set task, M.I. Altukhov proposed to use Nadezhdinsky (if the water was to be taken from other sources, it would have been necessary to combine them in order to meet the city's needs, and that

[1] According to Chirikov (1867), Rogozhinsky spring could provide 40,270 buckets per day, and Nikolsky 43,200 buckets per day; according to A. Stuckenberg (1869), the capacity of Rogozhinsky was 57,000 buckets per day, Nikolsky 80,000 buckets per day, and Nadezhdinsky 300,000 buckets per day; according to Yolkin (1871), the capacity of Rogozhinsky was 116,000 buckets per day and Nikolsky 178,343 buckets per day.

process would have created significant financial expenses). However, "Altukhov never conducted a rigorous research of the amount of water in other springs; and it gave people an opportunity to accuse him of failing to meet the conditions stipulated by the Water Supply Commission and Municipal Council" [6, p. 819].

In 1891, an analysis of the water quality (from drilled wells in Chulkovskaya settlement, on Rozhdestvenskaya Street, near the Nadezhdinsky well from which it was planned to take water for the water supply system) was conducted in F.F. Erismann's laboratory. According to F.F. Erismann's report, this water was suitable for the water supply system unless there were better options in the city [8, 9]. The results of the analysis of potable water in Rogozhinsky, Trostyansky, and Nikolsky, as well as drilled wells of the state mental health hospital and ammunition factory which could also be used for the water supply, evidenced that as far as the water hardness was concerned, Nadezhdinsky was the worst: 22.8° (in German degrees) as compared to 12°. Such analysis was also conducted by Master of Pharmacy F.I. Aderman, Tula public health physician P.P. Belousov [8][2], and at the early stage in 1869 by the Saint Petersburg Pharmaceutical Society [9, p. 37].

P.P. Belousov sent a document [10] to the Tula City Duma from the Tula Municipal Council and Construction and Water Supply Commission. It contained the draft contract with Bromley Brothers & Co for the construction of the water supply system [10, pp. 9–12]; overall calculations for the amount of 269,942 rubles [10, p. 16]; and a certificate (made by the engineer Nefedov) which states that "any and all works on the arrangement and preliminary surveying must not cost more than the amount the city has for these purposes, namely, 102 thousand rubles in cash and 213 thousand rubles in bonds" [10, pp. 2–8]. The "explanatory note on the analysis of the quality of water in the drilled well on Rozhdestvenskaya Street conducted with the purpose of locating water for the municipal water supply system" of 26 March 1893 is of particular importance [10, pp. 28–31]. It states that "the chemical analysis of this water was carried out by Master of Chemistry Aderman on 6–11 March 1893, and by Belousov on 20–23 March. The results are given in a table together with those obtained for Nadezhdinsky springs in the laboratory of Professor Erismann in August 1891" [10, pp. 28–29]. F.F. Erismann's opinion "on suitability of the drilled well water for the supply of the city", expressed with regard to the water from Nadezhdinsky, is given word for word: "As can be seen, the analysis of this water shows two distinctive qualities: firstly, the high amount of alkaline earth or high hardness, and secondly, its remarkable purity in terms of the absence of organic substances or products of decomposition thereof. Indeed, this water is deficient in easily decomposable organic substances. It does not contain ammonia or nitrous acid. It is distinguished by a very small oxygen changeability ratio and is deficient in nitric acid and chlorine. Since it does not contain suspended foreign substances either, one may say that it is rather clean both from mechanical and chemical points of view. From this perspective, it is quite suitable for the public water supply. However, its advantages may be significantly diminished because of its hardness. Indeed, the hardness equal to 23 German degrees exceeds the generally accepted limit of hardness of 16–18 German degrees. Still, the nature of hardness of the examined water sample speaks in its favor to a large extent: 1) calciferous salts predominate in it, and there are few magnesium salts which are the most hazardous to health; 2) alkaline earth in it is mostly in the form of carbonates, which explains the extremely insignificant hardness of water. When it is boiled, lime carbonate and magnesia deposit. Judging by a small amount of sulfuric acid, there are few sulfates in the examined water. This nature of hardness is comparatively favorable in a sanitary regard. The large degree of hardness per se does not lessen the advantages of this water to the extent that it can be considered hazardous for consumers' health. I think that taking into account the aggregate composition thereof, it should be considered suitable for water supply purposes" [10, pp. 30–31].

At the session held on 6 July 1892, the Tula City Duma accepted M.I. Altukhov's project,

[2] Pyotr Petrovich Belousov (1856–1896) was the first public health physician of Tula from 1889, a hygienist, and graduate of Imperial Moscow University. In 1896, he defended his thesis "On the current situation and immediate problems of the sewage disposal in Russian cities" under the supervision of F.F. Erismann.

and on 10 March 1893 (after the approval of the project by the Ministry of Internal Affairs), it entrusted the Municipal Council with entering into negotiations with Bromley Brothers & Co regarding the construction of the water supply system according to the design of M.I. Altukhov. On 13 April 1893, the Duma adopted the draft contract with Bromley Brothers & Co presented by the Commission and Municipal Council. Thus, the issue of the construction of the municipal water supply system in Tula, "long-discussed and escalated, was solved due to the decisive and insistent propaganda among councillors" [11, p. III].

The role of P.P. Belousov in the construction of the water supply system in Tula

Surprisingly, the construction and commissioning of the water supply system in Tula "backfired" at public health physician P.P. Belousov [11, p. III]. P.P. Belousov noted that while "the arrangement of the Tula municipal water supply system was drawing to an end, the city society which [had] been monitoring the construction for many years with strained attention became more and more doubtful of the quality of water chosen for the water supply system" [12, p. 38].

To ease this tension and avoid panic among the public, on 28 November 1893, P.P. Belousov delivered a lecture (in Tula, to the benefit of the Batashevsky correctional orphanage) and published the essay "Data for sanitary evaluation of Russian urban waters" [12]. In this work, he noted that the issue of the municipal water supply was of high priority [12, p. 38]. Being an expert in the field of public health science, he believed that the attitude of Tula citizens towards the construction was caused by lack of knowledge of the situation in other Russian cities. In this regard, his only purpose was to provide everyone an opportunity to "opine on the quality of water chosen for the water supply system and feel confident in discerning various highly controversial opinions in this regard" [12, p. 38].

P.P. Belousov considered it his duty to "remind [people] of the grounds developed in the field of hygiene for the sanitary evaluation of water and provide the information for the comparison of our water with water in water supply systems of other cities".[3] In his essay, he compared in detail various types of water used for obtaining the water supply water, such as ground, subsurface (spring), and surface (river and lake) water, and highlighted the advantages and disadvantages of subsurface waters as the source for the Tula water supply system.

All panelists put particular emphasis on the quality of water in the Tula water supply system and its hardness: "Speaking of the general characteristics of subsurface waters, one must add that they are harder and produce more solid residue than surface waters in the same locality. Still, at the same time, after going through a powerful natural filter, they are distinguished by purity in the sense of the contents of organic substances and lack of the intermediate products of oxidation thereof. Therefore, these waters are a bad nutritional medium for primitive plant bodies. From this perspective, potable water has an undeniable advantage over the surface water, no matter how perfect the filtration of the latter is. In its turn, the higher concentration of free carbon dioxide and carbonate alkaline earths blocks the development of primitive plant bodies in spring waters. Located in deep soil layers where the light of the sun does not reach, the temperature of subsurface waters is almost always low during the year. It is also one of the significant advantages over river and lake waters. In places where necessity compels people to use river water for the water supply of localities, they try to eliminate the mentioned disadvantages by means of filtration. However, the installation of filters is expensive and achieves the goal not in every instance. Besides, the filtered water is often muddy and colored. Therefore, in practice, the richest communities bring natural non-deteriorating waters into use, such as the waters from deep springs. This view on the advantage of spring water for the water supply is at present shared by all hygienists" [12, pp. 41–43]. P.P. Belousov described the situation

[3] In this work, P.P. Belousov relied on works by F. Fischer (Die Chemische Technologie des Wassers, 1880, p. 144), Professor F.F. Erismann (Further study of the quality and characteristics of water in the Samara water supply system, Samara, 1889, p. 12; "Hygiene course, vol. 1, p. 17), A.P. Dobroslavin (Hygiene, 1884; part 2, p. 45), Professor I.P. Skvortsov (On sanitary needs of Rostov-on-Don, 1893), Professor S.V. Shidlovsky (Sand purification of potable water, pp. 7, 32).

in Tula in detail in his article "The misconception of water supply in Tula", which was published in *Journal of the Russian Society for Public Health Protection* in 1895 [9]. In spring, the construction of the water supply system began. Doubts were voiced that the source water had been correctly chosen. To make certain that the choice was wise, on 29 September 1893, the Duma issued a decree that samples of water from all five drilled wells (connecting subsurface water with water supply machines) be studied in the laboratory of Professor V.V. Markovnikov.[4] This decree was not enforced for about a year. In December 1893, the construction of the water supply system was completed. Since it was commissioned without the preliminary flushing of pipes, instead of clean spring water, it produced muddy water with a lot of residue and a rancid smell. Thus, despite the existing analytical data, doubts arose whether the water from Nadezhdinsky was coming to the city. In summer of 1894, the water supply pipes were cleaned. The water became clear. There were no more doubts or criticisms, and it seemed that the issue was resolved. However, at the end of August 1894, during the output test of water supply machines, the Duma's decree of 29 September 1893 was recalled. On 31 August, a sample of water taken in the powerhouse, a mixture of water from all six (at that time) drilled wells, was sent to Professor V.V. Markovnikov. P.P. Belousov emphasized that the Duma's decree had been induced by "definitive distrust in the accuracy of the analytical data on the composition of water obtained in the laboratory of Prof. Erismann", and even more distrust in the results of multiple tests conducted by P.P. Belousov himself. While taking a sample of water for V.V. Markovnikov, he took another to be examined in the municipal laboratory, and on 5 September, he presented his report to the Municipal Council.

P.P. Belousov noted that he "did not want to touch on the sad story of the Tula water supply system, but this historical background [was] necessary to understand the tragedy of the situation in Tula in this regard". On 31 October 1894, the report of Professor V.V. Markovnikov was received on the unsuitability of the water for the supply of the city: "Considering the significant amount of salts dissolved in water, as well as the high degree of hardness, this water cannot be recommended for drinking and household use in general... The water from this source can be used in the municipal water supply system in case of emergency only and temporarily, until the opportunity to use better sources arises" [9, p. 40].

According to P.P. Belousov, it could be said that the situation was horrible, considering that "a huge amount of money was spent on the installation of the water supply system, and the result is bad-quality water". The state of things in Tula would have been as Professor V.V. Markovnikov described "if the conclusion of the highly respected chemist was an objective deduction from the data he had obtained based on the sanitary rules. But this is exactly what the opinion of the highly respected Professor lacks" [9, p. 41]. P.P. Belousov found an inaccuracy in the results of the analysis conducted by V.V. Markovnikov: "He points to the significant amount of salts dissolved in water. However, the amount thereof found in our water in Professor's laboratory not only does not exceed the amount allowed by hygienists in clean waters, especially those in which the dry residue mostly consists of the bicarbonate lime as is the case in our water, but on the contrary, is much lower than maximum amounts accepted for such waters" [9, p. 41].

P.P. Belousov was well aware of the "delicacy and responsibility of his position as a provincial physician who pointed to the inaccuracy (a serious one) in the analysis conducted by the highly authoritative chemist or at least under his command. The issue is a very simple, infallible calculation which does not even require great skills, provided that the job is done carefully". P.P. Belousov writes, "It is seen from the provided analytical data that the amount of the solid residue dried at 130° in a liter of our water in the calculation of the Professor is equal to 0.552g. I got 0.519 at the temperature of 120°C (which is around 0.501–0.505 at 130°C). Since the amounts of other components of water are quite similar or identical in both conclusions, in the recent days I made several checking calculations which gave me the same numbers as before. I had no doubt that there was a mistake in Prof. Markovnikov's

[4] Vladimir Vasilyevich Markovnikov (1837–1904) was a renowned Russian organic chemist. From 1873–1890, he was the head of the Main Chemistry Department at the Physico-Mathematical Faculty of Imperial Moscow University.

calculation (!), and on 9 November, I informed the Sanitary Commission of that and requested that they examine my findings" [9, p. 42]. According to the decision of the Commission, the water was re-evaluated in the municipal laboratory in the presence of members of the Commission and Master of Pharmacy F.I. Aderman. The dry residue amounted to 0.505g, and this fact evidenced that Professor V.V. Markovnikov's calculations were inaccurate.

P.P. Belousov explained that, in his opinion, V.V. Markovnikov had depreciated the advantages of the Tula municipal water, namely, cleanness and transparency, as V.V. Markovnikov himself admitted. According to P.P. Belousov, this water was among the best supplied to Russian cities, a fact confirmed by materials he had gathered on the topic. He emphasized that under other conditions, this opinion would not have been so important, but in the current situation, he writes, it "makes our concerns even messier and is the oil to the flame that has just begun to die out" [9, pp. 46–47]. Having received the report, the Municipal Council approached the Sanitary Commission with a request that observations in this regard be provided. The Commission concluded that the analysis of water conducted by Professor V.V. Markovnikov, except for the mentioned inaccuracy in determining the dry residue, was identical to the analysis presented to the Municipal Council by public health physician P.P. Belousov and confirmed the correctness of multiple examinations of the water composition. On the basis of the data at the disposal of the Commission (that the water-bearing stratum in which the drillings were put was protected from the surface contamination with a large natural filter, that the composition of Nadezhdinsky water had not changed since 1869 when it had been examined for the first time and there was no pollution in this period, etc.), it was concluded that the contamination of the subsurface water under the current natural conditions was unlikely, and the concerns of Professor V.V. Markovnikov were not sufficiently grounded.

However, P.P. Belousov realized that this opinion would scarcely be of importance because "even the authority of such an expert as Prof. Erismann was of little help to us" [9, p. 47].

The Duma's distrust of the results of the studies conducted by the first Tula public health physician P.P. Belousov and conclusions he made was caused by the conflict between him and the Tula Doctors' Society, of which P.P. Belousov was a member until the year 1893.

Conflict between the Tula Doctors' Society and P.P. Belousov

M.I. Altukhov's project and draft contract with Bromley Brothers & Co were adopted by the Duma "after a stormy discussion about the quality of water chosen for the supply of the city which elicited a response in the local Doctors' Society at the session held on 15 April 1893" [9, p. 38]. This session of the Society was dedicated to the "vital issue of the water supply" of Tula [13]. A short message of this session was published in No. 20 of *Vrach* ("Doctor" in Russian) newspaper in 1893 [8]. In the "Correspondence" section, a decision made at the session of the Tula Doctors' Society was published. It was executed by the secretary of the Society V.V. Tikhomirov. A similar opinion, "due to its importance", was presented to the Medical Department of the Tula Governorate Administration [8]. At the hearing, Chairman of the Society N.A. Sobolev[5] presented a report "On potable waters of Tula", and N.P. Kamenev[6] made a statement "On water supply in Tula".

N.P. Kamenev's essay "Materials on water supply in Tula", an extensive study (on 82 sheets),[7] included the data on the analysis of the chemical structure of all potable water in the city. The best samples contained 274–392 mg of the solid residue, and the water from Nadezhdinsky source contained 514 mg (up to 568.75 mg). N.P. Kamenev stated that the use of water from Nadezhdinsky well, and even more so from the drilled wells, inflicted damage on health and increased the economic costs.

The members of the Society (19 people) made a unanimous decision: the water from sources chosen by the Municipal Council for the supply "poorly [met] the scientifically established sanitary and economic norms to potable water".

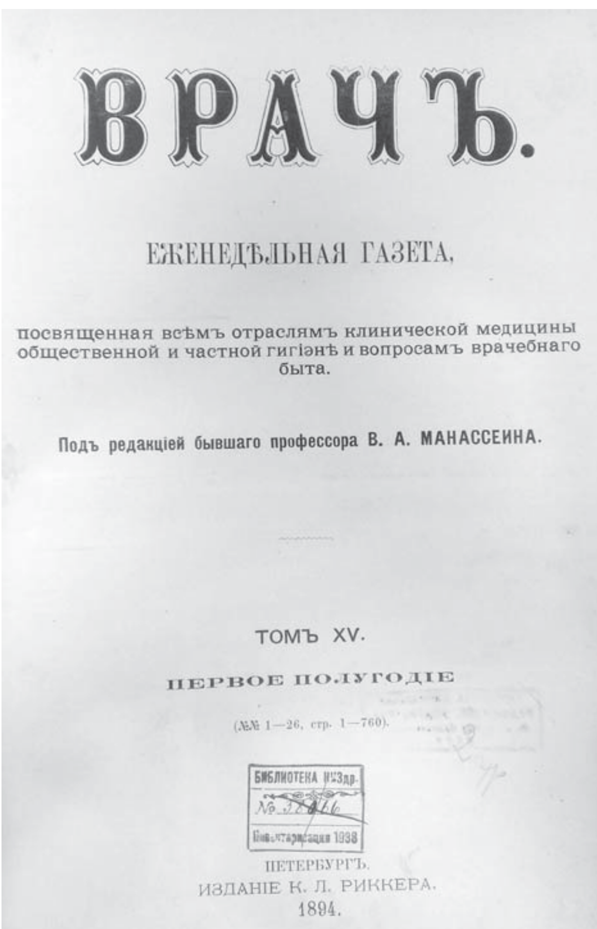
[5] Nikolay Alekseevich Sobolev (1827–1895) was head of the Psychiatry Department in Tula State Governorate Hospital until 1895.

[6] Nikolay Petrovich Kamenev (1857–1936) was a doctor of the Psychiatry Department in Tula State Governorate Hospital, and from 1895 its head.

[7] Doctor N. Kamenev. Materials on water supply in Tula. F. 221. Op. 1. D. 7. L. 62, 66–68, 78–79.

Such a choice could be made only if other sources that were better in quality had insufficient amounts of water for the city, but such studies of the water supply were not conducted by the Commission. It is remarkable that the following editorial note appeared on this page of *Vrach* newspaper: “We do not doubt that the unanimous opinion of doctors being competent judges in this case would make the Municipal Council change its mind and save the city from great trouble”.

Thereafter, P.P. Belousov and the Tula Doctors’ Society engaged in a debate on this issue on the pages of *Vrach* newspaper. P.P. Belousov could not but react to the decision of the Society made at the session on 15 April 1893 [8] and the editorial note published in No. 20. In No. 29 of the newspaper, in the “Correspondence” section, his letter to the editors was published [6]. He stated that he was “well aware of the progress of work on the installation of the water supply system” and that he was the author of materials which served as grounds for the decision of the Tula Doctors’ Society which, as he asserted, was “somewhat short, one-sided, and ambiguous; that is why the editorial staff is misled”. In No. 37, the response of N. Sobolev, Chairman of the Society, and A. Avdykovich, Vice-Chairman of the Tula Doctors’ Society, to this letter, written “for the benefit of the truth”, was published (Section “Letter to the editors,” 7 September 1893) [14]. In No. 47, V.V. Tikhomirov’s letter justifying P.P. Belousov was published (1 September 1893) [15], and in Nos. 9 and 10 (1894), P.P. Belousov’s “response seeking the ascertainment of facts” was printed [16, 17] (fig. 1).


ВРАЧЪ.

ЕЖЕНЕДѢЛЬНАЯ ГАЗЕТА,

посвященная всѣмъ отраслямъ клинической медицины общественной и частной гигіэнѣ и вопросамъ врачебнаго быта.

Подъ редакціей бывшаго профессора В. А. МАНАССЕИНА.

ТОМЪ XV.

ПЕРВОЕ ПОЛУГОДІЕ

(№№ 1—26, стр. 1—760).

ПЕТЕРБУРГЪ.
ИЗДАНІЕ К. Л. РИККЕРА.
1894.

Fig. 1. The front page of *Vrach* weekly newspaper (magazine).

The *Vrach* newspaper editorial office also entered the debate: “Publishing a rather voluminous letter of Dr. Belousov, we feel the burden of our responsibility to abide, at all accounts, by the ‘audiatur et altera pars’ rule (‘the other side should be heard too’). ... At the same time, we cannot but mention the deplorable fact that the highly respected Tula Doctors’ Society reaped a harvest of trouble for having openly expressed its opinion on such a vital issue for Tula as the choice of sources for the water supply system. God knows what this could have led to (things came to such a pitch that the administration sent the minutes of the Society to the Medical Department). ...We learned with pleasure that the Medical Department did not think that there was anything wrong with the Society’s activities. In fact, not even bringing up the subject of whether the decision of the Society was right or wrong, it is easy to understand what the result would be if medical societies were allowed to discuss scientific issues only when they are solved by them in a way that is pleasing to the Municipal Council or administration” [16, p. 283]. According to P.P. Belousov, there were several reasons why many Tula citizens took a stand against the use of water from Nadezhdinsky. At first, every citizen wanted to use the water to which he or she was accustomed. Secondly, the water from Nadezhdinsky was indeed harder than others. Thirdly, no studies of the amount of water in other sources were conducted [6, p. 819].

By order of the Municipal Council, in summer 1891, P.P. Belousov examined all the city’s drinking water sources, and the water from Nadezhdinsky was sent to the laboratory of Professor F.F. Erismann to be analysed. Master

of Pharmacy F.I. Aderman (an employee in one of the local drugstores) was also entrusted with its examination. P.P. Belousov published the results of his studies in Nos. 16 and 17 of *Public Health* in 1892 and the appendix to the Report of the Sanitary Commission in 1891. According to P.P. Belousov, the most distinguishing features of all the sources examined were the absence of organic substances and products of decomposition thereof (spring waters) in the water and the high level of hardness (Trostyansky: 14.1° [German degrees]; Rogozhinsky: 16°; Nikolsky: 18.5°; and Nadezhdinsky: 23°). In all sources, the hardness was conditioned by the presence of lime carbonate, which can be partially disposed of by boiling (constant hardness of the water from Nadezhdinsky was less than 7°). In this case, there could be no doubt that the water from all examined sources, in particular Nadezhdinsky was suitable for the supply of the city.

Since there was no absolute certainty that other sources lacked the necessary amounts of softer water, P.P. Belousov and some members of the Water Supply Commission insisted on the necessity of asking M.I. Altukhov to examine the amounts of water in other municipal sources during the preliminary works.

In autumn 1891, at one of the hearings of the Tula Doctors' Society, P.P. Belousov made a statement about the results of his study of the potable water in Tula [6, p. 819], which did not provoke any reaction from the Society at that time. At the same time, the Water Supply Commission, having the reports of a third party concerning the suitability of water and the assurances of M.I. Altukhov that it was insufficient in other sources, entered into negotiations with Nadezhdin concerning the purchase of main springs located on the territory of his mansion. The negotiations were unsuccessful. The Commission decided that the city would get water from wells drilled on the municipal land plot located near the Nadezhdinsky. In the second half of March 1893, the first two wells were drilled. The results of the studies conducted by P.P. Belousov and F.I. Aderman showed that the water from the wells was similar to that from Nadezhdinsky but was distinguished by a solid residue (514 and 56 mg) and a high content of chlorine and sulfuric acid (23 and 36, 51.9 and 72). Its total hardness amounted to 23.5°; its constant hardness was 7°. At the same time, it was free from organic substances and products of decomposition thereof. Researchers admitted that this water was from the same water-bearing stratum as the Nadezhdinsky water; therefore, it was suitable for the city's water supply, although they had trouble explaining the difference in the composition. Samples were taken right after the completion of works, without long-term pumping, which could be the reason why the indices were different, because, according to the data of the later analysis (from the next three wells), the water was no different from the water from Nadezhdinsky.

At the beginning of April, the Water Supply Commission presented to the Duma a progress report together with a draft contract on the arrangement of the water supply system [10, 18, 19]. P.P. Belousov noted that during two years of work of the Water Supply Commission in the Duma, numerous statements had been made that "the water supply system is not necessary for the city; we have enough water without it and there are more pressing needs, in short, the same old story which cost the city the loss of almost all water supply capital. When it became known that the water in drilled wells is worse than that provided by Nadezhdinsky, this circumstance was confusing per se for some people; others rejoiced at it, as at the most solid argument against the conclusion of a contract for the arrangement of the water supply system" [6, p. 819].

At the session of the Duma held on 13 April 1893, the matter of debate was the quality of water from drilled wells. The supporters and detractors of the contract "did not mince their words to prove either the good quality of water or its unsuitability, to the point that they found it hazardous for health (forgetting even that it had been used by the fourth municipal sector from time immemorial) and hardly suitable for latrine facilities and watering of streets". Since the majority of voters were unfamiliar with the issue, P.P. Belousov was invited to the session, where he gave a detailed comparative analysis of the water, noted all its weak points (higher level of hardness, higher content of chlorine salts and sulfates preconditioning the high constant hardness), as well as pointing to its purity, and noted that it was suitable for the supply of the

city. The issue of the conclusion of the contract was solved in the Duma, but rumours began to spread in the city that the quality of water chosen for the supply system was bad. Two days later (on 15 April 1893), the session of the Tula Doctors' Society was held. Doctor N.P. Kamenev, the determined opponent of the Duma's decision, tried to confirm his point of view with the use of the data on the chemical analysis of the potable waters in Tula obtained by P.P. Belousov in summer of 1891 and duly reported at one of the hearings of the Society. According to P.P. Belousov, N.P. Kamenev's explanations of were "lengthy, vibrant... and contradicting the basic health issues" [6, p. 820]. P.P. Belousov noted that Doctor N.P. Kamenev used foreign cities for comparison ("There was not a single Russian city except Moscow".).

P.P. Belousov noted that except for his own remarks, "the report of Dr. Kamenev did not spark any debate". To his surprise, P.P. Belousov learned that most people considered the water from the drilled wells hazardous for health. He immediately asserted that he did not share this opinion, hoping that his words would open a discussion, but members of the Society declined it. The Commission for Making a Conclusion of the Society on Water was established, and P.P. Belousov was invited to become a member of it. A decision was proposed by him (according to his words) and adopted almost without alterations, although, as P.P. Belousov noted, it could "mislead persons who were unaware of the case details or whose attitude thereto was biased" [6, p. 820].

Samples of water from one of the drilled wells were once again sent to the laboratory of F.F. Erismann to be analysed, and on 1 July, his reply was received: "Quite satisfactory water: ... taking into account the aggregate of physical attributes and chemical composition of water, we have reasons to consider it suitable for the supply of the city" [6, p. 820].

N.A. Sobolev's basic claim was that P.P. Belousov doubted the competence of the Tula Doctors' Society: "According to Dr. Belousov, the editorial staff was misled, and so the direction the Society took does not deserve any compassion: the Municipal Council has no reasons whatsoever to cancel the decision it made, and the unanimous opinion of doctors (including Belousov) is of no value at all, as they are coming from obviously incompetent people who discuss things they do not understand", as well as the erosion of the academic standing of the Society in publications which contained "a number of hints, transparent comparisons, and reprimands which clearly mislead a trustful reader into believing that the scientific level and goodness of our Society are very low" [14, p. 1042].

N.A. Sobolev also related "Dr. Belousov's story about the malicious party of principled (self-interested) opponents of the water supply system whose nefarious activities cost the city the loss of almost all water supply capital", and about some anonymous persons who "rejoiced at hearing that the water from the drilled wells was worse than that from Nadezhdinsky" and "did not mince their words" to stop the implementation of the water supply project [14, p. 1042].

P.P. Belousov was also reproached for the following. Having published his work on potable waters of Tula in several editions and reported on that at the session of the Society, he "evaded this important question and kept silence in the municipal sanitary commission... and gave an evasive reply at the critical moment at the session of the Duma on 13 April in front of the councillors, stating that he was under pressure! It is a pity that Dr. Belousov did not explain the source and features of that pressure..." [14].

According to N.A. Sobolev, P.P. Belousov failed to accomplish his official duty as a public health physician to explain the importance of "the re-introduced medical, sanitary, and economic facility being the water supply system" to the councillors who were about to make a decision on this long-discussed issue [14, p. 1042]. P.P. Belousov, in his opinion, was obliged to help them make the right decision because it was still possible to make things better before 15 April (when the decision of the Duma became legally effective). However, no such steps were taken because of the actions of the public health physician, which did not comply with "the interests of public health and benefit of the city". N.A. Sobolev noted: "The Tula Doctors' Society considered it their moral responsibility to provide the unanimous (Dr. Belousov included) conclusion on the basis of § 39 of its Charter to the Medical Department of the Governorate Administration. By the way, in case the opinion

of the Society is considered rather compelling by the relevant administrative authority, in view of the non-expiration of the term defined by the law, the decision of the Duma on the choice of the worst source for the water supply system can be suspended" [14, p. 1042].[8]

N.A. Sobolev called P.P. Belousov's statement on the improper use of the water supply capital "bashing" of the Municipal and Tula Medical Societies: "Thus, it is quite proved by the printed protocols at the Duma's disposal that the water supply capital never 'melted' in the sense of embezzlement or misappropriation as one could conclude from Dr. Belousov's letter; and in case there were *borrowings* [emphasis added] from this capital taken by the city at different times, it was done on legitimate grounds, with the knowledge and consent of the relevant authority, and the money was spent on honorable and urgent municipal needs and partially for patriotic purposes. Thus, 35,000 rubles were spent on building a bridge between two parts of the city; 25,000 rubles on wartime needs; 33,000 rubles on the establishment of the municipal academy in memory of Emperor Alexander II; and some money on building barracks and on other needs of the city. However, this capital, as soon as the need emerged, was immediately returned and is now used for the initial purpose. Nobody in Tula denied the benefit and necessity of the water supply system, and in case its construction was *suspended* [emphasis added], it was probably because until recently, the Municipal Council considered it impossible to go ahead with such a serious project without having all reliable data at hand".

In conclusion, N.A. Sobolev stated that the decision of the Tula Doctors' Society made at the session on 15 April 1893 on the municipal water "as undesirable for Tula due to its incompliance with the city needs under the present conditions [was] not affected by the correspondence of Dr. Belousov; apparently, the latter ignores the sanitary evaluation of water from the point of view of local interests" [14, p. 1043].

P.P. Belousov believed that the purpose of the Society's letter was to discredit him in the eyes of the Tula Municipal Council, and thus to maintain its own reputation. He congratulated the Society on the achievement of its goals. At one of the last hearings at the Duma, on the basis of the Society's statement, his observations were discredited. P.P. Belousov also said that not all members of the Society participated in "that sad story" and that he was well aware of those who were equally disappointed by that statement.[9]

On 24 February 1894, a session of the Society was held following the results of its activities in 1893. The secretary V.V. Tikhomirov reported on the scientific reports made on 15 April 1893 by N.A. Sobolev ("On potable waters of Tula" [13, p. 20]) and N.P. Kamenev ("On water supply of Tula)". V.V. Tikhomirov reminded those present that the session of the Society held on 15 April 1893 was entirely dedicated to the "vital issue" of the water supply of Tula, and that the short paper on the results thereof was even published in No. 20 of *Vrach* newspaper of 1893, obviously because of its importance [8]. Then he mentioned "some unpleasant events in the life of the Society in this year" – that the Society, "trying to be of use to the native city, had a rough lesson because the primary principle of activities of every society, viribus unitis[10], was violated". Without mentioning the name, V.V. Tikhomirov spoke of one of the members of the Society who had made a stand "against the competence of the Society in assessment of the sanitary needs of the city, thus striking not only at certain members but also the dignity of the whole Society", and said that "the deeply aggrieved" Society dedicated three hearings to the discussion of this letter, on 16 August, 1 September, and the emergency meeting on 7 September. As a result, a letter on behalf of the Society was published in No. 37 of *Vrach* newspaper [15, p. 1042], and in No. 47 [15, p. 1314] a personal letter by the author of the report published in No. 20 was printed [8].

[8] P.P. Belousov was afraid of the suspension of the construction: if it had not begun, the issue of the water supply of the city would have remained "set aside".

[9] On 16 August 1893, when the letter of P.P. Belousov published in *Vrach* newspaper was discussed for the first time, 34 members of the Tula Doctors' Society were present at the hearing; on 26 September 1893 there were 26 members present; and at the last session when the final edition of the letter was adopted, 17 members, among whom 9 only had been present at previous sessions [18, p. 313].

[10] "Viribus unitis" (Latin): "by combined efforts".

a)

b)

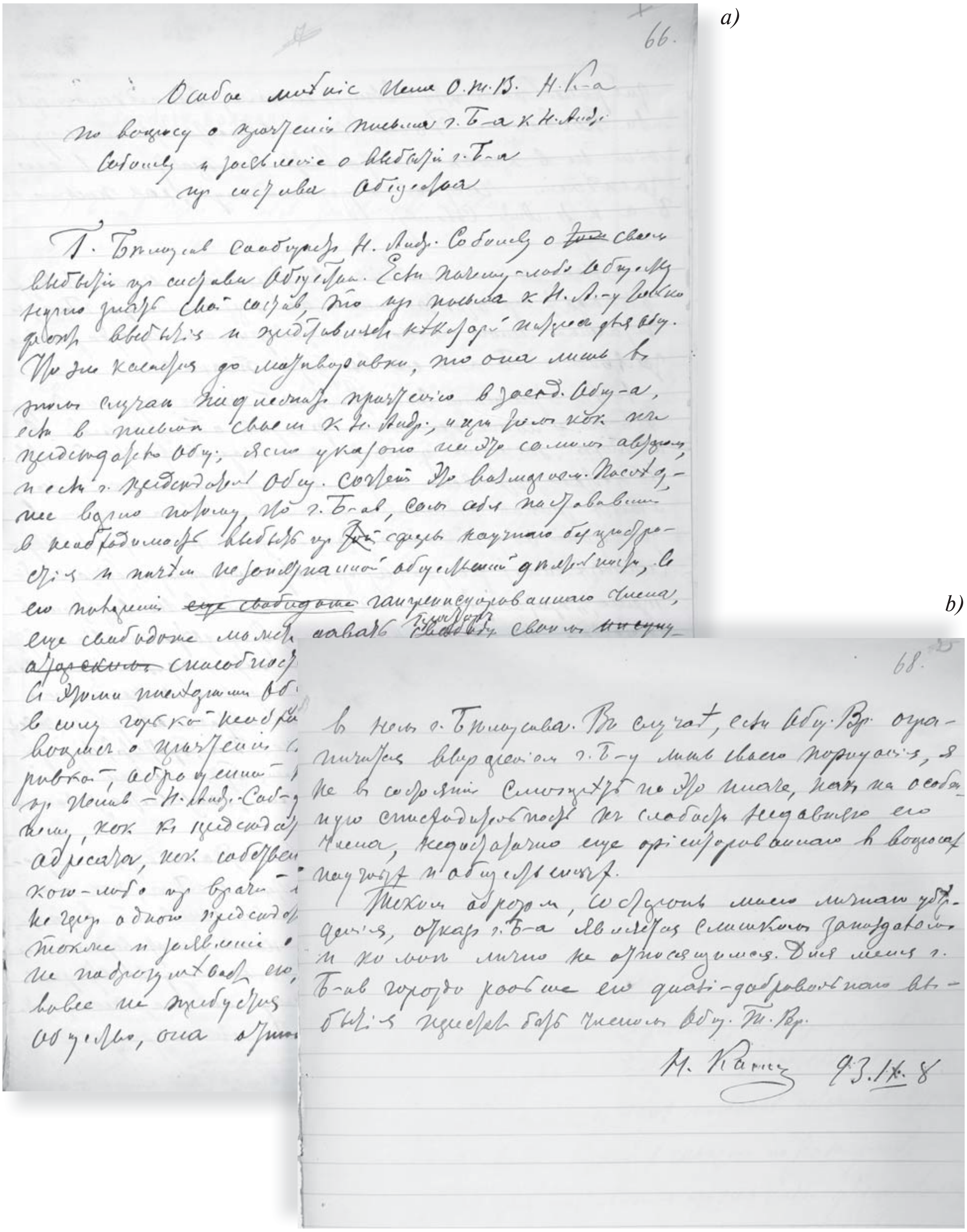


Fig. 2. First (*a*) and last (*b*) pages of N.P. Kamenev's manuscript "Materials on water supply of Tula" with the author's signature (March 1894 – December 1894): "Minority report of the member of the TDS (Tula Doctors' Society) N.P. Kamenev with regard to the meaning of the letter of Belousov to N.A. Sobolev and request for the departure of Belousov from the Society".
GATO. F. 221. Op. 1. D. 7. L. 66, 68.

N.P. Kamenev expressed his "minority report on the letter of P.P. Belousov to N.A. Sobolev" and a request that P.P. Belousov leave the Society. He considered that P.P. Belousov had "made it necessary for himself to get out of the scientific neutrality environment", that he had behaved "not as a public person, freely giving way to his abilities and insinuations", and that he was cynical. N.P. Kamenev also asserted: "Everyone in the Society must abide by the Charter. P.P. Belousov's attitude to the scientific society is disrespectful, even impudent, which proves the unjustified defiance. Because of this, he deserves that the Society part ways with him. In case the Society merely expresses its reproach, N.P. Kamenev will not be able to consider it otherwise than a specific condescension to the weakness of its recent member who is not yet well aware of scientific and social issues" (8 September 1893)[11] (fig. 2 a, b).

At the beginning of this report, in the section dedicated to the changes in the composition of the Society in this year, is the following record: "Pyotr Petrovich Belousov left the Society by his own volition" [13, p. 3].

Participation of the Russian Society for Public Health Protection in the stabilization of the situation related to the construction of the water supply system in Tula

Unwilling to leave the issue unsolved and confident in the correctness of his actions, P.P. Belousov approached the Russian Society for Public Health Protection with a request to propose the sensitive issue of the quality of municipal water and suitability thereof for water supply for consideration to a special subpanel of the Society. He provided his work and the results of the analysis of water from all drilled wells and city springs. He even foresaw possible objections and "unwillingness" to address the "local issue", noting that "by explaining things that baffle us, the Russian Society for Public Health Protection will do service not only to us but the calmer development of the water supply industry in Russia" [20, p. 1].

This proposal was made at the meeting of the third subpanel of the Society on 20 January 1895. According to S.V. Shidlovsky,[12] in order to make a decision, a specially elected commission had to carefully examine the printed factual materials in this case. M.I. Altukhov, K.I. Bobritsky, P.N. Brusyanin, A.A. Lipskoy, P.L. Malchevsky and E.P. Skorobogach, S.V. Shidlovsky (chair), and K.I. Bobritsky (secretary) became members of the commission [20, pp. 1, 2]. At the first meeting on 3 March 1895, the commission was in full strength. Having familiarized themselves with articles published in Nos. 20, 29, 37 and 47 of *Vrach* newspaper in 1893, Dr. P.P. Belousov's article "Data for sanitary evaluation of Russian urban waters", and his report, the members of the commission approached the Tula Doctors' Society and Dr. Belousov with a request for the information about the construction of the water supply system. The request was granted, and the commission received a number of documents.[13]

[11] Dr. N. Kamenev. Materials on the Water Supply of Tula. F. 221. Op. 1. D. 7. L. 66–66 ob.

[12] Sergey Vladimirovich Shidlovsky (1846–1912) was a hygienist and from 1879, an employee of the sanitary laboratory at the Medicine and Surgery Academy under the leadership of Professor A.P. Dobroslavin. In 1881, he was granted the degree of Doctor of Medicine for his first experimental work "Sand purification of potable water in large amounts". From 1891, he was the head of the sanitary laboratory at the Military Medical Academy (MMA). For 25 years he was a member of the Russian Society for Public Health Protection and an MMA academician.

[13] The following documents were presented to the commission: 1) Report to the Tula City Duma from the Commission established by the Duma on 11 May 1871 in the case on the arrangement of the water supply system in Tula; 2) "On water supply of Tula" by Engineer of Mining V.I. Tydelsky (separate reprint from No. 4 of the Mining Journal of 1890); 3) Report to the Tula City Duma from the Tula Municipal Council and Construction and Water Supply Commission as of 13 April 1893, with appendices; 4) Note on the water supply of Tula by Dr. N.P. Kamenev (separate reprint from Medical Survey, No. 22, 1894); 5) Report on the activities of the Tula Doctors' Society in 1893–1894 (XXXII). "On drinking waters in Tula", a note by Dr. N.A. Sobolev; 6) Information for the sanitary evaluation of Russian municipal waters. A public lecture read in Tula on 28 November 1893 by public health physician P. Belousov; 7) Report to the Tula City Duma as of 15 December 1894 on the analysis of Prof. Markovnikov with the opinion of the Sanitary Commission and two separate brochures: a) inspection of the water supply system from 5 to 9 December 1893; b) test report on water-raising engines with steam boilers from 17 to 20 August 1894; 8) Minority report of the councillor of the Tula City Duma and member of the Sanitary Commission Dr. Schepetov made by him at the meeting of the Duma on 15 February 1894; 9) Analysis of three samples

The second meeting of the commission (held on 25 September) was dedicated to their familiarization with the provided documents as well as letters of Doctors A.G. Avdykovich and P.P. Belousov. At the third meeting (held on 30 October) [20, p. 7], the chairman presented P.P. Belousov's article "Chemical analysis of drinking sources of Tula" and Nos. 9 and 10 of *Vrach* newspaper for 1894.

The results of the commission's work were presented to the third subpanel [21, p. 54].

The commission concluded that despite the availability of water sources in Tula and its outskirts, few of them could be admitted suitable for the municipal water supply. The unsuitability was determined by the poor quality or insufficient amount of water [21, p. 55].

According to the commission, among all examined waters, those flowing in underlying layers of Tula limestone were the most suitable for the supply of Tula. These waters came above ground in the form of Nadezhdinsky and Nikolsky springs. Following the results of the analysis, the springs were determined to maintain "the qualities of tasty, good, and pure potable waters" and must be admitted, "due to their lower mineralization in general and hardness in particular, the best of all examined drinking waters of Tula" [21, p. 55].

The use of water from Nadezhdinsky sources which did not even need the development to provide the city with the necessary amount of suitable potable water [21, p. 56] was the most cost-effective and probably the only feasible solution because the funds devoted to these needs were limited. The supply of the city with water equivalent in quality to the chemical composition of water from so-called artesian wells (such as those at the mental health hospital and ammunition factory) would have been much more expensive because additional expenses would have been required to find locations suitable for the most efficient use of underground "water flows" and to construct structures for procuring water beneath the soil surface. However, if only water artificially procured in the outskirts of the city had been used for the supply, it would have been more beneficial for the citizens.

Hard water does not clean as well as softer water. It is also more difficult to boil leguminous crops and meat and to make tea and coffee with hard water [21, p. 56]. Therefore, the use of harder water is related to greater expenses (detergents, etc.). No other remarks on the merits of the project were made.

The conclusion of the commission was as follows: "Solving the issue discussed for decades of the Tula water supply system (although not in such perfect form as, according to the commission, is desired and not meeting the interests of citizens in the best way, nevertheless) is a major contribution to the sanitary improvement of the city. The reinstalled water supply system provides an opportunity to stop using the quite unsuitable and hazardous (within the limits of the city) water of River Upa and small polluted ground wells and substitute it with suitable and healthy potable water, although it is not the best water which the majority of citizens wanted to use for the water supply. Maintaining these qualities in perpetuity must be a regular task of institutions and persons who are entrusted with the protection of public health" [21, p. 58]. The works of the commission with regard to the water supply of Tula were published in *Journal of the Russian Society for Public Health Protection* Nos. 5, 6 for 1896. On 11 May 1896, P.P. Belousov, "diagnosed with marsh fever and assumption of progressing tuberculosis, was sent by his friends to Yalta, where on 11 June, he was smitten with complete paralysis of the left side which never ceased to his death. On 29 June, P.P. Belousov was brought from Yalta by his colleague and friend to Tula. His condition was hopeless" [11, p. V]. Therefore, he could not address the published results of the commission's work.

Conclusion

P.P. Belousov was one of the most renowned medical professionals in Tula. One of the aspects of his activities aimed at the sanitary improvement of Tula was the establishment of the municipal water supply system. Such an issue was challenging for all the largest Russian industrial centres at the end of

of water from Rogozhinsky, Nikolsky, and Trostyansky wells from the laboratory of Professor Markovnikov; 10) Extract from the journal of the Tula City Duma dated 29 September 1893; 11) Urban map of Tula; 12) Draft report of the Tula Doctors' Society as of 15 April 1893. The following documents were not presented to the commission: the article of Dr. P.P. Belousov "Analysis of potable waters in Tula" in a report of the Sanitary Commission at the Tula Municipal Council, 1891 and Nos. 20, 29 and 37 of *Vrach* newspaper for 1893 and Nos. 9 and 10 for 1894.

the 19th century. Certain essays of P.P. Belousov addressing this problem are mentioned in rare works of researchers, but it remained unclear earlier what was the "misconception of water supply" in Tula. The circumstances under which P.P. Belousov voluntarily left the Tula Doctors' Society, his approach to the Russian Society for Public Health Protection, and the work of the commission at the Society at his request were not considered.

P.P. Belousov understood that it was not always possible to turn ideas that look good in theory into reality. As far as the construction of the water supply system in Tula is concerned, the ideal option was not brought to fruition because of the limitations of the "water supply capital".

P.P. Belousov was distinguished by his approach to solving local sanitary issues: he used to speak about his activities to draw the attention of citizens to a problem that could be important not for Tula only. In one of his works, he states as follows: "This short essay is caused by purely local circumstances, but I think that the information given in it can be of some common value because the issue of the water supply, with few lucky exceptions, is urgent everywhere and is one of the sorest spots of our urban economies" [12, p. 38]. Colleagues of P.P. Belousov drew attention to his love of truth, which caused him to be often misunderstood. Along with numerous friends, he had many ill-wishers. It was a characteristic feature of P.P. Belousov that he "did not obey the rules dictated by dry decorum when they were at variance with the truth. He looked for the truth in scientific issues that intrinsically were a part of his practical activities as a public health physician in a provincial city. He was one of those tireless and honest hard workers who try to turn the principles of scientific hygiene into reality for the benefit of his fellow citizens without great ado. He was one of those who find the highest moral satisfaction in the profession... if all doctors had acted like him in a number of cases, the issue of medical ethics that is so often discussed in Russia and abroad could have been considered idle" [23, p. 811].

Acknowledgements. The author expresses her gratitude for assistance in the preparation of materials to the following persons: head of the photo and video laboratory of Tula State University Mikhail Borisovich Gindin, chief custodian of the Tula History and Architecture Museum Irina Lvovna Lebedeva and lead expert Alexey Alexeyevich Kamolikov, archivist of the Department for Preservation of the Czarist-era documents of state institution National Archive of the Tula Region Ekaterina Vyacheslavovna Shutova, and archivist of the Department for Reference Apparatus Elena Viktorovna Andrianova.

REFERENCES

1. *Polnoe sobranie zakonov Rossiyskoy Imperii* [*Complete collection of laws of the Russian Empire*]. Saint Petersburg: 1874; coll. 2, v. 45, dep. 1, № 48498: pp. 821–839. (in Russian)
2. Sherstneva E.V. *Blagoustroystvo gorodov i sanitarnyy nadzor v Rossii v kontse XIX – nachale XX veka* [*Improvement of cities and sanitary inspection in Russia at the end of the 19th – the beginning of the 20th century*]. Problemy sotsial'noy gigieny, zdravookhranenya i istorii meditsiny. 2015; 23(2): 52–56. (in Russian)
3. Tereshkina O.V. *Stranitsy istorii zdravookhraneniya Tul'skoy gubernii vtoroy poloviny XIX veka: V.I. Smidovich* [*Pages of history of health care of the Tula province in the second half of the 19th century; V.I. Smidovich*]. Istoriya meditsiny [History of Medicine]. 2016; 3(1): 83–95. (in Russian)
4. Smidovich V.I. *Materialy dlya opisaniya Tuly: sanitarnyy i ekonomicheskiy ocherk* [*Materials for the description of the city of Tula: sanitary and economic sketch*]. Tula, 1880. 132 p. (in Russian)
5. *Doklad Tul'skoy gorodskoy dume ot komissii, uchrezhdennoy Dumoyu 11 maya 1871 g., po delu ob ustroystve vodoprovodov v g. Tule* [A report to Tula city Duma by the Commission, established by the Duma on May 11, 1871, on the arrangement of water supply in Tula]. Tula: Tipografiya N.I. Sokolova, 1873. 96 p.
6. Belousov P.P. ... [...]. In: Vrach. 1893; 29: 818–820.
7. *Doklad komissii po ustroystvu vodoprovoda v g. Tule* [A report by the Commission on the arrangement of water supply in Tula]. Tula: Tipografiya N.I. Sokolova, 1876. 20 p.
8. A report by the Permanent Sanitary Commission at Tula administrative board. Tula, 1891.
9. Belousov P.P. *Vodoprovodnye nedorazumeniya v g. Tule* [Water supply imbroglio in Tula]. Zhurnal Russkogo obshchestva okhraneniya narodnogo zdraviya. 1895; 1: 37–48.

10. *Doklad Tul'skoy gorodskoy Upravy i stroitel'no-vodoprovodnoy komissii v Tul'skuyu gorodskuyu Dumu* [A report by Tula administrative board and water supply-construction commission to Tula city Duma]. Ed. P.P. Belousov. Tula: Tipografiya N.I. Sokolova, 1893. 44 p.
11. *K voprosu o sovremennom polozhenii i blizhayshikh zadachakh assenizatsii russkikh gorodov* [Revisiting the current state and urgent tasks of sanitation in Russian cities]. In: Obshchestvenno-sanitarnoe Obozrenie. Materialy po obshchestvennoy gigiene Tul'skogo doktora P.P. Belousova. Saint Petersburg: Tipografiya M.M. Stasyulevicha, 1896. 222 p. Kholevinskiy S.M., Dolgopolova N. *Pamyati P.P. Belousova*. Pp. I–VII.
12. Belousov P.P. *Dannye dlya sanitarnoy otsenki russkikh vodoprovodnykh vod (publichnaya lektsiya)* [Materials for the sanitary assessment of the varieties of tap water in Russia]. Zhurnal Russkogo obshchestva okhraneniya narodnogo zdraviya. 1894; 1: 38–47.
13. *Otchet o deyatel'nosti OTV za 1893–1894 gg.* [Report on the Tula Doctors' Society's work in 1893–1894]. Tula: Tipo-litografiya E.I. Druzhininoy. 89 p.
14. Sobolev N., Avdykovich A. *Pis'mo v redaktsiyu* [A letter to the editors]. Vrach. 1893; 37: 1042–1043.
15. Tikhomirov V.V. *Pis'mo v redaktsiyu* [A letter to the editors]. Vrach. 1893; 47: 1314–1316.
16. Belousov P.P. *Pis'mo v redaktsiyu* [A letter to the editors]. Vrach. 1894; XV(9): 283–284.
17. Belousov P.P. *Pis'mo v redaktsiyu* [A letter to the editors]. Vrach. 1894; 10: 312–313.
18. *Otchet postoyannoy Sanitarnoy komissii, sostoyashchey pri Tul'skoy gorodskoy Uprave za 1889 g.* [A report by the Permanent Sanitary Commission at Tula administrative board. Tula, 1889]. Tula: Tipo-litografiya: E.I. Druzhininoy, 1890. 108 p.
19. *Doklad Tul'skoy gorodskoy Upravy v Tul'skuyu gorodskuyu Dumu* [A report by Tula administrative board to Tula city Duma]. Ed. P.P. Belousov. Tula: Tipografiya N.I. Sokolova, 1892. 10 p.
20. *Trudy komissii, pri III sektsii Russkogo obshchestva narodnogo zdraviya, po voprosu o vodosnabzhenii g. Tuly* [The materials of the Commission at Sector III of the Russian Society for Public Health on the subject of water supply in Tula // Journal of Russian Society for Public Health]. Zhurnal Russkogo obshchestva okhraneniya narodnogo zdraviya. 1896; 5: 482.
21. *Trudy komissii, pri III sektsii Russkogo obshchestva narodnogo zdraviya, po voprosu o vodosnabzhenii g. Tuly* [The materials of the Commission at Sector III of the Russian Society for Public Health on the subject of water supply in Tula // Journal of Russian Society for Public Health]. Zhurnal Russkogo obshchestva okhraneniya narodnogo zdraviya. 1896; 4: 17–58.
22. *Falkowski N.I.* The History of water in Russia. Of the Ministry of public utilities of the RSFSR. 1947. 312 p.
23. Blauberg M. *Nekrolog P.P. Belousova* [*Obituary of P.P. Belousov*]. In: Zhurnal Russkogo Obshchestva Okhraneniya Narodnogo Zdraviya. 1896; 9: 810 – 812.

About the author

Olga Vladimirovna Tereshkina – Candidate of Biological Sciences, Associate Professor at the Department of Human Physiology of Medical Institute, Tula State University, Tula (Russian Federation).