

## **The first sanitary doctor in Tula, P.P. Belousov: on the history of the field of hygiene in medicine in the late 19th century**

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Materials are presented on the work of P.P. Belousov – a representative of the sanitary-hygienic medical field in Russia at the end of the 19th century, the first sanitary doctor of Tula, and a student of F.F. Erisman.

Tula's unsatisfactory sanitary condition at that time was largely due to the fact that this city was an industrial center and it housed a large number of factories. The author shows how Belousov's work dealt with various monitoring issues in housing and communal services, food hygiene, school sanitation and veterinary spheres. The author pays special attention to one of Belousov's leading areas of practical and research work as a sanitary doctor in Tula – cleaning the city of sewage. This was one of the most pressing issues in sanitation and hygiene for Russian cities of the 19th century. Belousov's goal was the creation of a city system for the removal and disposal of sewage that met the requirements of modern hygiene science. He sought to organize sewage disposal in Tula in the most expedient, cost-effective way, using local, readily available resources. To do this, he combined modern approaches and particular features of sanitation in large Russian cities, as well as the results of experimental construction of sewage disposal fields in Tula. The data obtained by Belousov was used in his thesis "On the current situation and the immediate tasks for the sewerage system of Russian cities", which was written under the guidance of F.F. Erisman. The article contains information characterizing both positive and negative aspects of this experience. The author notes Belousov's personal and professional qualities, which allowed him in a short period of time to make an invaluable contribution to improving the sanitary situation in Tula.

**Keywords:** *history of medicine, Tula, P.P. Belousov, sanitary situation, sewage disposal*

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### **A brief description of the sanitary conditions of Tula in the late 19th – early 20th century**

The sanitary conditions of Tula during the second half of the 19th century were unsatisfactory [1] due to a number of reasons, the main one being the defense and industrial significance of the city for the Russian state since the pre-Petrine era. Tula housed a lot of metallurgical, rifle, and copper mining enterprises, as well as railway workshops and a number of industries including coal, sugar, cartridge, samovar, hardware, accordion, and others. Due to this fact, workers and craftsmen constituted the majority of the city populace with their low standards

of living and education [2]. Another important reason for the unsatisfactory sanitary conditions was Tula's unique geographic location, which for a long time hindered plumbing and sewerage. The dysfunctional sanitary and hygienic condition of the city was also significantly influenced by the so-called peculiarity of the local public life [4, p. 13] – the indifference of local self-governing bodies, as well as the inertness and passivity of the educated part of the population with regard to progressive social ideas and useful innovations. In particular, the conditions under which the activities of Peter Petrovich Belousov, the most prominent representative of Tula's healthcare in the late 19th century and Tula's first sanitary doctor, have been described as "an atmosphere of hatred and struggle", requiring "protection of the dear ideals of public

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service which are destined to become fulfilled when the public conscience awakens” [5, p. 7].<sup>1</sup>

### **The invitation of Doctor P.P. Belousov to the position of the sanitary doctor of Tula.**

Peter Petrovich Belousov was the first sanitary doctor of Tula. He made the greatest contribution to the “*case of concern for public health*” for both residents of the city and the province during the second half of the 19th century (Fig. 1). Tula region historians called him “an apostle of sanitation”. This expression taken from his obituary of 1896 [5] was again made relevant by local historian S.A. Rassadnev in the 1970s [6, pp. 5–7].

P.P. Belousov was born on January 23, 1856, in Odoyevsky district of Tula province to a village priest’s family. He received his elementary education in the Tula Theological School but was expelled from the second grade for his “inability and neglect to science” [5]. Later he graduated from the Belyovo Theological School; he was always grateful to the teacher who “managed to wake up and direct his abilities”, I.I. Voskresensky [5, p. 1]. In 1872, P.P. Belousov enrolled in the Tula Theological Seminary. In 1876, after four years of training and with no desire to become a priest,<sup>2</sup> he entered the Imperial University of Moscow, from which he graduated in 1881 with the title of a physician and a district doctor (*uezdnij vrach*). In 1881, P.P. Belousov was a rural doctor in the Podolsky province, and in 1882 a city doctor of the city of Yampol of the same province. In 1883, both following his sick father’s request and acting on his own accord he returned to his native province, to the



**Fig. 1. P.P. Belousov.**  
*From the author’s personal archive.*

Odoevsky district, as a district doctor (*zemskoj uchastkovij vrach*). In 1887, he became the head of the area hospital in Odoev [5, p. II]. At this time P.P. Belousov conducted his first scientific observations and generalizations concerning the prevalence of syphilis strains among peasants. These notes were presented in a number of publications, as well as in a report at the Second Symposium in memory of N.I. Pirogov. [5, pp. II, III]<sup>3</sup>

In 1888, P.P. Belousov passed examinations for a doctorate in medicine at the Imperial Military Medical Academy in Saint Petersburg.<sup>4</sup>

In accordance with the Russian City Regulations of 1870, approved by the highest command [7, pp. 821–839], which were created for the purpose of “a radical renewal of the urban social order and economy”, a number of significant changes took place in this area. The guidelines listed in the document were to be executed immediately in provincial and regional cities including Tula. Among the issues supervised by the governor, the regulations

specified topics related to the improvement of the city environment. Such topics included the actual arrangement of the city according to an approved plan and the organization and maintenance of streets, squares, pavements, city public gardens, boulevards, water pipes, sewers, canals, ponds, ditches and ducts, bridges, and city lighting. Additionally, the Regulations aimed to insure the welfare of the urban population, i.e. through the provision of food supplies to the population, the establishment of markets and bazaars, the protection of public health, and precautionary measures against fires and other natural disasters, as well as the compensatory system for the damages

<sup>1</sup> P.P. Belousov memorial cross, Vshvlyatskoye cemetery, Tula.

<sup>2</sup> The complete curriculum of a theological seminary from the beginning of the 19th till the end of the 20th century was six years and included three classes: rhetoric, philosophy and theology, each of which lasted for two years.

<sup>3</sup> Later on, P.P. Belousov took part in the 4th and 5th symposia, but the work he presented there was already directly related to the sanitary problems of Tula.

<sup>4</sup> Moscow Central Historical Archive (MCHA), F. 418. Op. 386. D. 37. L. 5. On passing the exams for the medical doctor degree by a physician Petr Belousov 14th of February – 2nd of March of the year 1888.

caused by them. Furthermore, the citizenry's well-being was attended to by the development of local trade and industry and the establishment of charitable institutions and hospitals, as well as theaters, libraries, museums and other institutions of the kind [7, p. 823].

Following Art. 73 of the city regulations, which stipulated the establishment of special executive commissions for the management of individual branches of municipal economy and public administration [7, p. 830], the Sanitary Commission was created under the

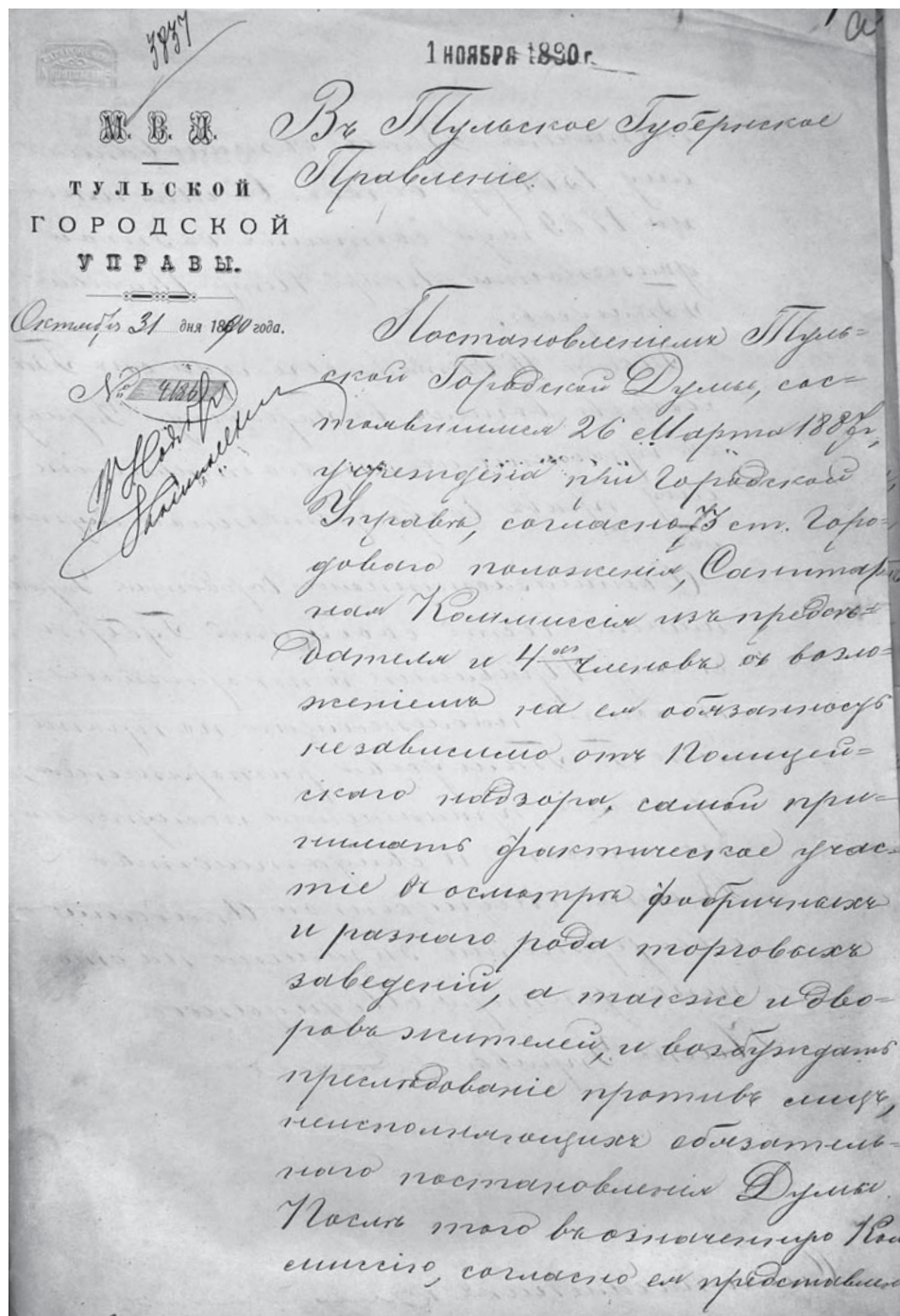


Fig. 2a. The Act of Tula Local Government on granting public service rights on the creation of public positions to the sanitary doctor of Tula Peter Belousov (31.10.1890 – 28.01.1891). a – page from case No. 203 of Tula Local Government Department of Medicine. State archive of the Tula Oblast' (GATO). F. 44. Op. 1. D. 1461. L. 1a.

1889. 10. 16

постановлено Думой въ каждомъ году  
 ему 1500 руб. вѣрбов. Съ этого числа  
 въ 1889 году постановлено въ томъ  
 же числѣ назначить Алекса. Петрову  
 Третьякову.

Имѣю 16 Октября сего года отъ Третьякова  
 вѣдѣние въ Тобольскую Губерн. въ  
 санитарию о предоставлении ему  
 правъ государственной службы.

Обобщенно сообщая Тобольскому  
 губернскому Правлению и на основании  
 справки Третьякова о его службѣ;  
 прилагаю прилагаемое по случаю  
 его службы и служебныхъ  
 Военно-медицинской Академии  
 о Высшемъ званіи Доктора на степеніи  
 Высш. Медицин. Академіи.

Мэръ Губерн. Вѣдѣній

**Fig. 2b. The Act of Tula Local Government on granting public service rights on the creation of public positions to the sanitary doctor of Tula Peter Belousov. b – page from case No. 203. GATO. F. 744. Op. 1. D. 1461. L. 1a. ob.<sup>9</sup>**

<sup>9</sup> Text on the pictures:

[a] To the Tula Province Government.

Following the decree of the Tula City Duma of 26th of March 1883, a Sanitary Commission is formed under the supervision of City Council; the commission is to consist of a chairman and 4 members with a duty to take part, independently of police forces, in the inspection of production and sales facilities as well as private yards; it has a right to take legal actions against the violators. After that, [b] a doctor is appointed to the said commission with a salary of 1500 rubles a year. As of May 1889, this duty is performed by Peter Petrovich Belousov. On October 16th of this year Belousov approached the City Council with a request to be granted a right of state service.

City Council has the honor to report all the aforementioned facts to the Province Council and humbly begs a decision appropriate for Mr. Belousov's request; hereby attached please find his service record and the certificate issued by the Military Medical Academy on his successfully passing the exam for the Doctor of Medicine degree.

City council member [signature].

city government of Tula.<sup>5</sup> It consisted of a chairman and four representatives. It was entrusted with the responsibility, “regardless of the police forces, to take an actual part in the inspection of factories and other various commercial establishments, as well as of the households’ courts; and to prosecute individuals not complying with the mandatory Duma resolution” (Fig. 2a). The State Archives of the Tula Region contain documents<sup>6</sup> according to which “into the commission stated above and in accord with its submissions, a doctor is appointed with a salary of 1500 rubles per year. As of May 1889, this position is held by Doctor Peter Petrovich Belousov” (Fig. 2b). This document is proof “of the appointment, upon consideration of the request by Tula City Council, of a physician and a retired Collegiate Assessor Peter Petrovich Belousov as a Tula City Sanitary Doctor, with the civil service rights starting as of June 31, 1890”.<sup>7</sup>

P.P. Belousov accepted his appointment as a doctor of the Sanitary Commission by the Tula City Council; prior to it, he had familiarized himself with the special methods of sanitary research by Professor S.V. Shidlovsky<sup>8</sup> [5].

#### **Description of sanitary issues relevant for Tula in the late 19th century, and P.P. Belousov’s role in addressing them**

The implementation of preventive measures with regard to improvement and sanitation of the cities as well as the formation of permanent sanitary control is associated with the appearance of special sanitary departments. The development of urban

sanitation had taken the path of specialization. That is to say, sewage and plumbing were under the control of town sanitary organizations, as were the issues regarding the sanitary control of provisions, schools, communal and housing spaces, and veterinary control [8, p. 53].

The basic character of sanitary issues in Tula at the end of the 19th century was described in 1880 by V.I. Smidovich [1, 3]. Addressing the majority of these issues became the responsibility of the city’s first sanitary doctor, P.P. Belousov.

From the end of the 19th century to the beginning of the 20th century, one of the most important directions for local government actions was the construction of aqueducts and sewerage. In P.P. Belousov’s practical and scientific works were formed two main foci: the creation of a system of waste removal (sewage disposal), and the optimization of plumbing construction in Tula. Aside from these directions, P.P. Belousov, according to his colleagues, was involved in a multitude of “active affairs around the city” [5]. From the minutes of Sanitary Implementation Commission meetings, we can form an idea about the types of those tasks and about their importance to the city. Preparation of annual sanitary reports was also the duty of P.P. Belousov, who was simultaneously a secretary for the commission. Only in 1896, due to a serious illness, he could not submit such a report. He had to resort to a message: “The Commission indicates that the activity for the reporting year of 1895 fully corresponded with the previously adopted direction” [9, p. 3].

What were these “active affairs”? One was the drainage of the marshy areas of the city and of the ponds [9, p. 4], the paving of streets with a possible change in their profile, and the arrangement of urban drains. According to the Sanitary Commission report, it was important “to take care of correct re-pavement of streets, without changes in street gutter profile, in order to avoid stagnation and decay of water. In addition, there is the issue of paving a number of streets crossing the Belyovskaya Pryamaya street, Fominskaya, Voronezhskaya and Nikitskaya streets (where not even one is paved all the way), which makes it very difficult to move around the area, especially in humid times of the year. This situation is extremely disadvantageous, in particular for the students of the Theological Seminary... The Sanitary Commission had ordered to request the paving of Gerasimovskaya

<sup>5</sup> GATO. F. 744. Op. 1. D. 1461. L. 1–3: Tula City Council decree on granting the rights of the ranking state service to Tula sanitary doctor Peter Belousov 31.10.1890 – 28.01.1891.

<sup>6</sup> GATO. F. 744, Op. 1, D. 1461, L. 1, 1a.

<sup>7</sup> GATO. F. 744, Op. 1, D. 1461, L. 3.

<sup>8</sup> Hygienist Shidlovskiy Sergey Vladimirovich (1846 – 1912) started working in the laboratory of hygiene of the Medical-Surgical Academy in 1879 under the supervision of Professor Dobroslavin. For his first experimental work, “Large scale cleansing of drinking water with sand”, he was awarded the title of doctor of medicine. In 1891 he became a head of the hygiene laboratory of the Military Medical Academy; he was a member of the same academy and for 25 years a member of the Russian Society for the Protection of Public Health.

leveling the entire area, establishing the gutters and completely paving it”.<sup>10</sup>

The second most important issue was the matter of the correct arrangement of urban slaughterhouses, which were polluting the waters of Voronka River with the slaughtered animals’ blood. The message from the sanitary doctor stated that “the blood from slaughtering is not collected, all the dirt from the gangways flows into Voronka River, and from it – into Upa River. The disposal of blood into the river has been practiced for about 3 years. In the blood compartment there is a vat and a box with previously collected blood, decomposed, swarming with worms; and bundles of decaying intestines. The oven where blood is dried has a sharp rotten smell. Slaughter of small livestock is carried out by the butchers themselves since the workers, who have allegedly not received salaries from the tenant for a long time, refuse to work”. P.P. Belousov described the state of the slaughterhouses as “an utter disorder”; however, the city administration refused to break the contract with the tenant of the slaughterhouses. Therefore, the state of affairs that had developed at the slaughterhouses was to remain unchanged for a long time [9, p. 20].

One of the recurring issues discussed repeatedly at the meetings of the Sanitary Commission was that of measled meat. Carcasses heavily affected by tapeworms were to be either destroyed or disinfected at the city slaughterhouses with high-temperature treatment before being sold. Lightly infested carcasses were sold without seals, but were branded with the word “measles”. The degree of infestation was to be determined by a veterinarian on duty [9, pp. 18–19].

A separate activity was regular sanitary control of various establishments [9, pp. 27–32]. For example, the court of the Uspensky Women’s Monastery was found to be in an unsatisfactory state. Trash and dishwater were disposed of right in front of the cells, and ditches along the buildings were filled with dirty water. Despite the presence of a garbage pit in a designated place, the whole court served as a dumpster. The latrines did not have hatches, midden pits were permeable for sewage, and many of them were adjacent to the cellars where provisions were stored. One of the commission’s conclusions

was particularly noteworthy: “Upon considering the facts in place upon the surveillance of Tula Women’s Monastery, and from the point of view of the assigned rules of practical hygiene, one must point out the utter contrast between the prior and the latter. For a person accustomed to at least some neatness, it may even seem that here, on the contrary, everything has been consciously done to achieve the greatest possible pollution, and to make cleaning impossible or unnecessary” [9, p. 30]. P.P. Belousov noted that “it is necessary to limit pollution as much as possible – this is the basis of cleanliness since it is easier not to pollute than to clean. Cleanliness can be regarded as the engine of practical hygiene, as a tool to prevent the disease before the treatment.” He further cited as an example Belgium, where prizes for cleanliness had been established, emphasizing, in his opinion, the extent to which people feel that tidiness is “the most precious virtue.”

Another aspect of the activities of P.P. Belousov was the sanitary inspection of organizations specializing in the production of artificial mineral waters with the purpose of checking the cleanliness of the premises, the presence of distillation cubes, and the compliance of the produced water with the accepted standards. According to the report on the inspection of the production of artificial mineral waters in the city of Chusov, at Ploshchadnaya Street, “in its own building, the institution is located on the ground floor of the building; it occupies one large room with an oven in the middle. The floor is cemented, the entire facility is kept neat, and the water is drawn from the city water supply. Near the exterior walls, there are devices for extracting CO<sub>2</sub>, purifying it, and saturating the artificial mineral water with it. All equipment is found in suitable neatness and cleanliness with the exception of the acid pump, which is not present at all... The owner of the establishment had claimed that artificial seltzer water is prepared from distilled water, but the distillation cube was not present in the workshop” [9, p. 5]. To determine the quality of “produced seltzer water,”<sup>11</sup> three bottles of freshly prepared

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<sup>10</sup> GATO. F. 744. Op.1. T.2. D. 1847. L.101–103.

<sup>11</sup> Seltzer or soda water is artificially carbonated when carbon dioxide interacts with baking soda (there are other methods of carbonation as well). Seltzer water received its name from Niederselters, where a natural carbonation source is located. In 19th-century Russia both carbonated and mineral waters were known as seltzer water.

water were taken to the city laboratory for analysis". Its results (presented in a table, which compared the composition of water from the city of Chusov to the composition of artificial seltzer water according to Struve's analyses and to the composition of urban tap water) clearly showed that artificial seltzer water was produced from raw tap water, and not the distilled water [9, p. 6].

For the purpose of disinfection, rag warehouses were also inspected.<sup>12</sup> According to P.P. Belousov's reports, their owners faced difficulties when sending products by the railway. The road management required a certificate of disinfection in accordance with the circular of the medical department of 1888, even though on September 5, 1893, this decision was nullified, leaving only the requirement for sending clean and well-packed cotton.

From time to time there were questions with regard to the functioning of city baths, for example, about supplying the baths under construction on the Naberezhnaya street with water from the well-located on the same street (the sanitary inspector presented a study of water samples), or about directing the dirty waste water from baths into the Upa river [9, p. 14]. "Bearing in mind that Sheremetyevskiye baths supplied with Upa river waters have absolutely dirty water in spring and during floods, the commission had decided to notify the head of the stated baths that they [would] be closed in the spring if by that time they [did] not provide tap water".<sup>13</sup>

Regular examination of the condition of public recreation places was also the responsibility of the sanitary doctor and the Sanitary and Executive Commission. In 1895, P.P. Belousov presented a report on the extremely unsatisfactory condition of the Kremlin garden: "...The latrines are kept very untidy and fetid, and in the same state is the garbage pit near the cafeteria; two tracks near the Kremlin wall are littered with burnt remnants after the theater fire, and hamper the already small garden area..." [9, pp. 21–22].

P.P. Belousov also developed a program for a sanitary and hygienic survey of schools based on the experience of his Moscow colleagues,<sup>14</sup> which was discussed at a meeting of the

Sanitary Commission on April 7, 1894. The program included mandatory sections on the size of premises and their sanitary and hygienic condition, illumination, the details of heating and ventilation requirements and so on. Firstly, the length, the depth, and the height of the school rooms were measured, as was the floor area per pupil, and the total number of pupils was counted. Secondly, the types of lighting and the places from which the light fell were determined in order to conduct the height measurements of the windows; the width of the lighted area, the area of one window, and the ratio of the lighted area to the floor area and to the height of the window sills were calculated as well. Thirdly, special attention was paid to the type of heating — Dutch or iron furnaces, fireplaces, central heating, or steam heating — and ventilation; to the number of air vents, furnace hoods, and ventilation shutters; and to the height, width, diameter, and number of the fans. Finally, the fourth group of questions in the survey of school premises included general comments on classrooms, cloakrooms, and latrines. The program was approved after the introduction of additions by V.I. Smidovich concerning the number of class hours and types of evening lighting.<sup>15</sup>

Special attention should be paid to the measures taken by P.P. Belousov for the eradication of the municipal solid waste landfill, including manure, and its transformation into a city park. He suggested that the contaminated soil not be removed but that the territory previously occupied by garbage be covered with a layer of new clean soil and planted with grass, bushes, and trees. Doctor N.I. Dolgoplov in his speech at P.P. Belousov's funeral said the following about this experiment: "P.P. Belousov, due to such activities, was great for the city of Tula. He created an unforgettable monument to himself and left a mark for the future generation... Many years will pass — the trees of the park, many of them personally planted by him, will grow, and in the shady avenues of this soon the healthiest and most beautiful corner of Tula children and laborers will get some rest. Perhaps, we will not get to use this future beauty, and it is difficult to evaluate the work of the dear friend at this time. But the future generation will appreciate it and

<sup>12</sup> GATO. F. 744, Op. 1, T. 2, D. 1847, L. 306 – 306 ob.

<sup>13</sup> GATO. F. 744, Op. 1, T. 2, D. 1847, L. 204 ob.

<sup>14</sup> GATO. F. 744, Op. 1, T. 2, D. 1847, L. 304.

<sup>15</sup> GATO. F. 744, Op. 1, T. 2, D. 1847, L. 305.

will be deeply grateful for the selfless work on the park creation. In the park, you could bury Peter Petrovitch and, probably, the grateful people would call it ‘the park of Dr. Peter Belousov’ [5, p. VI]. The experiment was brilliantly successful, and the assumption of N.I. Dolgopolov turned out to be true; now the Tula city park bears the name of P.P. Belousov.

The method of eradicating landfills by putting clean soil over solid waste became widespread later, during the Soviet era. In 1937, it was approved and recommended for use at the All-Union Conference on the city cleaning in Leningrad. At the suggestion of the doctor of medical sciences V.A. Gorbov, it was then named *the method of improved landfills* [6, p. 6].

#### **The role of P.P. Belousov in the development of sewerage in Tula and the arrangement of sewage fields**

“On the Current Situation and the Immediate Tasks for the Sewage of Russian Cities” was the theme of P.P. Belousov’s Ph.D. research. In assuming the position of a sanitary physician at the suggestion of the Board in 1889, he retained the right to annually take a two-month leave for laboratory research in Moscow and Saint Petersburg.

In the autumn of 1889, P.P. Belousov first visited Professor S.V. Shidlovsky in Saint Petersburg, and then the laboratory of the Hygienic Institute in Moscow. The laboratory was led by Professor F.F. Erisman,<sup>16</sup> who became P.P. Belousov’s supervisor – an enlightened and loving man, a true mentor, whom P.P. Belousov called “the highly respected teacher” [5, p. XV].

The respect was mutual. In the laboratory of the Hygienic Institute, where P.P. Belousov carried out analyses of the soil from the sewage fields, he enjoyed the companionship of both Professor F.F. Erisman and employees, some of whom became his friends. In particular, M.B. Blauberg, “Master of Pharmacy, who served

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<sup>16</sup> Erisman Fyodor Fyodorovich (1842–1915) – Russian-Swiss doctor of hygiene, the founder of social-hygiene medicine, who formulated the foundational principles of public hygiene. From 1882, he was a professor of the department of hygiene of Moscow University, which was in 1890 transformed into an institute of hygiene; in 1927 the institute changed its name to “Moscow F.F. Erisman Institute of Hygiene”.

at the Sanitary Station at the Hygienic Institute of Moscow University”, worked with P.P. Belousov for five years. It was to him that Peter Petrovitch was indebted for studying analytical methods for soil research [5, p. XVI]. M.B. Blauberg wrote that every visit of P.P. Belousov to the laboratory was a kind of celebration for the employees: “...The whole laboratory *in corpore* loved him; he was not a ‘man of the world’, and people who did not know him closely considered P.P. Belousov to be harsh, but those who could get to know him appreciated his rare kindness and modesty” [10, p. 810].

However, P.P. Belousov had many ill-wishers. He possessed inherent integrity: he often sacrificed personal interests and was never shy at expressing what he considered to be fair. According to the memoirs of contemporaries, P.P. Belousov “did not obey the rules that are dictated by dry decency when those went against the truth. And this truth he sought in the scientific questions that were involuntarily suggested in his practical activities as the sanitary doctor of a provincial city. He was one of those indefatigable and honest workers who, without superfluous words, try to introduce the principles of scientific hygiene in practical life for the benefit of their fellow citizens, one of those who finds the highest moral satisfaction in the work itself.” P.P. Belousov was particularly scrupulous in matters of professional ethics. As M.B. Blauberg<sup>17</sup> would note, if all doctors acted like him, then “the question of medical ethics, so frequently aired abroad and here, could be considered idle” [10, p. 811]. P.P. Belousov chose the theme of his scientific research himself; it was one of the primary sanitary measures for Tula. “In articles and some documents of P.P. Belousov for the congresses of the Society of Tula Physicians, there was already an outline of a plan for a program of his future substantial work for the thesis” [5, p. III] (Fig. 3). Results of research phases P.P. Belousov regularly presented, for example, in the form of reports at the 4th and 5th congresses in memory of N.I. Pirogov, include “Sanitary organization and its tasks in Tula” and “On the issue of removing

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<sup>17</sup> Blauberg Magnus Bogdanovich (1866–1921) – pharmacologist, Master of Pharmacy, Doctor of Medicine and Surgery. From 1884 to 1886 he worked as a doctor in Tula province and from 1886 until 1888 and then later from 1891 to 1895 he studied at Moscow University.



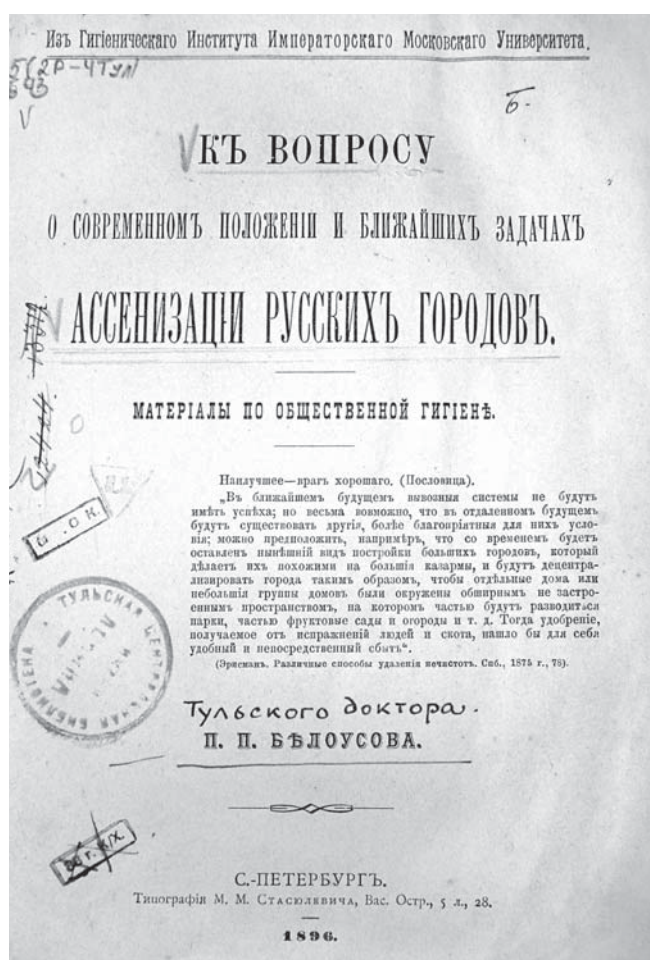


Fig. 3. Title page of P.P. Belousov's thesis. *Fund of GUK TOWNB.*<sup>18 19</sup>

<sup>18</sup> P.P. Belousov's dissertation published in Saint Petersburg in 1896 after the author's death; censor's approval of 25th of September 1896 with a memorial essay on P.P. Belousov authored by his colleagues M. Kholevinskaya and N. Dolgopolova on seven additional pages.

<sup>19</sup> *Text on the picture:*

On the current situation and the most important problems of the sanitation of Russian cities. Materials on public hygiene by a Tula doctor, P.P. Belousov. Saint Petersburg, M.M. Satsyulevich printing house, Vassilievskiy island, 5th line, 28.

Epigraph: "The best is the enemy of the good" (a proverb). In the nearest future the export sanitation systems will not be a success, but it is entirely possible that in the far future the conditions will be more favorable to them. It is possible to assume, for example, that in due time the current plan of large cities, that make them look like the casernes, will be abandoned and the cities will be de-centralized in such a way that individual houses or the groups thereof will be surrounded by large undeveloped areas, partially used for parks, fruit and vegetable gardens and so on. In the latter case the fertilizers derived from human and animal excrements would have found an appropriate and immediate use" (Erisman, Different ways of getting rid of the sewage. Saint Petersburg, 1875, 78).

and neutralizing urban sewage", as well as in the periodical medical press "On the issue of cleaning urban sewage" (Sanitary Specialties, 1891). In early 1893, P.P. Belousov went on a foreign trip to study the systems and methods of sewage in European cities, and in 1895, when the analytical part of the work was completed, "without abandoning the active current affairs around the city," he began to generalize the material and write the dissertation [5, p. III].

The goals of the research were determined thanks to P.P. Belousov's special interest in this subject [5, p. 9]. At that time, the theoretical development of the issues of sewage collection did not correspond to their practical solution, and the real situation in the sphere of sewage in Russian cities was characterized (with a few exceptions, as P.P. Belousov points out) as "dreary", "terribly out of hand", "the same as dozens or more years ago, or even worse" – because of the growing "density of urban settlements".

P.P. Belousov did not consider it an exaggeration to say that "the majority of Russian cities are latrines in almost all of their entirety". During that period, in apartments and on the streets, people often breathed air infested by evaporations of midden pits and used water, even for drinking, that was mixed with the feces of people and animals. The soil in the manors and under the houses was oversaturated with products of incomplete sewage decay. The consequences of these conditions are obvious; therefore, P.P. Belousov did not consider it necessary to cover them. It was necessary to state that the situation was already extremely unfavorable, although the theoretical side of this issue had been thoroughly developed [5, pp. 9–11] during the previous decades both in the West and in Russia.

P.P. Belousov raised a new question: why were the city departments not applying the developed and undeniable conclusions of hygiene and sanitary techniques? The main reason, in his opinion, was that the best method of urban sewage disposal at that time – sewerage with irrigation fields to dispose of sewage fluids – was "too expensive, hopelessly expensive for the vast majority of cities".

He noted: "For a long time, the removal systems will continue to predominate as a

necessity. However, strict implementation of all the hygiene requirements developed for them makes their (removal systems) operation even more expensive (!) than that of a correctly arranged sewage system. The consequence of this is precisely that terrible situation observed everywhere where export systems are used: a minimum of 0.9 of the amount of sewage produced by the population remains in place ...from year to year, accumulating and worsening the sanitary condition of settlements” [5, p. 12].

Characterizing this provision as a “vicious circle”, P.P. Belousov was simultaneously convinced that, compared to Western European cities, Russian cities had a distinct advantage – “thanks to extremely favorable conditions of their location”. The main goal of P.P. Belousov’s work became the search (on the basis of a detailed analysis of the existing situation) for the most expedient way of removing and neutralizing sewage, which would be permissible for hygienic requirements and at the same time available to the majority of the population [5, p. 13].

In his study, P.P. Belousov divided the waste to be removed from the cities into five groups: “eruptions” of people and animals, household sewage, street rubbish, used industrial (factory and plant) water, and sewage from streets and estates washed off by surface waters [5, p. 2].

Based on the information of the local sanitary commission, P.P. Belousov cited quantitative data on the waste produced by Tula. For the city, which occupied an area of 1,472 dessiatines 803 sazhens (about 1608.6 hectares), with a population of 85,624 people according to the census of November 29, 1891 [11], the annual number of “dense eruptions” was 171,550 poods (2,809,989 kg) and of urine 2,286,455 poods (37,452,133 kg). The amount of sewage produced by livestock was as follows: horses – 13,536,000 kg of “dense eruptions” and 2,707,200 kg of urine; cows – 14,250,000 kg of “dense eruptions” (excluding litter) and 4,389,000 kg of urine [5, p. 6]. For urban slaughterhouses, from the slaughter of 1,382 head of large and 9,465 head of small (according to the information for 1893) cattle per year, the total annual amount of garbage (paunch manure<sup>20</sup>) amounted to 75,000 poods (1,228,500 kg). At the slaughterhouses, another

kind of waste was blood. Despite the fact that most of it was collected for processing at the albumin plant, the waste made up 87,953 kg (with the total amount of blood from slaughtered cattle being 351,743 kg) [5, p. 7].

The amount of waste water from enterprises per year was as follows: Tula’s tanneries contributed 36,781 barrels (18,094,781 liters); the city’s six dyeing factories 516.5 barrels (254,097.34 liters, of which 118,070.4 liters were taken out of the city, 40,586.7 liters descended into the river Upa, and 95,440.24 liters were absorbed by the soil). The laundry facilities generated 1,170.5 barrels (575,839.18 liters, of which 168,988.26 liters were exported, and 406,851 liters were absorbed by the soil and drained through the city ditches). In the baths, the annual yield was 4,421,957 buckets (54,385,649.1 liters), most of which was drained straight into the river Upa, and 6,000 buckets (73,794 liters) into the river Tulitza [5, p. 11]. From the factories (breweries, cartridge, soap, and raw material producers), the most significant amount of waste water was produced by the munitions factory – 20,000 buckets (122,990 liters) per day. The sugar refinery consumed up to 200,000 buckets (1,229,900 liters) per day for supplying the steam boilers, washing the molds, preparing syrups, and most of it – up to 140,000 buckets – for vacuum condensing apparatuses. This water from the river Upa “[went] back into the river almost uncontaminated...” [5, pp. 8–9].

While measuring the total amount of sewage coming from different Tula enterprises, P.P. Belousov at the same time called for classifying it on the basis of chemical composition and assessing its contribution to the pollution of the urban environment in accordance with the classification.

Arguing about the goals of sewage disposal from the standpoint of contemporary hygienic requirements, P.P. Belousov pointed out that it was also necessary to take into account the economic and agricultural aspects of the problem [5, p. 22]. He classified as natural factors for decomposition and neutralization of sewage water air, soil, light, wind; which, on the one hand, act as physical factors, and on the other create certain conditions for the life of microorganisms that destroy waste. He noted that to certain bacteria, “judging by the latest research, belongs the primary role in the processes of destruction of waste.” When

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<sup>20</sup> The paunch contents of the slaughtered animals.

developing the section “Microorganisms”, P.P. Belousov referred to the work of a number of researchers.<sup>21</sup>

Among the existing methods for decontamination of impurities, P.P. Belousov emphasized the chemical method (milk of lime, alum cake, silicic acid, magnesium compounds, manganese chloride, zinc), the preparation of fermented manure and dry sewage powders<sup>22</sup> for the fertilizing purposes, and the filtering of urine [5, pp. 51–54]. Of the physical methods of decontamination of impurities (sewage channels), the most developed at the end of the 19th century should be considered the filtration of sewage through the soil and irrigation of the fields with it (the best results were achieved by combining these methods).

All existing systems of sewage can be classified in one of three groups: sewerage, export systems (“representing an extreme diversity”), and incineration of waste [5, p. 62].

The available information on the most common ways of removing and neutralizing sewage in Russian cities Belousov calls “vague, fragmentary, printed from time to time in the reports of the Medical Department, and in the form of scattered short notes on the state of affairs in this or that place.” Detailed and systematic data he could not find. P.P. Belousov sought to fill this gap by compiling, based upon the information collected in 1892 by medical inspectors and sanitary doctors, a detailed review of the methods of sewage treatment practiced in the 60 largest Russian cities, including Tula [5, pp. 78–79].

The material on the current state of affairs collected by P.P. Belousov concerning sewage disposal in Russian cities includes surveys of the organization, production, and characterization of export locations, and also on the methods.

In terms of the organization of sewerage works, all the cities can be divided into three groups, of which the first group included cities where a correct sewer drainage system was present such as Yalta, the second comprised the cities where a sewage system was in place but only in the central

part and from the remaining areas waste was removed through export (Odessa, Warsaw, Kiev). The third and largest group included Moscow, Saint Petersburg, Tambov, Voronezh, Kursk, and other cities where sewage was only present in individual institutions, and mostly impurities were exported “with greater or less attention.”

Sewerage cleaning was performed in a “tidier manner” in those cities where the cleaning of latrines and cesspits was carried out pneumatically, with pumps, and the contents were exported in sealed drums; this method was applied in Tver, Moscow, Mogilev (the provincial one), Minsk, Hapsal, Yuryevo, Grodno, Warsaw, Lublin, Tambov, Poltava, Zhitomir, Ekaterinoslav, Elisavetgrad, Odessa, and Astrakhan, in total in 16 of the 60 examined. In 14 of the other cities — among them Kaluga, Ryazan, Riga, Vilnius, Kishinev, Sevastopol, Taganrog, Rostov-on-Don, and Kerch — the removal was carried out in sealed and simple barrels, and the filling was conducted with scoops. In some cities — Arkhangelsk, Vologda, Novgorod, Vyatka, Ufa, Rostov-Yaroslavsky, Pskov, Yelets, Berdichev, and Yevpatoria — the export was conducted solely in simple barrels, and in winter in open boxes. In other cities, for example in Saint Petersburg and Kalisz, part of the sewage was rafted into city drains and street ditches. In addition, P.P. Belousov emphasized a “long list of cities” in which the removal of waste was an exception rather than a rule; these were the county towns, primarily in the southwestern province, and Jewish settlements.

A great variety was observed in the equipment of places in which the sewage was removed. For example, Yalta dumped its waste into the sea, and in part the issue was solved similarly in Saint Petersburg, Kerch, and Sevastopol. But most commonly all of the sewage was exported to landfills, less often to fields. Waste was dumped in the rivers in Warsaw, and to some extent in Nizhny Novgorod, Kazan, and Lodz (during high water). A number of cities did not have designated landfills. Landfills, where they existed, were normally located at a distance of 0.5–1 verst, less often 1–3 versts from the city premises. For example, Arkhangelsk, Vologda, Kostroma, Ufa, Kazan (except for the period of high water), and Samara (only 18 of the 60 cities surveyed) exclusively used landfill sites.

<sup>21</sup> P.P. Belousov lists the following researchers: Koch, Fodor, Frankel, Pasteur, Soyka, Nikolaier, Tryde Grancher, Deschemps, Karlinski, Naegeli, Hoffman, Klementyev [5, p. 25].

<sup>22</sup> Sewage powder is an organic fertilizer made of dried and powdered human excrements.

When describing the cities, P.P. Belousov noted that in Pskov, for example, “with this state of affairs, it will never reach the point of sewage accumulation” [5, pp. 116–117]: local peasants took the waste in simple barrels into the fields 5–6 versts from the city. There was no specific trade for “sewage workers”; however, the grain-growers from the city sought to utilize all the urban sewage as much as possible. P.P. Belousov added that the Pskov people “[tried] to outrun each other in this by stealing clients from one another, i.e. the houses from which the waste [was] taken” [5, p. 117]. The method of removing sewage into the fields he called “an instructive fact that should be used as an example”. Besides Pskov, this method was practiced in the Western cities along Vistula River “that [did] not know of the terrible inconveniences from their waste, exported outside the border”. These cities included Suwalki, Zhitomir, Vilnius, Grodno, Lublin, Lomza, Warsaw, Piotrków, Kalisz, Kielce, and Lodz, altogether 12 large settlements.

In his study, P.P. Belousov provided a plan for the experimental part of the work, its immediate goals; he outlined the results of comparative determinations of the chemical composition of soil and water samples. In his dissertation, he also offered an arrangement of various methods of sewage disposal for those settlements that for one reason or another were unable to use the correct sewage system.

When speaking of Tula, P.P. Belousov stressed that, as a rule, no measures with the purpose of decontamination of sewage and its most rapid mineralization were undertaken there. He saw the reason for this in the “highest, purely philosophical indifference: the existing state of affairs is usually regarded as an inevitable evil, almost an elemental force of nature, against which all human actions seem to be powerless, and therefore useless” [5, p. 135]. He was sure that practically everywhere there is an open question about how, with the economic conditions typical for most cities and the existing export system, to clean up sewage, eliminating harmful influences but not burdening the city with unbearable expenses. Proof of the great indifference to this issue of both public organizations and administrative departments Belousov believed to be the fact that in Tula until the end of the 1870s this question was practically ignored. “Only the

ghost of the Vetlian plague in 1879 made the City Assembly think of it, but the latter’s concerns in resolving such a serious and difficult issue did not go beyond the publication of the mandatory decrees by the local Duma on February 20, 1879, paragraph 6 of which stated that ‘a dump of waste should be conducted in the places indicated by the city’” [5, p. 135]. The expression “the city was suffocating from its own sewage scattered around it” was not an exaggeration.

Formed in 1887 under the city council, the Sanitary Commission in 1888 and 1889 devoted a significant amount of time to the problem of waste collection, and made a number of proposals [5, p. 137] to bring the places of sewage disposal into a “more harmless and decent condition”. However, none of them were implemented. By the end of summer 1889, the commission ordered P.P. Belousov to draw up a draft of the “most satisfactory” method of waste removal.

After studying the “methods of detoxification of wastes developed by science and giving satisfactory results”, P.P. Belousov excluded sewerage with irrigation fields, preparation of fertilizer crops and incineration, “because of doubts about the appropriateness of these methods and their high cost for Tula”. He saw “the only way to get rid of the stench and other inconveniences” as being in the land (soil), “which we have enough and which, moreover, remains forgotten and is not utilized in any way” [5, pp. 137–138].

P.P. Belousov calculated the ratio of different soil varieties to the sewage necessary to achieve complete deodorization. It turned out that for cleaning out half of the city’s sewage during the summer, 10 dessiatines (about 11 hectares) of previously plowed and finely sifted land were sufficient. It was assumed that the cleaning would be reduced to the correct (that is, in a certain order) laying of sewage on previously well-developed soil with subsequent smelting [5, p. 137].

At a meeting of the Sanitary Commission held on April 25, 1890, P.P. Belousov’s note was considered, which concerned getting the place of the Tula city dump of sewage into a “more sanitary condition”. After a detailed discussion, the commission made a number of conclusions [5, p. 139] concerning measures for early clearance (mineralization) and deodorization. The previously practiced method of waste removal

into deep pits was deemed ineffective. The method of processing it into sewage powder was not considered by the commission as recommendable to the city council due to its high cost. The “soil” method of waste management was recommended as expedient and requiring low costs due to the soil’s ability to decompose organic matter, and to absorb intermediate products of decomposition of impurities (for dry soil), for example “usually foul odor gases” like  $\text{NH}_3$  and  $\text{SH}_2$  [5, p. 140]. The commission also pointed out the need “for the proper and successful conduct of the project” to fulfill two conditions: the exported sewage should be laid out in a certain order, and be plowed and harrowed within no more than one day.

Special attention should be paid to the Sanitary Commission’s recommendation to the city council to seal an agreement on the exploitation of the relevant part of land with a private entrepreneur, so that he observed the conditions for cleaning sewage. In the places of the proposed landfill, the land (up to 30 acres), which did not bring any income to the city, was used as a pasture for livestock and was “extremely befouled”. The economic side of the issue (that is, the terms of the lease) was left to the discretion of the city Duma. On May 4, 1890, the administration submitted to the Sanitary Commission a project on this issue. The Duma instructed the city council, together with the Sanitary Commission, to elaborate the details of its practical implementation. At the suggestion of the city head, F. Gillenschmidt, part of the urban pasture was supposed to be leased to the landowners of the Tula region (*uezd*), some of them being residents of the city, and others peasants of the village of Volokhovo. At the meeting with members of the city council, F. Gillenschmidt also raised the matter of cleaning the sewage system with “the efforts of the Council itself”, but this proposal was categorically rejected [5, p. 140].

The following lease terms were proposed [5, p. 141]. The tenant was to lease 30 dessiatines, 10 of which were to be used for the sewage exported from the city and 20 for growing “any spring grains and phleum along with clover, or in autumn – the winter crops”. The next spring, these grasses were to be sown, and the tenant had the right to use the dessiatines planted with the grass for spring crops for four years, or for winter crops for three years. After the specified period,

the land was to be returned to the possession of the city. The next year the entrepreneur was to receive 10 dessiatines for personal usage, which during that summer would serve for cleaning out the sewage. For the drainage new 10 dessiatines were to be assigned, in a year also returning to the disposal of the entrepreneur. Thus, every year the entrepreneur was to receive 10 dessiatines for personal use. Each tenant was to use the site for five years, four of which were to be used for harvesting (meadow grass or grain). After the expiry of the term, each site was to return to the city’s jurisdiction for the pasture of livestock.

From the tenant the city council demanded that a number of conditions be met. The waste was to be sown to the depth of at least 4 vershoks<sup>23</sup> (18 cm), and 50 trees of different varieties were to be planted on each of the dessiatines to shade the leased land. In addition, the tenant was entrusted with monitoring the process of “laying out” the sewage on the fields, and the timing of their plowing.

However, the potential tenants, having familiarized themselves with the conditions, found them unprofitable. Nobody was ready to immediately pay the city for the proposed land (they offered as an option payment according to its “profits and yields” later, once the land was developed). The peasants refused to produce a plow for 4 vershoks (it is possible to plow with a sokha only for 2–3 vershoks – 9–14 cm) or to shade the fields. Only one landowner laid down counterclaims on which he could undertake the obligations proposed by the administrative committee on removing the urban sewage [5, p. 142]. His proposal included 11 points [5, pp. 141–142]. These terms were accepted by the members of the joint meeting of the city council and the Sanitary Commission, and there was also issued a resolution asking the board to make a contract with this landowner and to provide him with the land in question.

In reality, the tenant had already, at the initial stage, violated the previously stated conditions [5, p. 144]. The most economically significant violation was that the piece of land that was supposed to be leased was not leveled – it was hummocky, with pits, which contradicted the

<sup>23</sup> Vershok is a unit of length corresponding to the length of an index finger phalanx.

agreement. The soil was being plowed to a depth of only two *vershoks*. Sowing of waste was not carried out in time. For plowing, an area of pasture was allocated in close proximity to the city, behind Kiev street,<sup>24</sup> which was not supposed to be leased.

After the Sanitary Commission informed the city council of the violations, the tenant was given a warning. However, in response to the request to comply with the conditions, he refused to continue the lease. As a result, control over the correct laying of sewage ceased, and the landfill sites became worse than before the beginning of the experiment. An inspection by the Sanitary Commission [5, p. 145] revealed other violations: the tenant had not adhered to the specific areas, the plowing had been done haphazardly, and the waste removal (sanitation) workers, who had removed the sewage, had been spreading it randomly throughout the whole designated space, not only on the plowed land. Nevertheless, when inspecting that part of the field where the sewage was removed and plowed, the site “was found in a perfectly satisfactory state as there was no smell”. Therefore, the commission came to the conclusion that the proposed method of removing sewage, if properly conducted, achieved the set goal. At the meeting of September 15, 1890, the Sanitary Commission called for the further introduction of this method of sewage cleaning and made a number of decisions, while taking into account the errors identified [5, pp. 145–146]. In particular, it was suggested that the city and *Zemsky* police be enlisted to monitor the sewer workers.

By the end of the winter of 1890–1891 the city council appealed again to private parties and rural communities to arrange the plowing of sewage. However, no one responded to the invitation of the administrative board to familiarize themselves with the terms of the lease. The proposal to involve in this activity the city prison, which possessed free labor forces, did not receive support from the prison administration. For these reasons, the only possible option was chosen at the joint meeting of the administrative board and the Sanitary Commission: to entrust the cleaning of the sewage to the city council itself, which, for that purpose,

should hire peasants and make up an estimation table [5, p. 146].

At the same time, “the conduct of the Council itself was also a very serious inconvenience”. The success was the contract signed by the administrative board with two entrepreneurs (farmers). The condition of compulsory shading of the leased pasture through planting trees was excluded from it. At the same time, the entrepreneur was given the right to use the land (i.e. to sow it) at his own discretion, and the lease period was increased to six years. To ensure “the correct conduct of business”, it was stipulated that in the event of poor and negligent performance of the obligations taken (to clean up the sewage), the tenant was to be deprived of both the lease rights and the area sown in the given year.

On April 8, 1891, the proper cleaning of sewage in a specially prepared area and the process of neat sowing commenced.

The issue of cleaning the urban sewage in Tula P.P. Belousov summed up as being “resolved satisfactorily in a general sense” [5, p. 147]. However, he believed that some organizational improvements were necessary. In particular, in his opinion, the city’s lack of control was unacceptable, both in the fulfillment of the contract terms, and in the activity of the sewage collectors taking out the waste. In this regard, the Sanitary Commission asked the Tula police chief to move the post of a city policeman to partially monitor the movement of the sewers. The post was transferred, but the sewer workers began to use the one pathway going through the less controlled outskirts of the city. Another miscalculation in the organization of sewage cleanup (in the winter period) were judicial penalties for “improper dumping of waste”. Instead of becoming a preventive measure, fines through the court of 50 kopecks became “an encouragement for further violations” (upon paying 50 kopecks, one could dump waste near the city limits). Thus, a breach of obligations on the part of the tenants of sewage fields was a common occurrence [5, p. 148]; the most common among them remained shallow preliminary plowing, careless plowing, or the complete absence of plowing [5, p. 148].

Despite these significant shortcomings, it was probably clear to the city that the setup of sanitation fields was favorable, since in 1892 the city council decided to remove the “sewage-purposed” pit in

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<sup>24</sup> Kievskaya street was the central street of Tula; now it bears the name of Lenin Avenue.

the Third City Section, replacing it with a part of the city pasture leased to the peasant Belov. Additions to the contract with the new tenant were items about the deposit of 300 rubles, and those about the right of the office, in the event of poor performance, to compensate for the costs of hiring workers for the repeated process from the amount of the deposit [5, p. 148]. In 1894, new contracts were concluded with the philistine Chernopyatov for the Fourth City Section [5, p. 149].

In 1895, the last area of pasture, reserved in 1890, was filled up [5, p. 150]. By this time, the first used area, which was fertilized in 1890, became a good pasture for cattle.<sup>25</sup>

At a joint meeting of the city council and the Sanitary Commission, conditions were developed for leasing new areas of pasture; they included 13 sections developed to take into account the five-year cycle and addressed the shortcomings of previously concluded contracts “for practical purposes, so that in other places where it would be desirable to arrange sewage fields, the mistakes we have made are not repeated” [5, pp. 150–153].

P.P. Belousov noted that the construction of sewage fields in Tula provoked conflicting opinions. Some considered this measure costly and unprofitable for the city, since the area of urban pastures had become significantly reduced. In addition, from the free-of-charge leasing of the fields the city did not receive any obvious profits. Others, pointing out that the leased land was “completely fruitless”, considered this option beneficial to the city, since without any cost and in a relatively short time the city had received a good pasture. From a sanitary point of view, opinions also differed: the residents of the outlying areas were satisfied with the decision, as they were interested in destroying landfills more than others. However, some parts of the population pointed to a number of unsolvable problems including lack of control over exports and careless cleaning of sewage by tenants. The latter served as an argument against the expediency of sewage field setup [5, p. 153].

Thus, during the meeting of the Sanitary and Executive Commission on June 23, 1895,

when analyzing “the question of urban sewage stalling because of the lack of proper supervision over the work and movement of sewage workers”, one of the members of the commission, a prominent representative of Tula medicine at the end of the 19th century, the city physician F.S. Arkhangelsky, expressed doubt in the expediency of the adopted method of plowing the sewage. He noted that, despite almost five years of conducting the experiment, at nearly every meeting of the Sanitary Commission statements were made on the unsatisfactory condition of the landfill sites. “Spreading of sewage within the area”, according to F.S. Arkhangelsky, would have been better than plowing. The sanitary doctor in this regard stated that “the problem is the lack of control” [9, p. 18]. However, the control was not always poor. Archive documents indicate an opposite state of affairs. For example, the city head, Mossin, who was “very conscientiously fulfilling his duties in supervision of sewage workers”, was given a reward of 20 rubles.

P.P. Belousov acted as a disciple and a successor of the work of F.F. Erisman. In the last third of the 19th century, the sanitation issues of cleaning cities, neutralizing water, or removing sewage had not been resolved in Russia, in Western Europe, or in the United States. The transition to regular and planned waste disposal had only just begun, as had the massive construction of sewage systems.

The significance of P.P. Belousov’s work is his theoretical proof, explaining the process of decomposition of organic substances that make up the sewage in the soil and their transformation into nitrites and nitrates available for digestion by plants, and most importantly in his practical proof of the actual utilization of the proposed method by constructing sewage fields [6].

P.P. Belousov’s work was created before it had been proved that the decomposition of organic substances in soil occurs as a result of the life activities of microorganisms along with a synthesis of organic substances is carried out that yields soil fertility.

One can speak of the beginning of the formation of the microbiological branch in hygiene and epidemiology only by the last third of the 19th century, which is why the work of P.P. Belousov is of such high importance [6].

<sup>25</sup> In the appendix to his study P.P. Belousov provided a map of the sewage fields of Tula and diagrams of the soil measurements.

## Conclusion

P.P. Belousov is the most famous representative of medicine in Tula from the late 19th century to the present day. Among the results of his activities as a sanitary doctor are the organization of the park at the site of a municipal landfill, the optimization of plumbing, and the creation of sewage fields.

Alongside with the extremely important issues that require solutions and control, such as the sanitary inspection of important social institutions (schools, baths, monasteries), the proper arrangement of the city (street paving, draining of marshes, laying of gutters), P.P. Belousov developed, implemented, and managed to generalize the results of the construction of the sewage fields in Tula. It was P.P. Belousov who collected information on the cleaning of Russian cities from sewage at the end of the 19th century. On the basis of the data obtained from medical inspectors and sanitary doctors during 1892, he created a detailed survey of the methods and applications of sewage treatments practiced at that time in the 60 largest Russian cities.

P.P. Belousov lived for 40 years (he died on August 2, 1896); for seven of them he worked as a sanitary physician of the city of Tula (Fig. 4). On April 13, 1896, he defended his thesis "On the Current Situation and the Immediate Goals of the Sanitation of Russian Cities", already being seriously ill [5, pp. IV, V]. Professor F.F. Erisman noted that P.P. Belousov "worked in the provinces under the conditions far from favorable, independently determined the topic of his dissertation research, and contributed with his labor to explaining such an important issue as the sanitation of cities" [5].

P.P. Belousov's work on the removal of urban waste via the utilisation of sewage fields, which was created on the basis of scientific developments, was of great practical importance [12]. It was an attempt to improve the sanitary condition of the city in a rational, economically advantageous, easily accessible manner. P.P. Belousov believed that it is not worth investing heavily in innovation, if the



**Fig.4.** The house where P.P. Belousov lived (Tula, 36 Pirogova St.). *From the author's personal archive.*

existing system is capable of being effective and useful. However, his ideas were oriented not toward the "unconscious" present, but to a conscious, distant future. This is evidenced by a quotation from the work of F.F. Erisman "Different ways of removing sewage" (1875) that P.P. Belousov used: "In the near future export systems will not be successful, but it is quite possible that in the distant future there will be other, more favorable conditions for them. It can be assumed, for example, that in time the present kind of construction for large cities, which makes them look like large barracks, will be abandoned, and the cities will be decentralized in such a way that individual houses or small groups of houses are surrounded by a vast undeveloped space. In them part will be designated to parks, part to orchards and gardens, etc. Then the fertilizer, obtained from the excrement of people and livestock, would find a convenient and immediate use" [5, p. II].

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## REFERENCES

1. 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(2): 83–95. (in Russian)
2. Arkhangel'skiy F.S. *Doklad Tul'skomu Komitetu Popechitel'stva o narodnoy trezvosti: o zhelatel'nosti ustroystva v gorode Tule sredstvami Komiteta "Priyuta dlya op'yanevshikh"* [Report to the Tula's Committee of National Sobriety Fund: On the desirability of establishing a "shelter for the drunk" in Tula, using the funds of the Committee]. In: *Otchet za 1904 god Priyuta dlya op'yanevshikh v gorode Tula*. Tula: Tipografiya Gubernskogo pravleniya, 1905. 84 p. (in Russian)
3. 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)
4. *Otchet o deyatelnosti Obshchestva tul'skikh vrachey za 1894–95 gg. Svklyucheniem otcheta gorodskoy lechebnitsy Obshchestva tul'skikh vrachey za 1894 gg. Posvyahshaetsya pamyati chlena-uchreditelya V.I. Smidovicha* [Report on the Tula Doctors' Society's work in 1894–1895. The report of the Tula Doctors' Society's city hospital for 1894 included. In memory of a member and founder V.I. Smidovich]. Tula: Tipografiya E.I. Druzhininoy, 1895. P. 13. (in Russian)
5. *K voprosu o sovremennom polozhenii i blizhayshikh zadachakh assenizatsii russkikh gorodov* [On the issue of today's condition and immediate tasks of the sanitation in Russian cities]. In: *Public Health and Sanitation Herald*. The materials on public hygiene compiled by P.P. Belousov, a doctor from Tula. Saint-Petersburg: Tipografiya M.M. Stasyulevicha, 1896. 222 p. (in Russian)
6. Rassdnev S.A. *Zdravstvuyte, Petr Petrovich! Ocherk o sanitarnom vrache P.P. Belousove* [Hello, Petr Petrovich! Sketch about the sanitation doctor Petr Belousov]. Tula, 1975. 48 p. (in Russian)
7. *Polnoe sobranie zakonov Rossiyskoy Imperii* [Complete collection of laws of the Russian Empire]. Saint Petersburg: 1874; coll. 2, v. 45, dep. 1, № 48498: p. 821–839. (in Russian)
8. 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]. In: *Problemy sotsial'noy gigieny, zdravookhraneniya i istorii meditsiny*. 2015; 23(2): 52–56. (in Russian)
9. *Otchet postoyannoy sanitarno-ispolnitel'noy komissii za 1895 g.* [Report of permanent sanitary and executive commission for 1895]. Tula, 1896. 48 p. (in Russian)
10. Blauberger M. *Nekrolog P.P. Belousova* [Obituary of P.P. Belousov]. In: *Zhurnal Russkogo Obshchestva Okhraneniya Narodnogo Zdrav'ya*. 1896; 9: 810–812.
11. Smidovich V.I. *Rezultaty perepisi goroda Tuly, proizvedennoy 29 noyabrya 1891 goda* [Results of the census of the Tula city carried out on November, 29 1891 year]. Tula: Tipografiya E.I. Druzhininoy, 1894. 32 p.
12. Bepalov G.A. *Tul'skaya kanalizatsiya v nachale XX v. Ot assenizatsionnykh obozov k tsentralizovannoy sisteme* [Tula sewerage at the beginning of the 20th century. From cesspool wagon trains to the centralized system]. In: *Tul'skiy kraevedcheskiy al'manakh*. 2015. 12: 41–51. (in Russian)

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