
NOTES

Western Technology and Early Russian Pipelines, 1877-1917¹

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During the Eleventh five-year plan (1981-1985), the Soviet Union has committed itself to a massive expansion of its already impressive pipeline network. The purpose of this undertaking, virtually unprecedented by its sheer scope, is to insure the rapid and cheap transport of the immense wealth of hydrocarbon fuels locked in the distant and frigid wastelands of Northwestern Siberia, to industrial and household consumers in the European USSR and beyond.² Significantly, an important objective of the plan is also to develop gas export capacity to Eastern and Western Europe.³ This programme has been based, to a very large extent, on Western equipment and technologies imported on a vast scale.⁴

These goals, and the means to achieve them, through imported supplies, are hardly novel from an historical perspective. Indeed, one hundred years or so ago, when the Russian oil industry was still in its infancy, local industrialists turned to the West for the advanced equipment and know-how they required, but were unable to obtain from domestic Russian industry, for the creation of a pipeline system, then a radically new mode of oil transport. Underlying these efforts was first of all a desire to permit the rapid transit of large quantities of oil

¹ I wish to acknowledge my gratitude to Professor Carl. H. McMillan for his many useful comments and suggestions. Of course, any errors and omissions are my sole responsibility.

² For details of the USSR's current pipeline development programme, the reader is referred to: T. Gustafson, *The Soviet Gas Campaign - Politics and Policy in Soviet Decisionmaking*, Rand Publications Series (# R-3036-AF), Rand Corporation: Santa Monica, California, 1983.

³ J.B. HANNIGAN and C.H. McMILLAN, *The Soviet-West European Energy Relationship: Implications of the Shift from Oil to Gas*, East-West Commercial Relations Series, Research Report No. 20, East-West Project, Carleton University: Ottawa, 1983.

and oil products, over long distances and at low cost, to satisfy growing demand within the Russian empire. Second, the oil industry was intent on developing its export capacity, primarily for kerosene shipments.

The theme of dependence on foreign industrial capacity and technology, for the expansion of national industries and for the enhancement of export potential, is prominent in Russian and Soviet economic history.⁵ This paper proposes to examine it in the context of the evolution of pipeline transport in Russia prior to the October Revolution, specifically in order to add an interesting historical dimension to the contemporary political and economic issue of the significance of Western technology and equipment to the development of Soviet pipeline transport and fuel exports.

The Infancy of the Russian Oil Industry

In the economically primitive Russia of the late XIXth century, the first stirrings of industrial development had begun to transform the land. As a latecomer to the industrialization process, Russia enjoyed a number of advantages, both concrete and intangible. Perhaps the most important were the ability to gain inspiration from, and follow, the example set by the pioneers of this revolution, such as Britain, Germany and the United States, and to benefit more tangibly from the fruits of their accumulated technical experience. In practical terms, this meant that Russian industry could buy the machines and hire the experts it needed, without having to retrace the long and tortuous path broken by its more technically advanced peers.⁶ This is especially evident in the Russian oil industry, and in the associated field of pipeline transport.

The development of the Russian oil industry began in earnest in the 1870s.⁷ During the XIXth Century, oil had been extracted in small quantities through-

⁴ See: Office of Technology Assessment, *Technology and Soviet Energy Availability*, Westview Press: Boulder, Colo., 1981; R.W. CAMPBELL, *Soviet Energy Technologies*, Indiana University Press: Bloomington, 1980; and R.W. CAMPBELL, *Soviet Technology Imports: The Gas Pipeline Case*, California Seminar on International Security and Foreign Policy, Discussion Paper No. 91, Rand Corporation: Santa Monica, California, February, 1981.

⁵ For a detailed analysis of the contribution of Western technology to specific Soviet (and Russian) industries, see: A. SUTTON, *Western Technology and Soviet Economic Development*, Vol. 1 (1917-1930), Vol. 2 (1930-1945), Vol. 3 (1945-1965), Hoover Institution Publications: Stanford, 1968, 1971, 1973.

⁶ The idea that latecomers to the process of industrialization are able to benefit from the experience of more technically advanced countries has been suggested by A. GERSCHENKRON, in his *Economic Backwardness in Historical Perspective — A Book of Essays*, Harvard University Press: Cambridge, 1966.

⁷ For a general account of the Russian pre-Revolutionary oil industry, the reader is referred to the work by R. TOLF, *The Russian Rockfellers*, Stanford University Press: Stanford, 1976, and to the first chapter of M.I. GOLDMAN's *The Enigma of Soviet Petroleum: Half-Empty or Half-Full?*, George Allen & Unwin Ltd.: London, 1980.

out the Russian empire, particularly in the Baku area, for use as a very crude lighting fuel, or to be peddled off as a medicine claimed to have the most formidable therapeutic properties. Some oil was also exported, mostly to Persia.

At first, this young industry operated on a very limited scale, using quite rudimentary methods of extraction. The smallness of the various operations, and their low technological levels, were as much the result of an outdated system of property rights, which actually discouraged an intensive and orderly exploitation of oil fields, as of a lack of generalized demand for oil and its products within the country and abroad. Prior to the 1870s, the exploitation of deposits was nominally the exclusive preserve of the Crown, but, practically, the right to extract oil was leased to favoured subjects for fixed periods of four years, during which time as much as possible was extracted. Once a lease expired, the holder folded his entire operation, and sought a new one upon which to exercise his entrepreneurial talents.⁸ Consequently, the very small amount of time available to a lessee actually served as a strong disincentive for him to elaborate more efficient and extensive methods of extraction. Furthermore, the lease system prevented the consolidation of oil properties, and hence the expansion of companies, which also detracted from the achievement of scale economies and efficiencies.

If demand for oil remained rather small in the primitive Russian economy, it was nevertheless increasing, at least enough, it appears, to prompt the Russian government to abolish the old order, to encourage greater oil production. Therefore, in 1872, it decided to auction its oil-bearing lands to individuals, requiring instead that they pay a fixed yearly royalty to the Treasury. Under this new arrangement, owners developed a vested interest in their holdings: because of the longer time horizon at their disposal, they were motivated to expand the scale and improve the technological level of their operations. While the transition was gradual, lasting until 1877 when the government monopoly was completely abolished, the stage was set for the very rapid and impressive expansion of the Russian oil industry.⁹

Its development, based on this new system, was centred at first primarily around the city of Baku. It quickly became a boom town, where all species of adventurers and profiteers would gravitate in search of fame, but mostly fortune. Charles Marvin, a prominent English travel diarist of the last century, described Baku as what he called a "regular stunner":

"What was ten years ago a sleepy Persian town is today a thriving city. There is more building activity visible at Baku than in any other place of the Russian Empire".¹⁰

⁸ F.F. DUNAIEV, *Ekonomika i Planirovanie Neftianoy Promysblennosti SSSR*: Moscow, 1957, p. 19. See also W.J. KELLY and T. KANO, "Crude Oil Production in the Russian Empire: 1818-1919", *The Journal of European Economic History*, Vol. 6, No. 2 (Fall 1977).

⁹ C. MARVIN, *The Region of Eternal Fire*, W.H. Allen and Co.: London, 1884, p. 209.

¹⁰ *Ibid.*, p. 160.

The number and size of oil ventures grew at a vertiginous pace, under conditions of increasing demand, stimulated by a better understanding of the properties and uses of oil. Opportunities were now boundless indeed.

Russia's First Pipelines, 1877

Quickly though, the nascent industry was faced with a major problem, that of transport: how to bring the crude from field to refinery for distillation into kerosene and other useful derivatives. At first, oil was carried by pack animals, a monopoly of local Tatar carters, from the Apsheron peninsula near Baku to refineries located in the city, over a distance of some twenty kilometres.

Such a method of transport was extremely primitive, being very expensive, time-consuming and easily disrupted by the vagaries of the weather. It slowed down operations and prevented an optimal use of refining facilities.¹¹ To ensure both a continuous flow to them and to lower transport costs, alternative methods of transport were considered. A breakthrough came in 1877, when two Swedes, the Nobel brothers, already prominent industrialists in Russia (in the production of heavy machinery and military equipment), and now well-established oil men in Baku, introduced a radically new approach to the transport of oil by building two small pipelines (120 mm in diameter and 19 km in length) from their fields to their refinery. These were the very first pipelines in Russia, and they fostered a complete revolution in the local transport of oil.¹²

As for many new ideas, opposition to the Nobels' pipelines was intense at first, both from their business rivals, and from local carters whose monopoly had been broken.¹³ But a good thing being hard to resist, the immense value of this improvement was soon appreciated by the other producers of the area, and it diffused rapidly.¹⁴ Its overwhelming advantages were crystal clear: it was much more dependable, supplying an uninterrupted flow of crude oil to the Nobel refinery, and thereby permitting its more efficient operation. It was also considerably cheaper: transport costs for one pood of oil fell from nine kopeks

¹¹ R. TOLF, *op. cit.*, p. 52.

¹² C. MARVIN, *op. cit.*, p. 217. A contemporary of Marvin's writes of the Nobels' pipelines: "In this way they laid the foundation of modern activity and enterprise at Baku": J.D. HENRY, *Baku-An Eventful History*, Archibald Constable and Co.: London, 1905, p. 112.

¹³ R. TOLF, *op. cit.*, p. 52. Carters on the Pennsylvania fields had also been violently opposed to the introduction of pipelines, often resorting to serious acts of vandalism to express their discontent. See: J.S. CLARK, *The Oil Century - From the Drake Well to the Conservation Era*, University of Oklahoma Press: Norman, 1958, p. 78. See also: V.A. NARDOVA, *Nachalo Monopolizatsia Neftianoj Promyshlennosti Rossii*, Nauka: Leningrad, 1974.

¹⁴ Between 1878 and 1885, more than 200 km of small pipes (80 mm in diameter) were laid in the Baku area: N.Z. RUBINOV, *op. cit.*, p. 23.

to one kopek, and the Nobels' investment of \$ 50,000 was repaid within one year.¹⁵

Led by the Nobels' pioneering spirit, the transport of oil underwent a dramatic change, if only on a very limited scale at first. But their efforts marked the beginning of a period the Russians came to dub the "Nobelevskii", a time of feverish technical progress in the local oil industry, inspired by the Nobels' efforts.¹⁶

Interestingly enough, the novel solution to the problem of transport adopted by the Nobels was then called the "American Plan", in recognition of the fact that pipelines had first been introduced and perfected in the oil fields of Pennsylvania in the mid-1860s, barely a decade before the Nobel lines.¹⁷ And as in many other instances in the early (and later) stages of Russia's industrialization, novel techniques and solutions to local problems were sought abroad. The Nobels, although quite inventive industrialists in their own right, were well attuned to foreign technological advances, and were always quick to seize upon the opportunities these created, by adapting foreign discoveries to the Russian environment:

"Nobel is always... introducing fresh ideas from the United States. He is the connecting link between Baku and Pennsylvania... Without going into technical particulars, Nobel Brothers' mode of working may be defined as the American system intelligently modified and adapted to the peculiarities of Baku".¹⁸

In fact, to build the pipeline, the Nobels dispatched one of their trusted employees, engineer Alexander Bary, on a mission abroad to purchase the required tubes and pumps.¹⁹ British pumps (Blake) and boilers (Tangye) were thus installed on these first Russian pipelines.²⁰ More importantly, Bary was sent to the United States, in order to study all aspects of contemporary American oil production and transport techniques. He was also instructed to hire American drillers to have them work in the Nobel operations in Baku.²¹

The Nobels' efforts, as well as those of similar-minded individuals with a penchant for innovation, eventually made the Baku oil industry as technically

¹⁵ *Neftianoe Delo*, No. 7, 15 April 1899, p. 346. *Neftianoe Delo* was the journal of the Association of Baku oil industrialists. Tolf states that prices fell from 10 kopeks to 1/2 kopeks per pood. The figure of \$ 50,000 is taken from Tolf, *op. cit.*, p. 52. One pood of oil weighs 16.37 kg, and is equivalent to about five Imperial gallons.

¹⁶ C. MARVIN, *op. cit.*, p. 213. See also I.A. D'IAKONOVA, *Nobelevskaia Korporatsia v. Rossii*, Mysl': Moscow, 1980.

¹⁷ V.A. NARDOVA, *op. cit.*, p. 61 ALSO C. MARVIN, *op. cit.*, p. 184.

¹⁸ C. MARVIN, *op. cit.*, p. 219.

¹⁹ R. TOLF, *op. cit.*, p. 52. Marvin writes however that the pipes were largely manufactured in Russia, to avoid high import duties, and in Germany: C. MARVIN, *op. cit.*, p. 206.

²⁰ C. MARVIN, *op. cit.*, p. 206. Tolf writes that Nobel designed and manufactured the pumps himself.

²¹ R. TOLF, *op. cit.*, p. 65.

advanced as any other in the world. Indeed, this process was greatly encouraged by the heavy domination of the Russian oil industry as a whole by foreign capital, especially British and French.²² With it came advanced technologies and enthusiastic entrepreneurs, who influenced greatly and worked closely with local industrialists.²³

The building of small pipelines from local fields to local refineries, although quite major advances in themselves, only served to improve the local transport of oil. As production increased rapidly, the problem of transporting oil products, namely kerosene, cheaply and in large quantities, out of the remote Baku area to markets both within and without Russia, became more and more critical. The elaboration of new shipping techniques, such as the introduction of the world's first oil tanker by the Nobels, and the construction of a railroad linking Baku to the Black Sea port of Batum (now Batumi), undertaken at great expense in 1878 by the Russian government, and at the insistence of the Nobels' chief rival, the Rothschilds of France, offered at least a temporary solution.²⁴ The railroad in particular proved to be a major improvement, since it shortened considerably the distance over which oil was shipped. The creation of an outlet on the Black Sea stimulated local output even more, as the Baku oil industry was now able to compete directly with American producers on very lucrative European markets, and to transport cheaply and quickly its oil products into the very heart of an industrializing and urbanizing Russia, by way of the Don and Dnieper rivers.²⁵

In spite of its effectiveness, the railroad was soon overburdened. Its capacity could not be readily expanded, due to the presence of a natural obstacle, the Suram Pass, at 975 m the highest point along the line. It permitted the passage of only a few tank cars at a time, thereby creating severe backlogs. This problem was partially alleviated in 1889, when a short 67 km pipeline was laid over this

²² G. JONES and C. TREBLICOCK, "Russian Industry and British Business, 1910-1930: Oil and Armaments", *Journal of European Economic History*, Vol. 11, No. 1 (Spring 1982), pp. 85-86. See also: B. GHAMBASHIDZE, *The Caucasian Petroleum Industry and its Importance for Eastern Europe and Asia*. The Anglo-Georgian Society: London, 1918.

²³ J.P. MCKAY, "Foreign Enterprise in Russian and Soviet Industry", *Business History Review*, Vol. XLVIII, No. 3 (Autumn 1974), p. 348. See also by the same author: *Pioneers for Profit: Foreign Entrepreneurship and Russian Industrialization 1885-1913*, University of Chicago Press: Chicago, 1970.

²⁴ T.H. VON LAUE, *Sergei Witte and the Industrialization of Russia*, Columbia University Press: New York, 1963, pp. 12-13, and J.D. HENRY, *op. cit.*, pp. 113-116. Marvin states however that the railroad was built essentially for military reasons: C. MARVIN, *op. cit.*, p. 119.

²⁵ See: L. PAVLOVSKY and H.G. MOULTON, *Russian Debts and Russian Reconstruction*, McGRAW-HILL Books Co.: New York, 1924.

See also: H. HASSMANN, *Oil in the Soviet Union*, Princeton University Press: Princeton, 1953, p. 31.

perplexing barrier by the government, at the Nobels' entreaty. The kerosene from Baku was still hauled by rail to the Pass, where it was pumped over through the new pipeline, collected on the other side and then loaded again onto tank cars for ongoing shipment to Batum.²⁶ Cumbersome, this minor improvement did not address the more fundamental problem that both the railroad and pipeline, even working in tandem, were of still far too limited capacity to cope with the growing kerosene export shipments out of Baku. For these reasons, a far more grandiose and technically ambitious project was envisioned: the building of a large kerosene pipeline spanning the entire distance between Baku and Batum, some 883 km.²⁷

The Baku-Batum Kerosene Pipeline

The pipeline was indeed a major engineering feat by the standards of the day. Like the railroad, the Russian government reluctantly shouldered responsibility for its construction and administration, originally hoping to obtain all of the pipe and hydraulic equipment required for the project from domestic manufacturers.²⁸ However, this proved to be impossible, given the inability of Russian industry to produce either the pumping machinery or the 200 mm tubes, the widest diameter then considered safe for transporting oil.²⁹ As a result, almost all of the technology and equipment was obtained from abroad, and specifically from the United States. American suppliers were the natural choice over all others, given their wide and unique experience in producing tubing and other pipeline supplies.

The machinery needed to manufacture the pipe was purchased in the U.S., and installed at the Nikopol' pipe mills, then the largest in Russia.³⁰ The pipe-threading technology was obtained under licence from the National Tube Work Company of Pittsburgh, and finally, the steam-powered pumps, the most critical components, were specially designed and manufactured by the American firm Worthington Pumping Engine Company, then a world leader in the

²⁶ R. TOLF, *op. cit.*, pp. 96-97.

²⁷ By comparison, the first long distance pipeline in the United States was laid in 1879. 175 km long and 150 mm in diameter, it linked the Pennsylvania oil fields to the Atlantic seaboard. Prior to 1879, no pipeline in the U.S. had been longer than 50 km: J.S. CLARK, *op. cit.*, p. 121.

²⁸ R. TOLF, *op. cit.*, pp. 96-97.

²⁹ G.S. WOLBERT, *U.S. Oil Pipelines*, American Petroleum Institute: Washington, D.C., 1979, pp. 6-15. Up until around 1930, 200 mm was apparently the largest diameter through which oil could flow at normal operating pressures. Larger pipes tended to split at the seams, forcing reductions in pressures and resulting in a loss of operational efficiency. 200 mm pipes were not used in the U.S. until the early 1900 s.

³⁰ E. Iu. PISTOL'KORS, "Truboprovody dlia Nefti v Sviazi s Voprosom ob ikh Sooruzhenii v Sovremennikh Usloviakh", *Neftianoe i Slantsevoe Khoziaistvo*, No. 4/8 (April-August 1920), p. 45.

design and manufacture of pipeline pumps, and the main supplier to Standard Oil. The 16 pumps it provided and installed were apparently of a radically new design, being completely automated.³¹

The building of the Baku-Batum pipeline proved to be long and arduous, with numerous delays the consequence of administrative and technical inexperience. Project engineers, challenged by the difficult task of coordinating the various complex stages involved in construction, often saw their efforts defeated. Because of poor planning, pipes were not ordered quickly enough to maintain a smooth work pace, nor were the various pumping stations completed by the time the expensive imported pumps were delivered, forcing them to lay about idle and vulnerable to the onslaughts of the elements.³² The factories at Nikopol' were experiencing difficulties in mastering their newly-acquired pipeline manufacturing technology. Even if it eventually improved, the quality of the first pipes was so poor that it was seriously considered at one point to set up major mending and rethreading facilities near the construction site, to avoid the hefty transport costs involved in sending defective tubes back to the factory for repairs. Even more time was lost in devising a proper way to apply protective wrapping to the pipe.³³ The line was finally completed in 1906, fifteen years after construction had begun, at a total cost of \$ 12 million.³⁴ When commissioned, it was the longest and most technologically advanced in the world, with a rated capacity of 215,000 poods of kerosene per day (or 900,000 tonnes per year) with all its sixteen pumping stations in operation.

However, economic and technological progress is often hampered by the impassioned and inefficient choices of men. In spite of the human achievement, the pipeline failed to reflect its far greater cost effectiveness compared to its closest competitor, the railroad, as a result of an arbitrary pricing policy imposed by the government. Eager to protect the revenues generated by its rail operations, the government, which also owned and operated the pipeline, charged thirteen kopeks for each pood of kerosene it carried by pipeline between Baku and Batum, versus a real cost of 1.3 kopeks, and versus 15 kopeks by rail.³⁵ Furthermore, its completion coincided with a long-term decline of the

³¹ *Nestianoe Delo*, No. 2, 30 January 1899, p. 82. Also: No. 13, 17 July 1899, pp. 610-611, and No. 3, 15 February 1900, p. 135. THOMAS SMITH, the American Consul in Moscow, wrote that "the pumping engines are the largest and most important which have ever been put to work in connection with the transportation of petroleum through pipe lines": T. SMITH, "Oil Pipe Line in Russia", *Consular Reports* (U.S. Department of State), Vol. LXIII, Nos. 236-239, May-August 1900, U.S. Government Printing Office: Washington, D.C., 1900.

³² *Nestianoe Delo*, No. 11, 17 June 1899, p. 517, and No. 2, 30 January 1899, p. 82.

³³ *Ibid.*, p. 82.

³⁴ R. TOLF, *op. cit.*, p. 97. Hassmann puts the total cost of construction at 20 million rubles: H. HASSMANN, *op. cit.*, p. 68.

³⁵ H. Hassmann, *op. cit.*, p. 31. Freight rates for kerosene were increased from 10

output of the Baku area. Production started to fall after 1901, when it had peaked at 11 million tonnes. By 1910, it had fallen to 7.8 million. In 1900, Russia had exported around 1.5 million tonnes of oil and oil products, or approximately 14% of production, yet by 1910, exports had declined to 859,000 tonnes, or 9% of total output.³⁷ But in spite of falling shipments, the Baku-Batum line had made European markets that much more accessible.

The significance of this major advance in transport was not lost: soon thereafter, the Russian pipeline network expanded rapidly, with routes being added to provide an outlet to the quickly rising output of major new fields in the Groznyi, Maykop and Emba districts. Although detailed information is sparse, it appears that imports of Western pipeline equipment continued to play a direct role in these smaller projects, but to a lesser extent than for the Baku-Batum pipeline. The technologies imported from the U.S. for the manufacture and threading of pipes may very well have served on the other pipeline projects. The most advanced equipment, the pumps, probably continued to be imported.³⁸

Up until 1917, a great number of more grandiose pipeline schemes were also being considered, but they were interrupted by the outbreak of war and revolution. In 1917, the Russian pipeline network stretched out over 1,400 km. (See Table 1).

Russia's systematic use of Western technology and other inputs for the betterment of its oil sector, and for the expansion of its pipeline system, was to continue well after the industry was nationalized by the Bolsheviks, and after the nation had engaged itself on the path of rapid industrialization. During the 1920s, major export lines were laid from the Baku and Groznyi oil districts to the Black Sea, specifically to enable a higher level of exports to the West, to earn hard currency to pay for large-scale and comprehensive imports of plant, machinery and know-how. By and large, the very same motives are now prompting Soviet decision-makers to purchase Western pipeline supplies on a vast scale: the desire to achieve high levels of technical efficiency and reliability, and capacity, in pipeline transport, and also to enhance hard currency earning potential through exports of oil, and especially natural gas.

In the pre-Revolutionary years, the example of the West served to inspire the efforts of Russian industrialists in the oil sector, and the import of advanced

kopeks per pood to 16 kopeks in 1900: *Neftianoe Deloe*, No. 21, 16 november 1899, p. 1089.

³⁶ W. J. KELLY and T. KANO, op. cit., p. 322.

³⁷ 1900 export figures are from B. GHABASHIDZE, op. cit., p. 19, and 1910 figures are from H. HASSMANN, op. cit. p. 32.

³⁸ It was reported in 1920 that a number of British pumps had been ordered for the Groznyi-Petrovsk Port pipeline prior to the Revolution, and that these were now in storage in Constantinople awaiting further shipping instructions: L. A. LAZERSON, "K Voprosu o Vyboe Napravlenia i Poriadke Osushchestvenia Novogo Groznenskogo Nefteprovoda", *Neftianoe i Slantsevoe Khoziaistvo*, Nos. 9/12 (September-December 1920), p. 33.

Table 1
RUSSIAN OIL AND KEROSENE PIPELINES

Pipeline Route	Length, in km	Diameter, in mm	Number of Pumping Stations	Capacity, in '000 Tons/year	Completion Date
Baku-Batum	883	200	16	900	1906
Groznyi- Petrovsk	163	200	4	790	1914
Dossor-Ra- kusha (2 lines)	120	150	n.a.	400	c. 1911
Maykop- Krasnodar	108	200	6	900	c. 1910
Shirvanskaia- Tuapse [1]	79	150	n.a.	n.a.	n.a.
Rakusha-Caspian Sea (2 lines)	34	150	n.a.	400	c. 1911
Kaluzhskaia- Afinskaia	25	120	n.a.	< 5	1915
<i>Total Length of Pipelines in 1917: 1487 km</i>					

1. This line was apparently dismantled in 1913 because of insufficient output at the Maykop (Shirvanskaia) fields: William A. Otis, *The Petroleum Industry of Russia*, Supplement to Commerce Reports, Trade Information Bulletin No. 263, Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce: Washington, D.C., 25 August 1924.

Sources: J. Chapelle, "Le Pétrole en U.R.S.S.", *Notes et Etudes Documentaires*, No. 3435, La Documentation Française: Paris, 9 novembre 1967, p. 23; B.M. Bondarevskii, *Sovietskaia Neft'*, Soviet Neftianoy Promyshlennosti: Moscow, 1926, p. 121; S.M. Lisichkin, *Ocherki Razvitiia Neftedobyvaishchei Promyshlennosti SSSR*, Izdatel'stvo Akademii Nauk SSSR: Moscow, 1968, p. 303, 367; and N.Z. Rubinov, *Ekonomika Truboprovodnogo Transporta Nefti i Gaza*, Nedra: Moscow, 1972, p. 23.

Western technologies and equipment played a determining role in the realization of all Russian pipeline projects. Armed with these tools, and motivated by an intense entrepreneurial spirit, they quickly developed a world-class oil industry and attendant pipeline system.