

Academician Trofimuk:

Siberia floats on oil

Andrei A. TROFIMUK, a geologist and oil industry worker, Academician (1958), Hero of Socialist Labor (1944).

Even a short biography of this wonderful man with a list of his awards and regalia would occupy more than one page.

Academician Trofimuk was director of the Institute of Geology and Geophysics of the Siberian Branch of USSR Academy of Sciences for more than 30 years. He was one of the main organizers of oil science in the USSR; he took part in the discovery, development, and study of three largest — Volga-Ural, West-Siberian, and Lena-Tunguska — oil and gas bearing pools.

He is a “coauthor” of two scientific discoveries of the processes of generation and accumulation in the Earth’s crust of deposits of gas hydrates, solid compounds of natural gas and water.

A. Trofimuk was one of the first to support the application of mathematical methods in geology; he advanced direct geophysical prospecting methods providing a higher per cent of locating wells in oil-bearing formations.

Thanks to his insistence and ability to prove his point of view, giant oil and gas deposits were found in Precambrian sediments of East Siberia.

From his young years, A. Trofimuk was persistent in achieving his goals and had scientific intuition: during the Second World War, when there was a great demand for oil, he, despite the opinion of many of his experienced colleagues, insisted on boring wells in the Karlino-Kizenbulat zone, Bashkiria, where oil and gas deposits so needed in the war years were discovered.

A. Trofimuk worked for a long time in Bashkiria and then in Moscow. After that, together with M. A. Lavrentiev, he came to Siberia to create the first regional branch of the Academy of Sciences. “He enthusiastically supported oil exploration in West Siberia,” wrote Academician M. A. Lavrentiev, “and in the following years he clearly proved that this region was promising; he contributed both theoretically and practically to the opening of new oil and gas provinces and horizons in the Extreme North, East Siberia, and Yakutia.”

Being a person of high principles, A. Trofimuk refused the Order of Services to the Motherland, 4th Grade, that was to be awarded to him in 1988, as a protest against the reforms that were adverse for Russia. Today the Institute of Oil and Gas Geology and Geophysics, a street in Novosibirsk, a student scholarship, and a Prize for Young Scientists of SB RAS bear the name of the “chief geologist”.

A. E. Kontorovich:

“Great people of such integrity, true scientists, such beautiful people, such fighters for the common cause, and such patriots of our homeland as Andrei Trofimuk are not often born on our Earth. And I am very happy that I had a chance to work with this man.” (Glavnyi geolog, 2002, P. 170)

Quite recently it was considered that before 2050 we would not experience a deficit in natural oil and gas resources. However, as time is going on, forecasts of scientists become more and more pessimistic. In accordance with the report prepared by the National Petroleum Council on the order of the US government, in 25 years oil and natural gas obtained from traditional sources will be able to satisfy not more than 50–60% of the world’s demand. According to the estimates of analysts, by 2030 the daily world demand for oil will constitute 120 million barrels in comparison with the current 84 million barrels.

The latest report of the International Energy Agency (IEA) including 26 countries — oil consumers — gives a similar forecast. In 2007–2012 the world demand for oil is expected to increase annually by about 2.2%.

Can it be so hopeless? Do our grandchildren really have no chance for a worthy future, secured by sufficient resources of natural hydrocarbons?

It is believed that the future is indefinite and we choose it every moment. Let us look at one of the choices — the way proposed by Academician A. Trofimuk in his “Concept for the Creation of Large Gas and Oil Production Bases in East Siberia”, developed in 1987; we shall briefly dwell on the main ideas of this concept and compare them with the current situation in oil and gas production, as well as with the level of development of oil and gas geology and geophysics. We give the floor to Academician A. Kontorovich, who took an active part in the discussion of this concept at the time of its development.

The oldest oil

Andrei Trofimuk in his “Concept for the Creation of Large Gas and Oil Production Bases in East Siberia” justified the need for “further improvement of the geography of oil and gas production bases as the most important strategic task of the country’s economic development”.

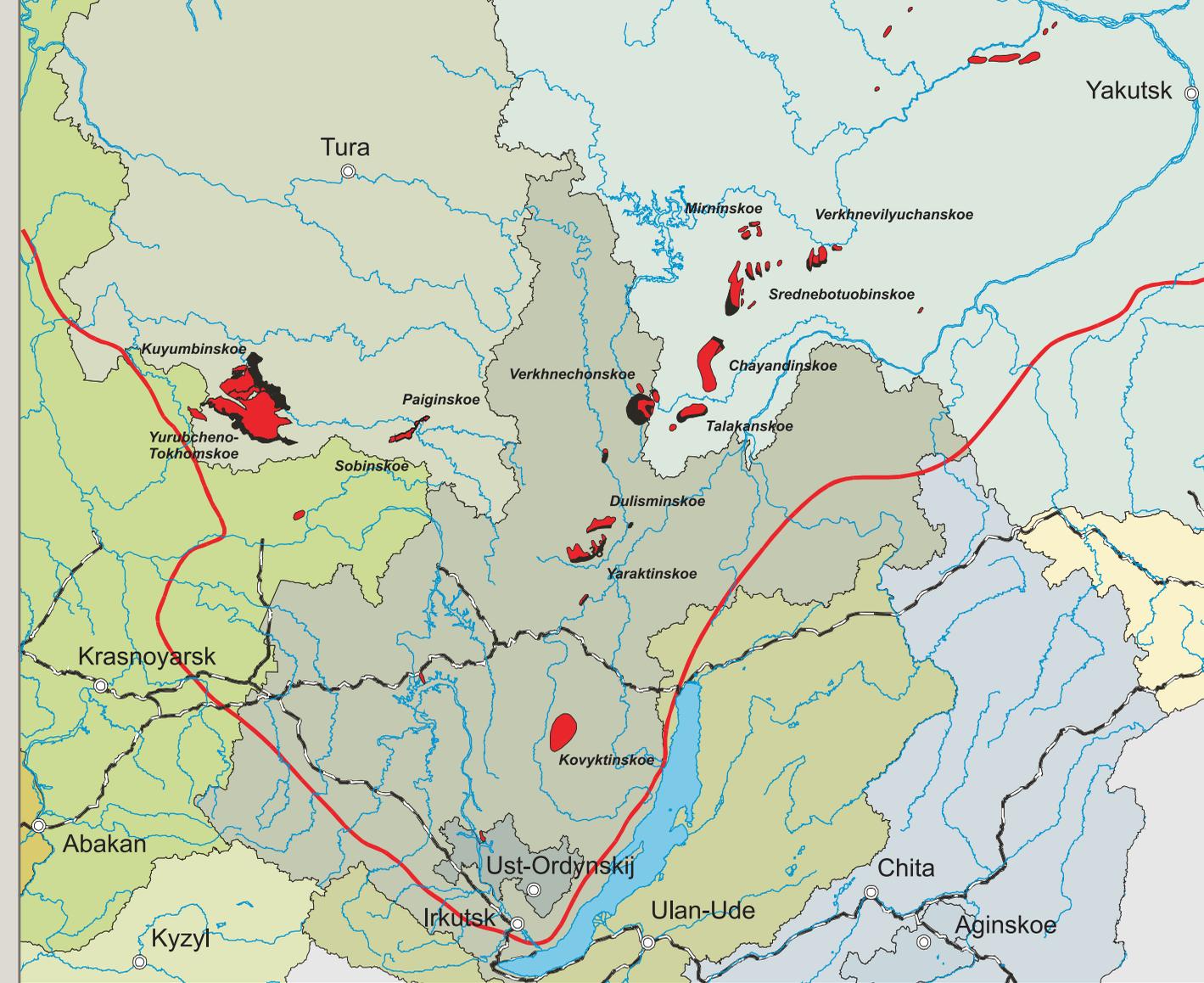
In tsarist Russia, oil was produced in its southern outlying districts. During the Second World War, oil and gas production bases were created in the Ural-Volga region and in the north of Sakhalin. Then it was the turn of West Siberia: “in the 1960s–1970s, an oil-and-gas production base was created in West Siberia, which was the largest in the country. By the end of the 12th five-year plan period the oil and gas produced at this base constituted up to 70% of the overall national production of hydrocarbon raw materials.”

A gas- and oil-bearing belt with hydrocarbon reserves, comparable to those of West Siberia, was discovered in East Siberia. In accordance with the concept, “at the end of the 1960s science validated the availability of large oil and gas resources in East Siberia as well. Prospective areas, almost twice as large as those in West Siberia, were detected in the vast expanse between the Yenisei and Lena rivers. Prospects for the creation of gas-and-oil production bases in East Siberia, whose territory constituted about 16% of the entire USSR territory, became real.”

A. Trofimuk believed that oil and gas were the major and economically profitable energy carriers of the 20th century: “One can hardly name any other product besides oil whose sale on the world market would bring a profit 3 to 5 times larger than its cost price.”

► A. Kontorovich: “Previously the cost of oil was 20 dollars per barrel, and now it is 70 dollars. The cost price has not increased considerably, since all the oil produced today was explored much earlier; today’s businessmen take into account the cost of prospecting very indirectly, when they pay the state for the information about deposits.”

The map of oil and gas deposits of the Siberian platform, made by specialists of the A. Trofimuk Institute of Oil and Gas Geology and Geophysics, SB RAS. Academician A. Trofimuk took part in the discovery and exploration of many of the deposits shown on the map



■ Oil ■ Gas — The outer boundary of the Lena–Tunguska oil and gas province, an area holding much promise in the search for oil and gas deposits



18 Construction of the oil pipeline Shaim — Tyumen (1962—1963)

The “Concept for the Creation of Large Gas and Oil Production Bases in East Siberia” “was addressed directly to M. Gorbachev, Secretary General of the Communist Party Central Committee. It has become known that M. Gorbachev studied this concept personally and directed it to E. Ligachev, a member of the Politburo of the Communist Party Central Committee”, who “charged B. Shcherbina, Vice-Chairman of the USSR Council of Ministers (and Chairman of the USSR Council of Ministers’ Bureau on the Fuel and Energy Complex) and A. Reut, First Vice-Chairman of the USSR State Planning Committee, to consider the issues raised in the concept, take a decision on them, and report to the USSR Council of Ministers.” On December 16, 1987, an organizational plan was approved, and persons responsible for dealing with the issues raised by A. Trofimuk were appointed; it was also proposed to “prepare a report to the USSR Council of Ministers on January 25, 1988. However,

it was only on February 19, 1988 that the Council of Ministers’ Bureau on the Fuel and Energy Complex held a meeting, chaired by R. Margulov, Deputy Chairman of the Bureau, during which it considered not the draft report but brief information about the creation of large oil and gas production bases in East Siberia. <...> One could easily conclude from this speech that creation of large oil and gas production bases in East Siberia was not a topical matter, because specific capital investments in a ton of new power, as well as the cost of a ton of oil to be produced in East Siberia, were the highest in the country. <...> It was easy to make such conclusions”, because “only reserves approved by the State Reserve Committee were taken into account, whilst the reserves whose discovery was predicted and projected” were ignored. Thus, “economically unacceptable figures were obtained” (Trofimuk, 1997, pp. 156—158).

A. Trofimuk: "...in June 1957 I had a meeting with Academician Lavrentiev. At this meeting, he was trying to find out why I had agreed to be a member of the Siberian Branch, to move to a Siberian city, and to head work on organizing a research institute, tentatively called a Geological Institute.

— "You", — said he, — "have already been working in Moscow for seven years; you are head of a large institute of the Ministry of Oil Industry with a research-and-production staff of more than 3, 000; you supervise the introduction of new technologies for the development of large oil deposits in the USSR; so why do you agree to exchange such prestigious work in the capital for work in Siberia, which has no oil deposits at all?"

— "You are right", — said I, — "so far not a single oil deposit worth developing has been discovered in Siberia, but from what I know about the results of search for oil and gas I can assert that Siberia is literally floating on oil."

<...> In the period from 1958 to June 1969, in his public speeches he [Lavrentiev] often said: "Academician Trofimuk asserts that Siberia is floating on oil, but he still cannot show a droplet of it." In June 1960, the first large oil gushed in the upper reaches of the Konda river in the Three-Lake region. It demonstrated that the West-Siberian Lowland had not only gas but large oil deposits" (Trofimuk, 1997, pp. 156—158).

► **A. Kontorovich:** "As early as in 1936 Academician M. Usov predicted that the oldest oil on the planet would be found in East Siberia. In 1958, future Academician I. Gramberg, who was a young scientist at that time, also predicted the presence of oil in the Precambrian sediments of the Siberian platform. These two hypotheses, however, remained unnoticed. In 1960, Academician A. Trofimuk, on his own, arrived at the same conclusion; he asserted that "we shall find the planet's oldest oil in East Siberia". This statement of the eminent scientist had a wide response and determined, to a large extent, the further strategy of oil-and-gas-prospecting works in East Siberia.

Oil in that region did not "come easy". Although the first oil was hit by V. Sinyukov in 1939, subsequent search for oil fields was not successful. In West Siberia, on the contrary, the first oil gusher spouted as late as in 1960, but



the next year deposits that became the "oil and gas basis" of this province were discovered. Today, it is West Siberia that has the largest oil and gas production base both of Russia and of the entire world. And the fate of East Siberia, a region with the so-called "complicated geology", is also complicated.

Nevertheless, Andrei Trofimuk had faith in East Siberia."

Trofimuk thought that the newly opened deposits in the Krasnoyarsk region, in particular, in the Evenki Autonomous Area, in the Irkutsk region, and in the Yakut ASSR, would become a stronghold for setting up large oil-and-gas production bases in East Siberia. Organization of such bases would make it possible to solve the following problems by the beginning of the 21st century:

1. To improve considerably the geographical distribution of oil and gas production bases.

2. To satisfy completely the needs of East Siberia and Russian Far East for oil, gas, and products of their processing.

3. To decrease the cost of oil and gas production of the national oil producing industry through the development of large and promising oil and gas deposits.

4. To recover the costs of the Baikal-Amur Railroad construction by transporting millions of tons of oil and potash salts to the Far East and to the Pacific Rim countries.

► **A. Kontorovich:** "When in 1979 the Central Committee of the USSR Communist Party and the Council of Ministers adopted the resolution to increase exploration works in East Siberia, this was the hour of triumph for the province. Whereas earlier the money allotted for geological prospecting was transferred mainly to West Siberia, now the situation has changed.

In 1979—1991 we, disciples of Academician Trofimuk, managed to discover, with his direct participation, dozens of deposits in East Siberia, in the oldest layers of the Earth's sedimentary cover. In 1994, the State Prize of the Russian Federation was awarded for the discovery of the oldest oil on the Siberian platform (and in the world)."

The concept of Academician Trofimuk was based on a comprehensive approach. In addition to the creation of new oil and gas production bases, the document cited above proposed a way to solve a number of transport problems and set the task of deep processing of hydrocarbon raw materials.

Oil "aorta"

In accordance with the "Concept for the Creation of Large Gas and Oil Production Bases in East Siberia", it would be most rational to transport

Academician Trofimuk is having a good time



In 1988 A. Trofimuk headed the Commission of the Siberian Branch of the USSR Academy of Sciences on the appraisal of the construction project of the Turukhan hydroelectric power station. The project was not approved

oil through a northern pipeline, whose total length was to be about 700 km. It was expected that hydrocarbon processing products would be exported to the Pacific Rim countries.

The oil pipeline would reach the Yenisei, which would allow using this river for oil transportation further to the North — to the Igarka, Dudinka, and Norilsk regions. The creation of a large oil refining complex at the Yenisei lower reaches would provide enterprises of that region and the fleet of the northern seas with oil and oil products. To solve these problems of oil and gas production bases, A. Trofimuk proposed to:

"1. Speedily design and construct the above-mentioned oil and gas pipelines and a helium plant in Boguchany.

2. Plan and construct, first, hard surface highways that would be parallel

to the oil and gas pipelines, and then build railways along them.

3. Reconstruct the broken down Urengoi-Igarka railway."

When dealing with the issues of transporting raw materials produced in the Irkutsk region and in the southwestern part of Yakutia, A. Trofimuk thought that the following steps would be necessary:

"1. Starting the construction of a railway from Ust-Kut via Kirensk to the Verkhnechonsk deposit.

2. Constructing a 440 km-long oil pipeline from the Verkhnechonsk deposit to Ust-Kut.

A. Trofimuk: "Siberia is literally floating on oil, and I think finding these buried oil seas is exciting."

3. Constructing in Ust-Kut a large oil storage and filling station, from where oil would be transported along the Baikal-Amur Railroad to the Russian Far East.

4. Constructing a gas pipeline from the Yarakinsk group of deposits via Ust-Kut, Zhigalovo, and Angarsk to Irkutsk, with a length of about 700–900 km, for supplying gas to the industrial centers in the south of the Irkutsk region.

5. Constructing in Usolye-Sibirskoye a helium plant and a helium storage facility to separate helium from gas and store it in salt reservoirs; the planned gas processing capacity is up to 10 billion m³ annually.

6. Supplying the Yakut ASSR with oil products, constructing an oil pipeline from the Sredne-Botuob deposit to Lensk and an oil refinery to process 3 to 5 million tons of oil.

7. Constructing a gas pipeline from Vilyuisk via Yakutsk, Tommot, and Berkakit to Tynda to transport syneclise gas from Vilyuisk to the Russian Far East.”

A working day of the oil and gas prospecting expedition.

A. Trofimuk (in the center), V. Surkov (on the far left),

A. Kontorovich (on the far right)



► **A. Kontorovich:** “The decision to construct the oil pipeline East Siberia—Pacific Ocean has already been made. The construction is proceeding fast, and I have no doubts that in 2009 this oil pipeline will start operation. All leading oil companies have already created programs of developing those East-Siberian deposits that we discovered together with A. Trofimuk in the 1970s—1980s. Regretfully, since 1990 nothing new has been discovered. I am sure that in the nearest time we shall be able to supply the oil pipeline with the first 30 million tons of oil, and the main dream of Andrei Trofimuk will become a reality.

However, here we have a serious problem. Each ton of oil produced in East Siberia will have 70 m³ of gas dissolved in it (accompanying gas). This gas is a very valuable chemical raw material. However, it is not mentioned in the adopted projects, although the pipeline is already under construction. It would be appropriate to remember Dmitri I. Mendeleev’s words to the effect that a stove can be stoked with banknotes. Developing A. Trofimuk’s ideas, we are doing our best to make the gas serve the country rather than be burned.

It is natural that the projected and actual realization of the scientist’s proposals does not completely coincide with his original ideas. Oil pipelines will be constructed not where A. Trofimuk proposed to lay them, because the country has changed in all respects. Nevertheless, his basic ideas and the developed comprehensive approach to the development of the province have remained true and realistic.

If no tragic events had taken place in 1991 and the Soviet Union with its mighty economy had not collapsed, we would have long been producing oil in East Siberia. However, life in this country took a different turn.”

Hydrocarbons as a raw material

Academician Trofimuk thought that for more efficient use of hydrocarbon raw materials one should export petrochemistry products rather than crude oil and natural gas. To this end, he recommended to create, jointly with countries-partners, enterprises for highly efficient and deep refining of hydrocarbons.

► **A. Kontorovich:** “The problem of oil and gas production is much more complex than it seems at a glance. For instance, eight or ten years ago I thought that the Kovykta deposit (Irkutsk region) must produce 50—60 billion m³ of gas annually. However, although such production volume is quite possible for this giant deposit, it would not be expedient in the present conditions.

The Kovykta deposit contains the so-called fat gas, which has a high concentration of ethane, propane, butane, condensate, and helium needed for many high-tech branches of economy, medicine, etc. All this is a raw material for petroleum chemistry. If we export the produced gas without removing these components, we will use our wealth very inefficiently. We must process gas to provide our country with petrochemicals and also export them.

Today the consumption of plastics, resins, fiber, and other polymers in this country is less than in developed countries by a factor of 15—20, and 60% of our consumption products is imported. And we have raw materials which open up fantastic opportunities! So far, the performance of existing plants designed to process petrochemical raw materials, in particular, those based in the Irkutsk region, has been poor due to the lack of these raw materials. Now they can be supplied; for this, however, one should construct gas processing plants, plants to separate and liquefy helium, and facilities to store helium, gas, and future products of petrochemistry.

Thus, the problem stated by A. Trofimuk, of using produced oil and gas is of current importance; it should be added, however, that gas should be produced only in the amounts that can be processed.”

Sayings by Andrei Trofimuk:

“The presence of permanent — but mild! — opposition to the boss is helpful for work”

“For a geologist, no wells are empty!”

“The feeling of rightfulness suppresses the feeling of fear”

“If my subordinates are guilty, so am I: they acted on my instructions”

On oil and gas prospecting

A. Kontorovich: “One of the most important problems of Russian economy is that the country destined for many years to remain a “raw material” state does not try to replenish the reserves of oil, gas, and other minerals.

Since 1994, we have been using the resources prospected earlier, and every year more oil and gas is produced than explored; whereas in the Soviet times we explored annually 2—3 times more than we produced.

In 2006 Russia produced 3 million tons more oil and 3 billion m³ less gas than in 1991 (the year when the Soviet Union collapsed). One can say that the produced amount of oil and gas remained almost the same. In 1991, however, 4,300,000 meters of wells were bored for the purpose of exploration, while last year we bored only 1,300,000 meters.

The oil and gas reserves left are more complicated from the point of view of geology, and to make use of them no less than 6 million meters of exploratory wells must be bored annually.

The Earth’s interior belongs to the state.

And although in recent years the government has greatly increased budget financing for geological prospecting (which is very good!), it is not the government that should search for deposits in the present-day system of resource development.

The task of the state is to help resource developers find new zones promising from the point of view of geological prospecting; the problem, however, is that this does not take place. If the government, with the help of scientists, does not transform the situation with geological prospecting and does not form partnerships with businesses, the production of hydrocarbon raw materials will inevitably start to decline.

The Law on the Interior was adopted in 1992: it was developed on the basis of practical experience of the USA, Australia, and Canada, because at that time our country had no experience in this field.

Then dozens of amendments were introduced into the law; as a result, now it is not a comprehensive whole. Adopting a new law has become necessary. To sum up, we now have a lot of problems which we did not have in the distant 1980s, when A. Trofimuk developed his concept.

The strategy of a geologist is to detect large deposits. And the better Soviet geologists worked, the harder is the work of their Russian “successors”.

Virtually all gigantic deposits have already been discovered; the deposits left for us are small or medium-sized; these are more difficult to find because they have a more complicated structure and require boring great many wells.”

In 1988 A. Trofimuk published the paper "Natural Hydrocarbons, Coals, and Pyroschists (Forecast of Development of Investigations)", in which he described his viewpoint on the development of geology and geophysics as both scientific and applied basis for oil and gas production. In particular, he proposed the following:

1. By revealing the conditions for the formation of oil, gas, peat, coals, and pyroschists, to justify the regularities of distribution and places of the largest concentrations of these minerals in the Earth's crust sedimentary cover.
2. To develop effective methods for the detection and exploration of combustible minerals so as to increase the reliability of revealing reserves and conditions of their occurrence and to decrease the specific costs of their detection.
3. To create deposit development technologies that would increase the recovery ratio of combustible minerals at minimum costs." To intensify prospecting and exploration works, A. Trofimuk recommended that direct methods of detection and delineation of hydrocarbon deposits be developed and widely used. He considered that an important step here was the creation of an interdepartmental association for hydrocarbon prospecting and exploration by direct methods.

A. Trofimuk proposed that special attention be given to improving the quality of oil reserves, and recommended establishing two indicators by which the quality of such reserves could be assessed:

- (i) the density of produced reserves per unit area, and
- (ii) well productivity, expressed in tons per 1 atm of pressure decrease in the base object under development.

Besides, he advised introducing a bonus plan for the discovery of deposits, which would encourage explorers to find large and prolific deposits at minimum costs.

In his "Concept for the Creation of Large Gas and Oil Production Bases in East Siberia", A. Trofimuk supported the creation of a state reserve of hydrocarbon raw materials, because even a very small air temperature decrease in winter causes failure and interruption in the power supply and in operation of oil and gas processing enterprises.

Therefore "it is necessary to create reserves of hydrocarbon raw materials: natural gas and crude oil should be stored underground. This could be achieved through laying up highly productive wells and resuming using them in periods of high demand for hydrocarbon raw materials."

What has the future in store for us?

► **A. Kontorovich:** "Everything proposed by A. Trofimuk in 1988 was absolutely correct, but today, naturally, his ideas are being transformed into other projects. The technologies and methods used at present have evolved considerably, and the petrochemical plants that were in full operation before are now at the stage of stagnation. And, most importantly, the country itself has changed.

The Siberian Branch is trying to overcome these difficulties. For instance, a special state commission, created by a presidential decree, is dealing with problems of developing East Siberia (specifically, the Irkutsk and Baikal regions), and the Russian Far East. Members of this Commission from the Siberian Federal District are A. Kvashnin, a plenipotentiary of the President; Academician N. Dobretsov, Chairman of SB RAS; and me. We do our best to incorporate the best of the latest achievements in the strategy being developed."

Now let us turn back to the question raised at the very beginning: can it be so that our grandchildren will be left without hydrocarbon raw materials?

A. Trofimuk's country was the huge Soviet Union, but today we live in Russia and have to adjust ourselves to a smaller scale. In accordance with the concept presented, the following resources would be left for our descendants by the beginning of the present century:

- undiscovered oil reserves within the territory of the former Soviet Union, equal in volume to all extracted and detected reserves;
- more than 50% of oil left in deposits under development due to technical or financial difficulties;
- oil and gas resources in the zone of shelves and oceanic slopes, which are greater than the total oil and gas resources extracted and detected in the USSR;
- 30–40 billion tons of high-viscosity oil and hard bitumens, which were not used at the time when the concept was created;
- gas hydrates, that is, a new resource of hydrocarbons in the form of solid gas, discovered by Russian scientists at the sea and ocean bottoms, and in permafrost zones (in accordance with the scientists' forecasts, confirmed

by American and Canadian researchers, hydrocarbon raw material reserves found in these territories are by two orders of magnitude greater than free gas reserves of all the continents).

Academician Trofimuk considered that "our descendants will be able to extract and use these resources better than we can, which, taking into account the achievements of science in the development of thermonuclear energy, will suffice for several millennia."

Time will show whether they will follow the way pointed out by the outstanding scientist or will find their own way into the future. It is most important that this future be happy.

Workers of the Vostokneft trust
Ural-Volga region, 1935

A. Kontorovich: "All research work done by Andrei A. Trofimuk is a striking evidence of his love for his homeland, for our Siberia, and for Siberian people. It shows his struggle for the development of science, education, and economy of this large and rich region."

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