THE NATURAL WEALTH OF THE SOVIET UNION AND ITS EXPLOITATION

BY
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Amid the tempestuous growth of socialist construction we have already entered upon the third, decisive year of our first Five-Year Plan which the factory workers and all the other toilers of our Union have firmly resolved to accomplish in four years. Not only do we believe and trust, but we definitely know that this resolve will be carried out. The first swallows of a new summer have already arrived. Some branches of industry and some enterprises have fulfilled the first Five-Year Plan in two and a half years. By order of the State Planning Commission of the U.S.S.R. a special commission has been created to draw a national plan of economic activity for the second Five-Year Plan. Just now we are passing through an exceptionally crucial period in the process of our construction. We must exert every effort to carry out 100 per cent at all costs the tasks outlined in the programme of the third, decisive year of the Five-Year Plan thereby assuring its actual fulfilment in four years and thus creating all the necessary prerequisites for the successful realisation of also the second Five-Year Plan, *i. e.,* the plan for the erection, upon a socialist foundation, of the glorious edifice of socialism, the first stage along the road to a fully developed communist system of society. We have to build the second Five-Year Plan upon the basis of the experience gained in the great work accomplished by the first Five-

Year Plan. Especially now it is incumbent upon us to perfect our knowledge concerning the natural resources of our country, taking full stock of what we know and what we do not know on this question and taking all the necessary steps to render our knowledge more complete.

Whenever the question of our natural resources is raised, one hears the hackneyed stereotyped truism being trotted out: "Our country is great and abundant . . . ."

To be sure, there can be no question as to the greatness of our land. The red banner of labour is flying over one-sixth of the earth's surface, having gathered under its folds about 150 million human beings of different peoples comprising one family of brotherhood and toil. Nor can there be any question of its abundance; yet it is essential now more than ever to ascertain the exact *extent* of that abundance in concrete figures, so that we may be sure of the continued fulfilment of our plan throughout the second Five-Year Plan. On this point, I fear, we cannot give a clear and concrete answer. We may, at times, have to resort to *generalities,* and at other, even mumble something inarticulate. Such replies cannot of course afford us any degree of satisfaction.

Statements about our natural wealth have indeed become truisms. The whole world knows about it, especially the bourgeois ruling class. They have every reason for casting covetous glances in our direction, slyly watching for any "slip" we might make somewhere in our business dealings so that they might be able to lay hands on our "abundant" land and transform it into a colony, having first established here such "law and order" that it would shake the earth in its very foundations.

To substitute this truism, a whole series of colourful and illuminating instances may be cited. For instance, the forests of our Union comprise one-fourth of the forest area of the whole earth. We possess vast tracts of black soil. Much of the gold used to bribe "internal" and "external" scoundrels of every kind to organise sabotage and engage in other treasonal activities and espionage work was obtained from our mines, by the sweat and blood of our workers, from the mines of the Urals and the gold-fields of Siberia. Ninety-five per cent of the world's stock of platinum was furnished by us. Our reserves of iron ore surpass those of the whole bourgeois world put together, and as regards our potential wealth in petroleum, we are ranked the first in the world even by our enemies.

These instances might be multiplied, but the above will suffice to convince us that "our land is indeed great and abundant." Nevertheless, I make bold to declare, reiterating the statement made by Emmons, a leading American geologist: "We are poor in knowledge of our own wealth."

We do not know our own wealth, not because it does not exist, but we did not study it or, in pre-revolutionary days, did not study it much, while in our own Soviet days we have just begun to study our natural resources. Moreover, our progress in this respect is not quite satisfactory and it is time we sounded the alarm to wake up to the importance of this matter. To begin with, we have been so little concerned with this question that as yet we have not even established a definite terminology in this field. We call our natural wealth and our natural resources forces of production. A Commission for the Study of the *Natural Forces of Production* was functioning at the Academy of Sciences since 1915; its place has now been taken by the Council for the Study of the Productive Forces of the Country.

On analysing the work of these institutions it will be found that the term "natural forces of production" was used to signify something corresponding to the general conception of "natural wealth" or "natural resources." Both the Commission and the present Council for the Study of the Productive Forces of the Country had been studying our natural resources. According to the Marxian point of view, the only correct one, the term "productive forces" denotes those forces which take part in the process of production. These forces are, first, the live force of the worker applied to the object of his labour, and the object itself of this labour, which, together with the tools of production, constitute the means of production.

Labour is, in the first place, a process in which both Man and Nature participate, and in which Man of his own accord starts, regulates, and controls the material reactions between himself and Nature. He opposes himself to Nature as one of her own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants. By thus acting on the external world and changing it, he at the same time changes his own nature (Marx, *Capital,* Vol. I, Charles H. Kerr edition, page 197). In the process of labour, man adapts himself to external nature, yet he does so not passively, but actively, placing between himself and nature, if necessary, the tools of labour, the tools of production. An instrument of labour is a thing, or a complex of things, which the labourer interposes between himself and the subject of his labour, and which serves as the conductor of his activity (*Ibid.,* page 199).

Coal, ores, running water, etc., become forces of production when drawn into the process of production, when taking part in it and jointly with the live force of the worker equipped with the tools of production creating products of labour. The question arises, should those reserves of coal, or oil, or forest lands which take no part as yet in the earth or upon its surface, and which take no part as yet in the process of production, be considered forces of production? I believe such a designation would be wrong. They are merely natural substances, not yet drawn into the process of labour. These resources, *e. g.*, coal or oil, have been in this state for millions of years, ever since their original formation. Mankind passed them by for ages without paying any attention to them, as if they were entirely useless matter. Primitive man probably took no note whatever of the "sacred idol" of modern bourgeois society, gold. When attracted by its glitter, he may have tried to bite it with his teeth to ascertain whether it was edible, and finding it of no use in this respect, he threw it away in disgust.

It was only when man, in the process of labour, in the process of acting upon nature, had learned from experience the intrinsic properties of various natural substances and their usefulness to him in the sense of satisfying certain of his requirements that such substances became use values to him, while the unutilised stores of such natural substances rose to the importance of boons of nature or natural wealth. The whole history of the struggle of man against nature, of his adaptation of the forces of nature to serve his needs, through various forms in the production processes, consists in the study of the forces of nature and their exploitation.

Homo neandertalensis possessed very limited knowledge of the wealth of nature, extremely meagre indeed from our present point of view. Our remote ancestor probably took stock of the supplies of stone from which he made axes, hammers and flint arrows; he may have had some selection of trees from which he prepared sticks for himself, kept stock of a small quantity of animal and vegetable raw materials which served him as food, and so forth. However, as the conditions of production became more numerous and more complex, the art of adapting the forces of nature directly to human requirements likewise became more widespread and more complex. In other words, with the advance in technical progress, man learned more and more about the properties and qualities of the substances and forces of nature, continually extending their sphere of utilisation, thus enhancing the importance of these natural resources.

To sum up, natural wealth, or natural resources — whether mineral, animal, or vegetable — cannot be said to exist in a definite predetermined quantity. The development of natural resources, and the degree of their exploitation, is the function of a definite development of the forces of production, of the technical and economic conditions of a given human society or of a given country. It was only after the discovery of fire that the advent of the iron age was made possible, which supplanted the stone age and added iron ore to the utilised wealth of nature. Not so very long ago no attention was paid to coal, whereas now it is one of the most important sources of energy. Only some 70 years ago nobody was interested in petroleum, whereas now we find "civilised humanity" ready to cut one another's throats for it.

The history of drawing of oil into the system of human economy is particularly instructive. At first, it was used only to obtain an illuminant, kerosene. Benzine and mazout residues were simply discarded as waste. Thus, at Baku, mazout used to be poured into ditches running through the streets, and that portion of the town became known as "Black Town," a name it has retained to this day.

Why was mazout thrown away? Because they did not know how to burn it. As soon as the required process was discovered, mazout became an exceedingly valuable fuel, surpassing by far the highest grades of coal in usefulness.

Benzine has a similar history. Prior to the appearance of internal combustion motors and automobiles, benzine had no uses, as its application in pharmacy was rather negligible. Today, it is a most valuable product, especially in connection with the development of aviation. The distillation of benzine by crude methods no longer satisfies the huge demand.

Recently, an epoch-making method of petroleum conversion has been developed, an entirely new branch in the oil industry, the cracking process, which has multiplied the output of benzine many times. Owing to the steady growth in the demand for liquid fuel, lubricants, etc., the utilisation of coal is taking a different turn. We now see the liquefaction of coal becoming an important process, as is the manufacture of artificial, synthetic oil. In this connection we note the growing importance of our deposits of combustible shales, the exploitation of which was furiously opposed some five or six years ago by one of the most notorious enemies of the toilers of the Soviet Union, one who at the time wielded a tremendous influence on our industrial managers.

Thus, times do change in the process of the dialectical development of social life which is the function of relationships in production.

Old Hellenic myths tell us that in the blissful Olympian days the goddesses fell out among themselves over the apple of Paris; today we find the bourgeois Olympus ready to shed and actually shedding rivers of blood for the black, filthy lucre called coal and oil. In the course of the latest blood bath, which for some reason has been termed the Great War, these worshippers of the golden calf destroyed 23 million human lives, and now, as though nothing had happened, they are chanting hymns of peace and good will on earth, an earth drenched with the sweat and blood of the workers, while preparing for a new holocaust, a new partition of the world with its natural resources, or wealth. Notwithstanding the presumptuous twaddle of many high priests of science declaring that we are witnessing a period of tremendous activity in scientific research, man has far from mastered the resources of nature. There is still a long road of struggle with nature ahead. Only after he has gained real liberty, and overthrown the yoke of his oppressors, when he has abolished class society and done away with the struggle for existence, only when every one is working according to his ability and receiving according to his needs, will mankind have secured the necessary leisure to engage in intensive collective creative activity, to become even more intimately acquainted with nature and make greater efforts to wrest from nature her hidden forces and treasures. Only then will man gain control over the energy within the atom and the sun, the power of radiation and the might of the ocean. It is quite obvious that the natural wealth and the natural resources of the established communist system will be far different from those we now possess. They will constitute the function of an unprecedented development of the forces of production.

Now we are growing, like the giant in the fable, not only day by day, but hour by hour. We accomplish in one year what it used to take decades to bring into being; in a decade what would have taken a century under different circumstances. We are determined to overtake and outstrip our "civilised" neighbours. We are building. We are erecting the glorious edifice of Socialism, realising the dream of the noblest of human minds that sacrificed their lives for this dream. Our entire country is in the process of reconstruction; our workers, engineers, technicians and producers of every kind are working, millions of them, vying with each other, spurred on by supreme enthusiasm and a firm resolve to lose no time and to accelerate the pace of progress to the utmost. The din and clatter of industry are heard in all parts of our great Union, mingling with human voices, the sirens of factories and mills and screeches of locomotives, blending and uniting in one great symphony of labour emancipated.

We are already completing the foundations of this grand edifice planned by our great teachers, Karl Marx and V. I. Lenin, and carried out by the mighty will of the working class and of its vanguard, the Communist Party of the Soviet Union. We are confronted with the tremendous task of completing this edifice at all costs. To be able to do this, we need more than firm resolve and ardent desire; we must have raw material aplenty, mountains and seas of metal, coal, oil, benzine, building stone, etc., etc.

Everybody knows, in this country as well as abroad, that the output of our labour in many branches of economy has increased two-and-threefold compared with the pre-war levels; nevertheless we are experiencing a shortage of everything. Iron and coal, oil and other products of our labour are still so-called "deficit goods." * How can we account for this?

This is due to our tremendous uninterrupted growth, when the demand for various goods has increased a hundredfold in connection with our construction programme. Our industrial giants develop so lustily, they outgrow their garments before they have been completely tailored. Hence the ardent appeal for unrelaxing effort. But no one who is not a bickering philistine or a "right" or "left" opportunist will wax despondent on account of

* Goods for which the increased demand far exceeds the supply and which must therefore be strictly rationed.—*Ed.*

this shortage, but each will endeavour to make good this deficit by putting his shoulder to the wheel.

The stupendous task of building Socialism in this country necessitates our facing squarely the question of our natural resources or natural wealth. I shall examine this question somewhat more fully in order to answer how far we are prepared, how far we are able to utilise this wealth in our process of construction.

However, before proceeding further, I must make the following proviso.

I cannot even attempt to cover the whole subject of our natural wealth, even in the liberal space of time allotted to me. I shall therefore limit myself to an examination of those resources which represent sources of energy (power resources), and of that natural wealth which supplies mineral raw materials of every kind (mineral resources). As regards the rest of our natural wealth dealing with animal and vegetable life, as well as the resources of our soil, I am not going to touch on this subject; because it is sufficiently vast to form the theme of a separate full report. Moreover, my comrades from the Academy of Sciences will deal in part with these questions in their respective reports.

Power resources are subdivided into two principal groups: (1) non-renewable resources, which include the deposits of all kinds of coal, oil (petroleum), natural gases and in part peat; and (2) constantly renewable resources, which include water power, the energy of the wind, the annual increment of forest lands, peat, straw, etc. The first group belongs to the category of useful minerals while some of the members of this group, *e. g.*, oil, represent not only sources of energy but are also basic materials for the manufacture of a number of products, of which about 400 different varieties are prepared in the United States of America.

I will begin with the group of non-renewable power resources, classed also under the category of useful minerals. At the outset I must stress one particular feature in regard to their exploitation: what nature created in the course of many millions of years, man consumes in a very short time, measurable in years or decades, while the source of supply cannot be replenished.

This naturally leads many people to entertain misgivings about the future and to speculate on the subject of how soon the mineral power resources will be exhausted. An attempt of this kind was made in 1924 by one who has since gained world notoriety as an enemy of the working class and a traitor to the country of the Soviets, Leonid Ramzin. He bases his calculations upon an estimated contemporary coal reserve of 7,398 billion tons, an annual world output of 1,300 million tons of coal, and a constant growth of consumption and consequent mining of coal, which he puts at 2 to 3 per cent per annum. Applying the principal of geometrical progression, he sets the date of the exhaustion of the world's reserve of coal at only 200 years hence. He admits that this date will vary in accordance with the proportionate growth in the world's output of coal. Nevertheless, his progression formula remains the same, as it applies to a small number of centuries.

I believe any attempt to set a date for the exhaustion of the coal reserves is entirely futile. To begin with, we do not yet know our actual reserves of coal in view of insufficient geological surveys on the subject. Until 1915 our coal resources were estimated at 234 billion tons. The opening of the Kuznetz Basin doubled this figure. In perspective we have the Tunguz Basin, occupying a huge territory, which may not only double our coal reserves but increase them tenfold. Geological surveying has not yet been applied to the whole globe. There are entire continents which have hardly been surveyed, *e. g.*, Africa, South America. It is not at all unlikely that the 7,398 billion tons may turn out to be 73,980 billion tons. Secondly, it was apparently assumed as a fact by Ramzin that in this "best of all possible worlds" everything was going to remain in the bourgeois state of chaos with its geometric progression of growing recklessness in the exploitation of natural wealth. We are convinced that the early advent of a Communist order of society with its principle of planned economy and rigid co-ordination of requirements and utilisation will put an end to this chaotic management. Moreover, under the Communist system the human element in production will blossom forth in its full vigour, leading to the discovery of natural resources that were not dreamed of by the bourgeois scientists.

We can now see the background of this pseudo-scientific approach to the question at hand, particularly so in regard to Ramzin's estimate of the oil reserves. He illustrates the date for the exhaustion of the oil reserves by the following table:

	World	U.S.A.	U.S.S.R.
Annual growth of pre-war output	8%	8.5%	5.6%
Corresponding date of exhaustion	22 yrs.	7 yrs.	64 yrs.
Date of exhaustion of deposits:			
If rate of growth of output is	4.5%		
Date of exhaustion	29 yrs.	8 yrs.	74 yrs.
If rate of growth of output is	0		
Date of exhaustion	57 yrs.	10 yrs.	563 yrs.

Hence he draws his deduction: the U.S.S.R. must do its utmost to save its oil deposits, which constitute one of the largest items of its natural wealth.

Now, after the trial of the Industrial Party, we know why Ramzin was so anxious to save our oil reserves. Intervention and the overthrow of the power of the Soviets and of the workers and peasants were going to be paid with our oil deposits, among other items. That is why he was so anxious to save our wealth in oil.

In assaying our mineral wealth and the degree of its utilisation the basic postulate to guide us should be the proper study of mineral beds, the depth of deposits and their physical and chemical properties. This in turn calls for the proper and rational organisation of geological research and surveys of prospecting expeditions to explore useful minerals. At the present time there is a colossal discrepancy between the crying demands of the country for geological service and the gratification of these demands by our geological institutions, which showed themselves to be unprepared to cope with the tasks set them by the country which is building Socialism.

I am inclined to attribute this to historical reasons, to a baneful legacy bequeathed us by the pre-revolutionary past of our country.

Until 1912 the entire Geological Committee consisted of a force of only 11 or 12 geologists spread over the huge territory of the Russian Empire, while its budget amounted to some fifty thousand rubles. After the reforms of 1912 the corps of geologists was increased to 50 and the budget was raised to 250,000 rubles. Furthermore, a like sum was appropriated to be used as a special fund for carrying on prospecting in oil, coal and mineral areas. Altogether, the funds at the disposal of the Geological Committee did not exceed half a million.

Geological service was even more poorly organised in other state institutions, while the formation of geological units at industrial enterprises was still being held under advisement. The staffs for such geological units were recruited from the ranks of "official" geologists.

Under Soviet rule the Geological Committee at once rapidly grew both in number and in the amount of funds allotted to it by the state. At the present time the Chief Geological Survey Bureau is allowed a budget of 80 to 90 million rubles, outranking all other geological institutions in the world in this respect. Nevertheless, it is still unable to satisfy all the demands made upon it by various economic organiastions. The chief drawback lies in the lack of sufficiently qualified cadres. Exceedingly responsible investigations have to be entrusted to inadequately trained workers. Only last year were higher schools for the training of geologists established. These will help to solve the problem of geological cadres. Even now, after nearly 50 years of work by our Geological Institution, we do not yet possess a complete 10-verst * geological chart, which should furnish the basis for more detailed geological prospecting expeditions in search of minerals. We have not yet even begun to map a complete 10-verst scale (1:50,000) geological chart of Siberia, where an era of great activity has been inaugurated;** nor have we a 10-verst geological chart of such an important mineralogical region as the Caucasus. I am not going to dwell on other shortcomings in his field. We must do our utmost to help the C.G.S.B.

* About six and two-thirds miles.—*Ed.*

** Only 160,000 sq. km., or 3.4% of the total area, is covered by detailed geological charting, while material has been published on only 90,700 sq. km. (about 2% of the territory). According to data supplied by V. Vasilyev in his book, *Siberia's Power Resources* (Novosibirsk 1931), Siberia possesses 7.57% of the world's power resources and 78.9% of those of the Soviet Union.

organise geological research to guarantee the proper and timely exploitation of all important useful minerals, such as coal, iron, oil, lumber, etc.

In connection with the question of the proper organisation of the geological service of our Union, mention ought to be made of still another outstanding defect in studying our mineral resources, to wit, the absence of suitable topographical maps, an indispensable requisite both in geological charting and in mapping out the soil. We are greatly handicapped by this lack of topographical data almost every time we undertake the geological charting of a new district. Not so very long ago we grappled with the problem of getting up a chart of the Grozny oilfield district, and the principal obstacle we encountered was our crass ignorance of the topography of the terrain. The same dearth of topographical information made itself felt when we organised geological prospecting in the Baku district, on the so-called Kabristan Pastures. If we are handicapped by the lack of topographical maps in districts ranking first in industrial importance, what can you expect in districts of secondary importance in our Soviet Union? Thus, at this very moment, when we are faced with the tremendous problem of studying the territory of the Ural-Kuznetz Combine, we are at a disadvantage once again by reason of the absence of suitable topographical maps.

We are in such urgent need of ascertaining the topographical basis of our country that we cannot afford to wait until such maps are furnished by the Chief Geodetical Bureau.* It is imperative that we organise aerophotographic charting, which has given such splendid

* There is a passable map available, but only for 11% of the territory of Siberia, also a one-verst map (1 : 5000) for 0.7% and a two-verst map (1 : 10,000) for 6% of the territory.

results in the U.S.A., and which we applied to the study of our oil-bearing regions.

When speaking about taking stock of our mineral resources, it is usually pointed out that a good deal of work has already been done in this respect. The reference is to the work done by the Commission of the Natural Forces of Producion, of the Academy of Sciences: (1) Vol. IV of *Natural Productive Forces of Russia;* (2) the four volumes of *Non-Ore Minerals,* and (3) a series of surveys of individual useful minerals and the researches of the Geological Bureau contained in the two volumes of the *Survey of Mineral Resources,* covering 1925—26 and 1926—27; also separate surveys on coal, iron, oil and other useful minerals. However, all this is but a drop in the bucket, which far from satisfies the existing need to take stock, not in a general way, but with an eye to industrial exploitation, which should permit not only of large-scale planning and zoning of the exploitation of useful minerals, but also the drafting of concrete production plans, thus co-ordinating construction enterprises with the extent of the available resources. Prospecting and stock-taking of mineral resources should be put on the urgency list and should receive our promptest attention.

In speaking of the study of our mineral resources, mention ought to be made of the exceptional importance which the geophysical methods of prospecting have recently acquired, embracing the graviometric, magnetometric, seismometric, electrometric and radiometric methods. Most of these methods have fully justified all legitimate expectations.

While remaining perfectly objective, I must declare that we have achieved much and do not fall behind other countries in this regard.

Suffice it to refer to the magnetometric and graviometric investigations of the Kursk magnetic anomaly of world renown, which expedition established the true cause of this previously mysterious phenomenon and discovered tremendous deposits of iron-ore quartz, undoubtedly of incalculable industrial value. The electrometric measurements conducted along the Schluem-Berger method have given special results in studying the oil districts of Old and New Grozny. The successful results of the Grozny surveys resulted in extending this method of investigation to the Baku, Ural-Emba, and Central Asiatic oil regions, while attempts were made to apply this method also to the Chukovsky oil-field in the Urals. Graviometric investigation, usually accompanied by seismometric investigation, has produced exceedingly interesting results in the Ural-Emba oil district, where a series of salt moulds was discovered constituting the nucleus of the oil-beds, thus showing them to be fairly analogous to the famous Gulf Coast oil fields on the coast of Mexico.

I fondly hope that all these methods will be applied as widely as possible in surveying and prospecting for useful mineral deposits.

I deemed it necessary to characterise somewhat fully the basic methods used by the study of our mineral resources in order to show that there is still much room for improvement, and that this part of our work requires serious attention.

I shall now pass on to describe the extent of our knowledge of these mineral deposits which constitute the chief sources of our motive energy.

In this characterisation I shall bear in mind, above all, the sum total of the resources of our motive power, as well as the quality of these resources as revealed during the process of their exploitation.

I deem it necessary, first of all, to dwell on the calorific and combustible minerals in which huge supplies of solar energy have accumulated throughout a number of geological epochs; when burning these substances of nature, we release the thermal energy thus contained, and if necessary, we transform it either into mechanical or into electrical energy. During this process of transformation *huge quantities of accumulated solar energy are wasted.*

As already stated, a few score years, or perhaps even a shorter period, suffice to destroy a quantity of energy which nature has taken millions of years to create. This is one point I want to make. Next, we must consider that the degree of utilisation of thermal energy in the process of its transformation is quite negligible. For instance, the mechanical energy obtained from thermal energy was equal to 9.2 per cent in 1903, 15.5 per cent in 1914, and 24 per cent in 1924, in percentages of the total energy contained in the fuel consumed. Although the ratio of utilisation rises as the result of improved methods of burning, nevertheless a waste of three-fourths of the stored-up energy is nothing short of barbarous prodigality. We must ferret out new ways of utilising the heat supplied by nature in the shape of coal, oil and natural gases.

Coal Deposits in the U. S. S. R.

Coal, in its three forms: anthracite, bituminous, and lignite, constitutes one of the basic sources of energy and is therefore one of the most important bases of our industry. The bulk of the coal is used in the shape of fuel, and its importance as a fuel in the Soviet Union may be gathered from the fact that in recent years about 60 per cent of the fuel used has been coal. Some grades of coal produce coke, which is employed in metallurgy to smelt pig-iron. The coking of coal yields a number of by-products which are used for the production of explosives, drugs, lighting gas, etc. Lately new uses have been found for bituminous coal as well as brown coal and combustible shales. The hydrogenisation and berginisation method make it possible to obtain a liquid fuel and a number of other oleous products derived from coal which is of prime importance in the solution of the liquid fuel problem.

Owing to the importance of coal in modern economic life the greatest attention is paid everywhere to the study of its available supplies. This country also has given the question much thought, especially as it bears on the Donetz Basin, at the expense of neglecting the study of other sources of useful minerals. The world's supplies of coal, according to data of the XIII Geological Congress given in one of the latest bulletins of the Geological Committee, dated October 1, 1927, are estimated at 7,714,407 million tons.

First place with regard to coal resources must be accorded to the U. S. A., whose deposits are estimated at 3,838,600 million tons; *second* place to Canada with 1,234,100 million tons; *third* place to China with 995,800 million tons, and *fourth* place to our Union with 552,300 million tons. Every year as the geological investigation and surveying of our territory progresses, the statistics showing coal resources undergo a change. Thus, in 1913, the total coal supplies of Russia were estimated at only 233,945 million tons — in other words, 17 years of investigation and prospecting resulted in more than doubling our known coal supplies.

It was during this period that the famous Kuznetz Basin was discovered, with its billions upon billions of tons of coal. Even in the course of one year, 1926—27, our estimated coal supply increased by 66.5 billion tons. This increase must be credited to the more accurate estimates of the supplies of the Kuznetz Basin as the result of our geological investigations.

It stands to reason that the continued thorough geological study of the territory of our Union will considerably increase the total of our known supplies. Thus, geological research the last few years has resulted in the discovery of the Petchersky coal-bearing region in the Northern Urals; in the basin on the Yenisei River between its right tributary and the Upper and the Lower Tunguzka, a huge coal basin, hardly explored, occupying an area of 800 to 900,000 sq. km., or an area 40 times the size of our Donetz Basin, was discovered.

Our very latest investigations have uncovered the existence of the very rich Karaganda coal region in Kazakstan, which is of especial importance now in connection with the construction of the second All-Union metallurgical centre to rise in that region.

The coal basins now under exploitation have not been exhaustively studied. Even our famous Donetz Basin has not been fully studied, let alone the other more recent coal districts.

Numerous coal fields are known to exist within the confines of the U.S.S.R., chief among them being the Kuznetz Basin, followed by the Donetz, Irkutsk, Moscow, Minusinsk, Kazakstan, and Sakhalin deposits.

Of utmost importance as regards quantity and quality of coal produced is the *Donetz Basin,* situated in the Ukraine, in the southern portion of the European part of the Soviet Union. It occupies an area of 20,000 sq. km. and holds coal-bearing beds abounding in carbon to a depth of 2.5 km. This thick bed contains about 200 layers of coal, of which 49 have been found suitable for exploitation. *In general the coal seams under exploitation are 15—18 metres deep.* The remaining layers are of such poor coal content that they cannot be profitably exploited.

The total deposits of the Donetz Basin on October 1, 1927, were estimated at approximately 70 billion tons, divided into basic categories as follows: anthracite, about 40 billion tons; bituminous, about 30 billion tons.

Upon the basis of our present requirements of an annual output of 56 million tons according to the plan for 1931, assuming this figure to remain stable, the estimated supplies should last more than 1,000 years. Even if we mine as much as 300 million tons per annum in this region, during the next Five-Year Plan the Donetz supplies would last our descendants more than 200 years.

Thus, it would seem that there was no reason for anxiety as regards our coal supplies in the Donetz Basin, at least not for many years to come. Yet, this assurance is quite unfounded. We must bear in mind that these general deposits include various categories of predominantly "supposed" deposits. This, by the way, is generally characteristic of the supplies of all our coal regions.

According to a statement made by one of our leading experts, P. I. Stepanov, a geologist, who is especially conversant with conditions at the Donetz Basin, the actual deposits represent only 0.27 per cent, the probable deposits, 18.76 per cent, and the possible deposits, 80.9 per cent of the total. Such a ratio is far from assuring. As regards the so-called industrial mines, *i. e.,* coal veins suitable for exploitation due to a combination of technical and economic factors, the situation is even more precarious. Alarming data in this respect are contained in the annual review of our mineral resources for 1926—27. We find there, on page 1005, a table which gives a depressing picture of the prospective exploitation of the Donetz Basin deposits. About four years ago coal deposits being worked were calculated to last an average of 11 years, while coal mines not yet worked would last an average of 40 years; this applies to bituminous coal. As regards anthracite, the mines worked would last 8 years, and those not worked 15 years. Bear in mind that this estimate was made about 4 or 5 years ago.

During this period the figures may have changed for the better. I regret to say that I am not in possession of more recent data. However, judging from the statement made in the official report of the Geological Committee at the April Conference on Scientific Research Planning, when the Donetz industrial deposits were estimated to last a period of 12 years, there was no change for the better and the situation remained pretty much the same. Moreover, the aforesaid calculations were based on the coal output of 1926—27, which amounted to about 25 million tons, whereas the output has since more than doubled. Hence the catastrophic situation as regards geological prospecting in the Donetz Basin is quite obvious. Yet this basin, according to our Geological Bureau, "is the only coal basin within the borders of the U.S.S.R. which can be said to have been studied, if not exhaustively, at least with a satisfactory degree of thoroughness." The degree of thoroughness here referred to has been definitely characterised above.

Naturally, the calculated *total* geological deposits of the Donetz Basin do not represent a mythical figure; nevertheless these deposits should be made more tangible, so to speak, by means of detailed geological investigation, to correspond to the mounting coal requirements of the country in which Socialism is being built and will be completed in the near future. Given these figures of the coal deposits, if we apply the methods used to transform coal into liquid fuel by means of hydrogenisation, we shall solve also the problem of finding substitutes for oil and oil products by the time these supplies give out. One preliminary condition is indispensable: a proper rate of progress in prospecting and geological research work must be set and maintained.

Second in size, in the European part of the Union, is the *Moscow* coal basin, which occupies a huge territory in the central part of the country. Its industrial importance is immeasurably inferior to that of the Donetz Basin both as regards the quantity and the quality of coal deposits. The coal layers here are mostly interspersed with Jurassic and chalk deposits, with an underlying bed of limestone of the Devonian age possessing absorbent properties which are utilised in the draining of the pits.

The coal layers are imbedded like wedges, reaching a depth of from 4 to 6 metres. The number of layers ranges from 1 to 7. In origin, the coal is of the Sapropelic variety and is divided into two types: cannel and boghead coal. Cannel coal crumbles when mined and disintegrates when exposed to the air; it is self-inflammatory, containing up to 20 per cent ash and up to 5 per cent sulphur. Its heat value varies between 3,000 and 4,200 calories. Boghead coal is more durable, better preserved when exposed to air and contains less ash and sulphur. Its heat value is from 6,000 to 6,750 calories. It contains a high percentage of volatile substances, from 60 to 80 per cent, which renders it suitable for dry distilling, as well as for the manufacture of liquid coal by means of hydrogenisation.

Scientific research institutes are at present working on the problem of coking the Moscow coal. The Moscow Basin's share in the fuel supply of the country is 3.1 per cent. Owing to its geographical location, it acquires constantly growing importance in the economy of the Moscow region, especially in connection with the building of central electric power stations. *The total coal deposits are estimated at 8,330 million tons of which the actual plus the probable supplies are estimated at 90 million tons, or 1.08 per cent, the rest being possible supplies.*

Matters are in rather bad shape as regards the exploitation and industrial utilisation of the coal in this district: on October 1, 1927, there were only 10.2 million tons of coal being worked, as tabulated by the Geological Bureau, which, at a contemplated annual output of about a million tons, promised duration of some 5 or 6 years. Since the output in this district is rapidly growing (from 1.8 million tons in 1930 to 4.6 million tons in 1931), the time limits suggested are exceedingly alarming.

Coming now to secondary coal regions in the European part of the Union, mention should be made of the coal districts along the western slopes of the Ural mountains. Here the coal beds run parallel to the Ural slopes from the Chus River northward to the Cherdynsky region. The deposits of the *Kizel district with estimated deposits of 263 million tons are now being worked.* Anthracite coal is being mined in the Yegorinsky region on the eastern slope of the Urals. In the south, along the Orsk-Troitsk Railway, we have the Poltavo-Bredinsk deposits where bituminous and anthracite coal is mined. Besides bituminous and anthracite, brown coal (lignite) is mined in the Urals, in the Chelyabinsk region and in the Bogoslovsky factory district.

The total coal deposits of the eastern slope of the Urals are estimated at 528 million tons, including about 480 million tons of brown coal, or about 91 per cent.

I am going to dwell on minor coal regions in the European part of the Union. Their total deposits do not exceed 20 million tons.

The *Kuznetz Basin.* Western Siberia will in the near future become the centre of our coal mining industry. The most prominent field of operations here is one of the world's largest coal reservoirs, the *Kuznetz Basin,* situated on the River Tom between the city of Tomsk on the north and Kuznetsk on the south.

The coal bed extends over more than 25,000 sq. km. The basin is of fairly complex tectonic structure, especially on its periphery. While the deposits are fairly smooth in the central portion, they are surrounded by a continous circular zone of folds. The capacity of the coal veins is as much as 7 to 8 kilometres. The number of coal layers varies from 40 to 60, of which 20—30 are workable. The depth of the layers range from 1 to 14 metres, while the total capacity of the coal layers is 104 metres.

The coal of the Kuznetz Basin is very diversified in character, beginning with poor semi-anthracite and ending with dry long-flame coal. All the coals are renowned for their high technical qualities: purity, small ash and sulphur content, and high calorific value, even 8,000 calories. They differ considerably from the Donetz variety of coal in coking possibilities. Kuznetz begins with a 25 per cent content of volatile substances, whereas the Donetz coals are coked with an 18—26 per cent content of volatile substances. Some of the Kuznetz coals yield a high grade metallurgical coke which will play a prominent part when the Ural-Kuznetz Combine, the second powerful metallurgical base of our Union, is organised.

The coal supplies of the entire area have not yet been tabulated. In January, 1928, they were estimated at 400 million tons by the Geological Bureau, of which about one-half was anthracite (210 million tons) and the other half represented bituminous coal (190 million tons). The mining of coal in the Kuznetz Basin is entirely out of proportion to its possibilities. In 1926-27 the output was a trifle over 2.5 million tons, in 1930 it was increased to over 5 million tons and under the 1931 plan it was further increased to 10.7 million tons.

As regards workable supplies, I may mention that a few years ago the situation here was better than in the Donetz Basin. According to our former production plans, the deposits under operation were to last about 20 years, and even 30-40 years for some of the pits. At the present time plans are in preparation to force the development of the basin to a point where this assurance becomes negligible and calls for intensified geological investigation.*

The *Minusinsk Coal Basin.* The Minusinsk Coal Basin having an area of about 300 sq.km. is situated southeast of the Kuznetz Basin, in the upper regions of the Yenisei River where it is joined by the Abakan River. The capacity of this coal seam is about 1 km., its age dating apparently back to the Permian period. There are 44 coal layers, more than one-half of which are workable. The depth of individual layers is as much as 5 to 9 metres. In quality the coal is of the long-flame type and frequently yields caking coke. It has a calorific value of from 6,300 to 7,000 calories. The total deposits of the basin are estimated at about 14 billion tons, of which about 80 million tons are actual plus probable deposits. The present output is negligible. The construction of the Atinsko-Minusinsk Railway afforded an outlet for the coal from this basin to the Siberian trunk railway.

The *Irkutsk Basin.* This basin is situated between Lake Baikal and the town of Nizhneudinsk along the Siberian trunk railway line. It is crossed by the Angara River and its left tributaries. Its total area, approximately equal to the area of the Kuznetz Basin, is 25,000 sq. miles. The coal layers are embedded in deposits of the Jurassic age. The number of workable layers has not yet been precisely ascertained but probably varies between 2 and 5.

* Of the 400 billion tons of geological deposits of the Kuznetz Basin only 500 million tons have so far been prospected. In order to increase the output to 130 million tons by 1937, which means the sinking of 187 shafts, it will be necessary to prospect 167 districts comprising a total of 6 billion tons. This will necessitate the boring of about two million metres of shafting. It is not yet settled where mining villages had best be built and where shafts are to be sunk. Wherever building operations are started, coal is found; on the other hand, shafts may not be sunk because the ground has not yet been prospected.

One of the layers under exploitation has a depth of from 60 to 1.4 metres, while another has a depth of 5 to 8 metres. The great variety of coal to be found there includes: (1) brown and bituminous coal, especially predominant in the Khakharei deposits, with supplies of about 75 million tons in the Priangara region, remarkable for its high percentage of volatile substances (42-82 per cent). The lignite contains up to 12-14 per cent ash and moisture. In places, the bituminous coals yield a badly caking coke. The calorific value is from 6,000 to 6,600 calories. The total deposits are estimated at 52 billion tons, of which 385 million tons, or about 0.7 per cent, are classed as actual. Only the central portion has been covered by detailed geological investigation, a territory extending over 71 sq. km. (out of a total area of 25,000 sq. km.). Mining operations in the district are insignificant in scope. In 1926—27 658,711 tons were mined, although this district occupies first place among Siberian coal mining operations.

East Siberia, from Lake Baikal to the Pacific Ocean, contains numerous small deposits of coal scattered in isolated groups:

(1) The *Trans-Baikal* region with coal deposits of the Jurassic age containing brown coal (calorific value about 5,000 calories) with a considerable percentage of ash. Total reserves are about 320 million tons.

(2) The *Amur River* region, containing brown coal of the Tertiary age with deposits totaling 375 million tons.

(3) The *Maritime* region where numerous deposits of bituminous and brown coal are known to exist, the most important being the deposits of the district of Vladivostok. In this district 9 deposits are being worked out of a total of 13 coal deposits existing in the whole of the Far Eastern region. The total coal reserves here are estimated at 615

million tons including 412 million bituminous, 40 million anthracite, the rest brown coal.

(4) The *Lena River* region with stores of about 115 million tons.

(5) The *Sakhalin Island* region. The main coalfield here extends along the western shore for a stretch of 200 km., a strip of land 10 to 15 km. wide. The coal veins date from the Tertiary and the chalk age. The veins contain long-flame coal, semi-anthracite and other varieties. The total supplies are estimated at 2 billion tons.

Kazakstan Coal. A whole number of coal deposits are known to exist upon the vast steppes of Kazakstan, most remarkable among them being the Karaganda deposits, situated 185 km. southeast of the town of Akmolinsk and 30 km. distant from the Spassky copper smelting works. They are known to contain 12 layers of which 5 are already being worked. The coal yields a caking coke; the deposits are estimated, according to data of the Geological Bureau for 1926-27, at upwards of 4 billion tons. I am not going to take up time with other, smaller deposits.

The fundamental deduction naturally to be made after a résumé of our coal resources is that, while we possess huge potential reserves of various kinds of coal, we must admit that they have been subjected to only a cursory study and been prospected, from the industrial point of view, to a still smaller extent. In fact, prospecting does not keep pace with the actual working of the coal mines, especially now that increased demands for coal are being made. Consequently, it is our primary and urgent task to remove the aforesaid obstacles blocking the path to constructive progress.

Oil Wealth of the U.S.S.R.

There is hardly any need to dwell at length on the economic, and consequently also political, importance of the production of oil to our socialist construction, especially to the collectivisation of agriculture in which the tractor, fed on kerosene, takes the place of the ancient plow now relegated to the scrap heap of ancient history. This is a subject upon which volumes have been written both in general and special literature. Suffice it to point out the fact that during the last ten years petroleum has become essentially a political commodity.

Last year the U.S.A. topped the list of oil-producing countries by its output of 143 million tons, or 64.1 per cent of the world's total output. Second place went to Venezuela, producing 22 million tons in 1930, and third place to our Union which produced 20 million tons the same year.

Venezuela, owing to the general industrial depression, has curtailed her output the first half of the current year so that in March-April we overtook her and are now the *second* largest oil-producer in the world. We also hold second place in point of the total output of our oil industry during the whole of its existence. From 1871 to 1930 inclusive, the oilfields of our Union gave up approximately 400 million tons of oil.

The oil industry of the U.S.A. during the course of approximately 70 years of its existence (from 1859 till 1930) produced a total of 2,263 million tons (5.7 times the output of our Union) of a total value of 17,217 million American dollars. It seems, however, that in the not too distant future the respective roles of the U.S.S.R. and the U.S.A. in the world's oil industry are going to be reversed.

Turning to definite figures concerning the oil wealth of our Union, we must state at the outset that we possess very meagre and by no means definite information on our oil reserves.

The figures now available relate chiefly to oilfields that are already being operated, and in the main are confined to oil wells under exploitation or to prospected regions which can be exploited on an industrial scale. These are the so-called prepared and prospected oil reserves. These figures are more or less close to the facts. As for prospective oil deposits which may subsequently be discovered in the same territories during the process of exploitation, as the boring gets deeper, such reserves belong to the realm of conjecture. For instance, in the Surakhan oil region there are possibilities of very extensive oilfields being discovered in the lower depths of that territory.

Finally, there is a fourth category of so-called possible reserves, *i. e.*, of oilfields that may be discovered as the result of prospecting for new territories. This group is quite vague in character. To this group belongs a number of oil-bearing districts on the Apsheron Peninsula situated in the vicinity of the existing oilfields.

The estimates of the oil resources so far published take into account all the categories of sources of supply; in other words, the total resources are given of which the prepared and prospected portions constitute but a very small fraction.

Now while our estimates of our resources of such useful solid minerals as coal and iron ore result in figures greatly at variance with the actual facts, owing to the paucity of statistical and other scientific data, our information on our liquid mineral wealth is in still worse shape, as oil, unlike coal or iron, is often struck as a result of a mere whimsical freak of chance, so that any conclusion arrived at as to our liquid mineral wealth bears but a remote relation to reality.

Without going into a minute critical examination of the existing methods of estimating oil deposits, I must emphatically declare that the two chief methods now applied — the bulk method, and the method based upon the curve of exploitation — are fraught with great risks of error, chiefly traceable to the fact that we are operating with inaccurate data of doubtful value. Therefore, we must assume a highly skeptical attitude on all statistics published concerning oil reserves, and give serious consideration only to the verified figures relating to prepared and prospected reserves, and even these should be used with great caution. No wonder we find a whole gamut of exceedingly contradictory figures concerning the oil reserves. Nevertheless, one cannot deny that such estimates of our oil reserves are not wholly devoid of importance and may serve as a means of orientation.

After making these preliminary reservations, we may now proceed to state the facts known about our oil wells.

In the statement of our power resources submitted to the London Power Conference in 1924, the oil reserves of our Union were estimated at 2,882 million tons, including 1,442 million tons at Baku, 900.9 million tons at Grozny, 262 million tons in the Ural-Emba region, 98 million tons in the Sakhalin region, 65.5 million tons in the Kuban region, 32.7 million tons each in the Trans-Caucasian, Ukhta, and Trans-Caspian regions, and 16.4 million tons in the Central Asiatic region (Ferghana).

This estimate was based upon data furnished by Russian geologists. These figures put us in the lead as regards deposits. They exceed considerably the total output of the United States during the 70 years of the existence of the oil industry (from 1859 till 1930 inclusive). As already said, during the whole of this period the U.S.A. produced 14,235 million barrels, or about 2 billion tons. Another estimate of our oil resources was made in 1931 by a foreigner, a leading American geologist, David White. He puts the figure at 860.6 million tons, which is less than a third of the estimate first mentioned.

This total resolved itself into the following constituents:

Baku region	253.9 million tons
Ural-Emba region	253.9 „ „
Grozny region	99.3 „ „
Sakhalin region	90.3 „ „

Reserves of 33.8 million tons each are given for the Ukhta, Maikop, Kerch, Ferghana, Kakhetia, and 8.2 million tons for the Tersk Region.

We do not know on what data these estimates were based. It is interesting to note, however, that the estimates for Baku and Grozny are fairly close to the figures based on the exploitation of the old oilwells of Baku and Grozny obtained in recent years by applying the method of studying the curve of exploitation.

It is also worth while to compare our oil resources with the world's resources. According to estimates submitted to the London Conference, the total world reserves were estimated at 7,696 million tons. The figure of our deposits, 2,882 million, constitutes 37.5 per cent of the world's total. South America comes second with a reserve of 1,230 million tons, or 16 per cent, the U.S.A. is third with a reserve of 930 million tons or 12 per cent, while Persia and Mesopotamia are fourth with a reserve of 765 million tons or 10 per cent. According to Mr. White's estimate, our share of the world's stores is only 9.7 per cent, which relegates us to the third place after South America and the U.S.A.

I believe all these estimates are far from the truth, I may even say quite fantastic, because they are far-fetched, or rather, are based on highly problematical data. As we turn to a specification of the nature of the oil deposits of the different regions, we again strike indefinite and contradictory figures.

The *Baku region* resources were twice surveyed by Prof. D. V. Golubyatnikov, in 1922 and in 1924. The 1924 estimates were made by the bulk method, taking into consideration the extent of the oil layers, their capacity, coefficient of porosity, saturation, and yield. Consequently, they were based upon some actual material facts. Their faults are inherent in the method employed.

He estimated the total oil deposits in the old fields (Lenin region, Surakhan, Bibi-Eibat, Binagada, Artem Island, Atashkya (Shubana), Gekmala-Hurdalan, Balajara) at 504.4 million tons. Moreover, there are new regions whose geological structure and outward indications point to favourable oil prospects, but where the degree of saturation of the oil layers has not yet been ascertained. Prof. Golubyatnikov has estimated the resources of the latter at 402.6 million tons, making a total of 907 million tons. During the 7 or 8 years which have elapsed since this estimate was made, great changes have occurred. The Kala region, estimated by Prof. Golubyatnikov at 277 million, has been prospected and has given negative results. To offset this, the new Kara-Chkhur area has made its appearance, forming a southward continuation of Surakhan field. The "Ilyich" (Bukhta) oilfield has nearly doubled in size and been augmented by the new Putinskaya area. Prospecting in the Kyorgez region gave positive results. The productivity of a number of newly prospected oil regions has been more definitely ascertained, and this allows us to assume that the Kala miscalculations have been fully compensated and that Prof. Golubyatnikov's estimates are perhaps not far from the truth. At any rate, they ought to be recognised as important from the point of view of orientation.

In recent years, V. V. Bilibin, one of our leading specialists in this domain, made some estimates of the Baku oilfields. He put the resources of the old areas on October

1, 1929, at approximately 190 to 200 mililon tons, including about 70 million tons of prepared and prospected reserves, about 40 million tons of visible, and about 80 million tons of supposed reserves. His estimate does not include the reserves of Puta, Kergez, and Kara-Chkhur.

It is safe to assume that by properly preparing the bottom layers of the oil fields, not only the first, but also the second Pyatiletka will be fulfilled. We feel confident that our old and trusted Soviet Baku will not fail us.

Prof. Golubyatnikov gives also a distribution of the oil supply according to grades (in tons):

Regions	*Crude Oil*	*Kerosene*	*Naphtha Fuel*
Old	51,549,000	144,125,000	308,755,000
New	—	208,719,000	193,874,000
Total	51,549,000	352,844,000	502,629,000

Our scientific institutes are already making laboratory experiments in refining naphtha fuel to obtain higher grades of oil. These experiments deserve the closest attention, because the supplies of naphtha oil are relatively small. We will not go far astray if we assume that the prospecting of new regions will also lead to the discovery chiefly of heavy fuel oil.

When the oil supplies of the Grozny region were studied, the same diversity of opinion characterised the final results. The geologist S. I. Charnotsky, applying the method of exploitation curves, in 1921 estimated the supplies of the Old Grozny area at 40.9 million tons, and of New Grozny at 32.8 million tons, together 73.7 million tons. The geologist V. A. Selsky gives a more conservative estimate of the old area, which he credits with 20 million tons, and estimates the new area at 26.3 million tons, a total of 46.3 million tons.

All these calculations were upset by the actual working of the Grozny oil region. The latest estimates of the prospected and prepared deposits (not the general reserves), as ascertained by the Commission which worked under my chairmanship in May of last year at Grozny, are put at not less than 60 million tons.

The layers of the productive Chokrak oilfield, lying below the 22nd layer, were not taken into account; neither were the possible supplies of other Grozny oilfields.

The discovery of oil in the Benoisky region (see below) should cause us to revise our attitude towards the whole of the Grozny region. Prospecting must be pushed here to the utmost if we are to carry out our programme not only of the first, but also the second Pyatiletka. I regret that the lack of data does not permit me to classify the Grozny oil resources according to grades.

The oil resources of the Maikop region I have so far estimated at 25 million tons. No attempts were made either by myself or other investigators to estimate the supplies of the Khadyzhinsky region. No definite figure can be given concerning the supplies of the rest of the Kuban oil fields. However, going by intuition, one may speak of reserves of about 25 million tons; the same can be said also about Daghestan. Thus, the total supplies of North Caucasus, exclusive of the Maikop deposits, may be estimated at about 70-75 million tons. These figures, however, still require verification by prospecting.

It is equally impossible to give a precise estimate of the supplies of the Ural-Emba region. Let us try to approach the solution of this question in the following manner:

The supplies of the "Dossor" oilfield under operation are estimated at about 5 million tons. In the Ural-Emba region about 100 dome-like mounds bearing evidence of oil were discovered; let us assume that one-half of them will prove productive to the same extent as Dossor. In that event the total oil supplies of this district would equal

5 times 50, or 250 million tons, which is quite close to the figure given by the American geologist David White. We do not and cannot make any estimates as regards the other districts, as we have no relative data. Let us examine instead the possible prospects of a further development of our oil industry.

I have said that the respective roles of the U.S.A. and the U.S.S.R. may be reversed, and I did not say so without reason. We are in the ascendent, whereas the United States has already reached the zenith of its oil power; its inevitable decline will set in, while we shall grow from year to year. It may well be said that we are just beginning to live properly. As a matter of fact our Union, owing to the relatively poorly developed state of its oil industry, has not exhausted its oil possibilities by far, whereas the United States will soon approach the limit of its oil resources. The total area of our oilfields now under operation does not exceed 10,000 hectares, whereas in the United States the productive oil and gas producing areas in 1925 showed a total of about 860,000 hectares. During the whole period we have drilled no more than 10,000 wells, while in the U.S.A. up to 1928 inclusive 763,000 wells had been drilled; in 1929 alone 23,356 wells were drilled, 7,914 of which, or 30 per cent, proved dry. In other words, in the U.S.A. in one year they drilled 2.6 times as many wells as we have done during the entire period of the existence of our oil industry. They operate much more aggressively than we do. While in the U.S.A. boring operations were carried on all over the country, and hundreds of new oil wells were discovered (in the state of Oklahoma alone 300 oil and gas deposits were struck), we are stubbornly confining our activities to 4 or 5 localities.

The Baku oilfields have been worked by us for about 60 years, those of Grozny for 40 years, and of Maikop and

Emba for 20 years. It is only recently that we have begun to take timid steps trying to branch out beyond the localities now worked and to look for oil over more extended areas. There are a great many places left to look for oil; we certainly have no less oilfields than they have in the U.S.A. To begin with, the territory of the Caucasus is but sparsely explored. Even in the vicinity of the old oilfields on the Apsheron Peninsula there are areas still waiting for more thoroughgoing investigation that has been done hitherto, *e. g.*, the district between Binagada and the Sula-Tepe mountain. The vast regions of the Kabristan pastures, the Salyan steppe, the Kharamin and Ajikabul mountain ranges—all these localities have yet to be prospected. Oil fumes are met with most anywhere in those parts, while the structure of the soil is favourable. A little prospecting would at once extend our oil field appreciably. We have discovered the Neftechal oilfield at the mouth of the Kura River, where the wells drilled yielded a steady flow of 120 to 150 tons daily, and the industrial importance of the new Puta-Kyorgez oil region is also conceded. In the heart of the Kabristan pastures we obtained industrial oil near the Chail-Dag mountain. Close to the famous Surakhan oil wells we discovered the new rich oilfield of Kara-Chkhur with gushers spouting a thousand tons a day.

All the oil we obtain in the Baku region comes from the so-called productive section of the late Pliocene age, while the presence of abundant oil in the deeper layers of the Tertiary and in the still lower Mesozoic has been amply demonstrated. All these lower strata await investigation. All this means that there are scores of oil deposits that have not yet been investigated within the boundaries of the Baku region, on the Apsheron Peninsula, on the Kabristan pastures, in the Ajikabul region, and in the Salyan steppe.

Neither have all the localities been investigated in the Grozny region, in Daghestan, or in the Kuban oil district. Yet, in all those regions there are numerous localities of interest to prospectors. Prospecting in some of these localities has already justified our hopes. Thus, at the end of 1930 we located an oil gusher in the Black Mountains of the Benoisky region, 170-180 km. southeast of Grozny, emitting 400 tons daily from an oil bed which is quite new, namely, the lower part of the Maikop stratum lying considerably lower than the basic oil strata which feed the Old and New Grozny oilfields. The discovery of that fountain has not only made the Benoisky region prominent but has also heightened interest in the vast Black Mountain region, where a number of oil-bearing localities may be encountered. Even the old oil areas are now acquiring an added importance. We may discover there, at a more or less considerable depth, an extension of the Maikop oil-bearing stratum. A different view is now taken also concerning those districts in which previous prospecting had led us to be skeptical of success, *e. g.,* the Sunzha, Tersk, and Gudermess regions.

Prospecting operations in the northwestern part of the Caucasus and in the Uba oil regions also gave satisfactory results. Oil was discovered oozing from a well in the district of Varenikov station on the Adaguma River.

We further expect the prospecting going on in Trans-Caucasus, in the Shirak steppe, to lead to the discovery of more or less extensive oil fields.

Nor has the last word been said about the oil regions of Central Asia. Quite recently a well was located in the Shor-Su district spouting to the tune of 300 tons daily. Prospecting ha? not yet been completed in the deep strata of the Cheleken, Nefte-Dag, Boi-Dag and other islands, and none has yet been done in certain other localities with indubitable indications of oil, such as the Trans-

Caspian region, the Turkoman Republic, *e. g.*, the district of the Chikishlar mud-bubble. It is hard to explain the almost total lack of prospecting in the vast Ural-Emba region covering an area of over 100,000 sq.km. in which over a *hundred* of those dome-like eminences already referred to indicative of the presence of oil have been recorded.

Of these numerous mounds *only two* are being exploited on an industrial scale, *viz.*, the Dossor and the Makat, to which a new Baichunas oilfield has lately been added. Prospecting is carried on at only a few points on these numerous mounds: in the Karaton, Iskin, Novobogatinsk, and Temir regions, and at the Keikebas oilfield, while the remaining mounds, despite unmistakable evidence of oil deposits, are entirely ignored. Yet, as I have already pointed out, geophysical investigation has established the connection between these dome-like mounds and salt deposits which renders them geologically akin to the famous salt mounds on the coast of the Gulf of Mexico that are important sources of oil. Energetic and boldly conceived prospecting may develop the Ural-Emba regions into a huge oil producing region, good for millions of tons. All prospecting activities should be concentrated heavily upon that area, especially as it has a direct bearing on the Ural-Kuznetz problem. In the event of successful prospecting the Ural-Kuznetz Combine will be supplied with oil and petroleum products from the eastern section of the Ural-Emba region.

Along the western slopes of the Urals a strip of land with unmistakable traces of oil extends over a distance of upwards of 2,000 km. The presence of oil near the town of Sterlitamak has been ascertained. Oil was obtained from a number of wells dug at the Chusovsk settlements. Signs of oil made their appearance in one of the shafts drilled in the Kizel coal region, and also in the Cherdyn region. Further north, in the district of the Pechora River, oil was struck at a number of points, *e. g.*, on the Malaya Kozhva River, and bituminous coal was located at the Tochilnaya mountain. The likelihood of striking oil in Chusovsk in the course of boring for salt has attracted great attention to the entire district and prospecting is in progress at numerous points. Much was made of the discovery of oil in Chusovsk and big and quick results were expected. But matters have been allowed to drift. Prospecting operations carried out in that district on an American scale and with American speed have shown that there are oil deposits in Chusovsk at the relatively small depth of 320-340 metres, connected with the porous limestones of the Upper Carboniferous age, but the deposits were found to be limited to an exceedingly small area.

Later, when wells were dug, deeper indications of an extensive petroliferous area were found. Consequently, the last chapter on the Chusovsk district has not yet been written. We must patiently await the results of further borings in the deeper strata of the earth before rendering final judgment.

West of the aforesaid district, between the Kama and the Volga Rivers, and on the Volga itself, there are a number of points showing signs of oil appearing either as thick black mineral oil oozing out of fissures in the rock formations (Sukeyevo on the Volga, Kamyshla on the upper reaches of the Sok River, a left tributary of the Volga) or in the shape of tar sand or asphalt.

All these localities are certainly of importance from the point of view of prospecting, and prospecting operations are in progress at numerous points. North, on the River Ukhta, in the vicinity of Timan, the presence of oil was known long ago, and exploring and prospecting operations were carried out. Lately the Ukhta Expedition conducted work there. A steady flow of oil was found on the

Chibyu River, a left tributary of the Ukhta, in well No. 5, yielding from 1.5 to 2 tons daily, the oil flowing from a depth of approximately 500 metres. Prospecting is carried on there with a view to its industrial exploitation, and possibly a new oil region supplying our industries will be established there.

The Sakhalin oil region also holds out great hopes as the industrial exploitation of the Chkhinsky oilfield there is meeting with success. The efficient organisation of prospecting operations in that district will no doubt enhance its industrial importance. There are many places worth while investigating in that region, *e. g.*, Katangli, Ekhabi, Nutovo, etc.

Moreover, the question for oil must be carried also into the European part of the Union lying west of the Ural Mountains, in the districts of Vyarka and Yelabuga, and generally to those localities where tectonic forms of strata are found, which are taken to indicate the formation of oil deposits. The Americans have scouted around for oil on similarly level territory and hit numerous oilfields. The search for oil must also be extended to the Eastern Urals after a preliminary geophysical exploration of that terrain. In short, the future of our oil industry depends entirely upon the scope of our prospecting operations, and whether they are carried out with the requisite bold determination and intrepidity.

Natural Gas Resources of the U.S.S.R.

Natural combustible gases may be found either in conjunction with oil deposits, of which they constitute a concomitant element, being largely found dissolved in the oil, or they are met with as independent gas deposits.

Natural combustible gases are divided into two groups: (1) the so-called "dry gases," and (2) "wet gases." Dry gases consist chiefly of methane, and partly of ethane, while wet gases, in addition to methane, also contain heavier gaseous or vaporous carbohydrates, *e. g.*, butane, pentane, etc. These gases are easily condensed, yielding very high grades of gasoline.

The chief uses of combustible gases are: (1) as fuel, (2) in the extraction of gasoline, (3) as a lighting medium, and (4) in the manufacture of soot.

Although we have an All-Union combination for the oil and gas industries, our gas industry is very feebly developed despite its great possibilities. We have huge stores of gas connected with oil. Had we possessed a more or less accurate idea of the real reserves of oil in our country, and of the immensity of the gas factor, (the quantity of gas, in cubic metres, which escapes in the process of exploitation from oil beds per ton of oil exhausted), as well as of the gradual modification of this factor in the course of time, we would have been able to form at least an approximate idea of the gas resources from our oil deposits.

The Grozny oilfields are notable for having the smallest "gas factor," 3.5 to 4 per cent, or 35 to 40 cubic metres per ton. The gas factor in the "C" layer of the Maikop oilfield is very high, reaching to 40 per cent, or 400 cubic metres per ton. The gas factor of the Baku oil terrain occupies a middle position between the Maikop and Grozny fields, being usually taken as 20 per cent, or 200 cubic metres per ton.

If we multiply the totals of our various oil deposits given above by the gas factor, we get an approximate idea of the gas stores contained in our oil resources. It should be noted, however, that the subject of gas factors, which is important not only in estimating our gas resources, but also in ascertaining the role played by gas in the exploitation of our oil deposits, has hardly been broached in this country, while the figures I gave are essentially tentative in character. Thus, in the Maikop region, the oil supplies were tentatively estimated at 25 million tons. Assuming that the gas factor in the exploitation of the oil deposits will remain at an average of 20 per cent, we get an equivalent of about 5 million tons of gas, 1,000 cubic metres of gas being approximately equivalent to 1 ton of oil.

The Baku oil deposits, if we accept the estimate of resources made by Prof. Golubyatnikov, should therefore contain in the neighbourhood of 180 million tons of gas.

There is no possible way of estimating the gas held underground in the gaseous deposits of the U.S.S.R. as so far they have been neither investigated nor operated. At the present time, after enumerating these gas regions and stating that they contain large quantities of gas, we have exhausted our learning on the subject. Such gas-bearing regions, apart from the oil-bearing regions, exist in the south of the European part of the U.S.S.R.: the districts of Melitopol, Kerch, and Taman; the northwestern portion of the Caucasus where mud-bubbles are located; the districts of Sochi, Daghestan, and the whole southeastern part of the Caucasus which is the classical mud-bubble region. Prominent in Trans-Caspia is the Chikishlyar gas region, while Central Asia also boasts of several gas regions, of which the gaseous nitrogen springs of Tyang-Shang are particularly interesting. The Dergachevsky gas tracts in the southeast of the European part of the Union in the Novo-Uzensky district have been known for a long time, and lately the Novo-Kazan gasiferous regions situated between the lower branches of the Volga and Ural Rivers has come into prominence. Mention should also be made of the Ukhta gases. The gases of the Dergachevsky and Ukhta regions contain a certain admixture of precious gases, including helium.

The extent to which our gas resources have been utilised is quite negligible. Before the revolution the gases emanating from our oil deposits were almost unutilised, and millions of tons were allowed to escape freely. Now, after the introduction of the so-called closed exploitation in our oilfields, we catch the gas and utilise it in two directions: first, as fuel, and second, for the extraction of gasoline at our gasoline works, of which we now have six: three at Baku and three at Grozny.

However, the quantities are rather small in comparison with what we might obtain. Thus, in 1930 we obtained 572,000 tons of gas from our oilfields, or 3 per cent of the oil mined. The 1931 plan envisages the mining of 944,000 tons of gas. Comparing these figures with the corresponding figures for the U.S.A. we see how puny ours are. In 1925 the U.S.A. obtained 33.7 million tons of gas, whereas in the current year we produced only 127,000 tons.

At present America produces up to 50 billion cubic metres of gas, equivalent to approximately 50 million tons of oil, which matches our record oil output set for 1933. In 1926 the gasoline works in the United States of America manufactured about 5 billion litres of gasoline, or about 31.3 million barrels.

Of course, our figures appear almost infinitesimal when compared with those of America, but when placed alongside our pre-revolutionary statistics, we see a considerable gain in the utilisation of gas. The 1931 plan provides for an output of gas of nearly one million tons, which is equal to the oil output of the entire Maikop region and is more than twice that of Emba. Moreover, this gas is obtainable without any special outlay of money, being merely incident to the production of oil. If we are to develop our gas industry on a large scale, it is an essential prerequisite that all areas rich in gases be thoroughly explored.

Peat Resources of the U.S.S.R.

A fourth mineral supplying energy is peat, which represents the primary state of the carbonification of vegetable fossils piled up under definite conditions. The importance of peat in our fuel budget grows year by year, especially as a local fuel in districts removed from other mineral fuel supplies. The development of the peat industry is of paramount importance to us, as our country ranks first in the world in peat deposits. It is true, we cannot express these resources in so many dollars or rubles, for we have not taken stock of all of our boundless marshes for the peat deposits they contain. However the fraction that has already been surveyed points to our abounding wealth in this useful mineral.

According to these preliminary calculations the European part of our Union alone contains an area of marshes and swamps estimated at 75 million hectares, exeeding in size the swamp area of the rest of the world. Assuming that only one-third of this area is suitable for the conversion of peat into fuel, our supplies of air-dried peat would still be equal to about 65 billion tons, which is approximately the weight of the total coal deposias of the Donetz Basin.

This mineral enjoys a distinct advantage over kindred fuels of carbonic character in that it partly belongs to the class substances whose supplies Mother Nature continually renews. If we could utilise all our peat swamps, the natural increment alone, according to the engineer Kukel,* would cover all our requirements of motive power. No wonder that Lenin's prophetic vision discerned the tremendous economic importance of peat, for he gave every encouragement and support to the development of this young industry in our country. The argument that most

* Kukel, *Modern Energetics, Its Aims, Successes and Prospects,* footnote on p. 162 (Russian).

of our peat swamps are situated in thinly populated districts remote from industrial centres will be obviated by the satisfactory solution of the problem of long-distance transmission of electrical current.

Water Power Resources of the U.S.S.R.

The next source of energy is the force of flowing or falling water which represents transformed heat energy received by the earth from the sun. By virtue of this energy huge volumes of water in the shape of vapour are raised from the surface of oceans, seas, lakes, etc., and condensed in the upper strata of the atmosphere and precipitated back to earth. The return movement of these masses of water to the seas, oceans, lakes, etc., assumes the form of rivers, brooks and other flowing bodies of water. This energy of water returning to its original bed is utilised by man. The magnitude of this force depends upon the quantity of water in motion and the height of its fall, and may be expressed in the following very simple formula:

$$F = 0 . 75 \times \frac{1.000}{75} QH$$

where Q is the quantity of water in motion in cubic metres per second, H is the height of the fall in metres (75 kilogram-metres per second = 1 horse-power).

Quantitatively, Q depends on the amount of atmospheric precipitation, or the degree of irrigation, while H depends on the topography of the country.

Applying this formula, it will be possible to fix upon a number of localities in the vast territory of our Union that contain stores of water power of varying potentialities.

First place must here be conceded to the Caucasus, which possesses a large expanse of water irrigating the soil, while the mountainous character of the country insures high altitudes for the falling waters. The Turkestan section comes next. Western Siberia is low-lying land down to the Yenisei River, bounded on the south by the high Altai Mountains in which large rivers have their courses. Consequently, we have here a wealth of water power. It should be noted that in East Siberia, though there are high mountain ranges, the waters are ice-bound for the greater part of the year. Nevertheless some of the rivers represent immense stores of water power, *e. g.*, the Yenisei, and especially the Angard River which has steep rapids along its course. The Far East is well supplied with water power resources, if we leave the regions of perpetual ice outside of our calculations. The European part of our Union represents a vast plain with calmly flowing rivers and a low fall of water, so that on the whole it does not favour the concentration of large water power resources. However, certain exceptional points are quite rich in concentrated water-fall power, *e. g.*, the rapids of Dnieper, the Bug and the Dniester. Furthermore, on the periphery of the Lake Region in the north there is a considerable drop before the water reaches sea level (*e. g.*, the Volkhov River rapids).

The water power resources of our country have been but little studied and the data badly digested. There is no complete chart showing our water power. Our total known water power is estimated at approximately 65 million horse-power. In this respect we are running neck to neck with the U.S.A. In order to gain even an approximate notion of the magnitude of this inexhaustible power which is being continually renewed, it should be borne in mind that the capacity of the stationary engines in the U.S.A. is 130 million h. p. (in our country this is so far only 12 million h. p.) while the total capacity of stationary engines throughout the world is 300 million h. p.

Consequently, our known water power resources, which so far have been investigated only quite superficially, would suffice to replace one-half of all the stationary engines of the U.S.A. or one-fifth of the stationary engines installed throughout the world. But we must confess that we utilise only 830,000 h. p., that is, 1.3 per cent of this huge reserve of water power.

Let us deal now somewhat more minutely with our main reservoirs of water power. Huge plains like the Western, the Moscow, the Central Black Earth, and the Nizhni-Novgorod regions, with their leisurely rivers, can safely be left out of consideration, while we concentrate our attention on the wide expanse of the Dnieper with its famous rapids where gigantic Dnieprostroy, the pride of the Soviets, is rearing its head, and will soon approach its completion. The power resources of this river are estimated at approximately 800,000 h. p.

There is a hum of activity heard in the southern part of our Union, under the shadow of the grey peaks of the Caucasian mountains. Soviet labour is already at work endeavouring to harness the power of these mountain streams and to make the "savage beauty" of the Caucasian landscape serve the purpose of socialist construction. The water power resources of the Aragva and Terek River systems have so far been estimated at 16 million h. p. Further away to the southeast, beyond the Caspian Sea and the vast sandy deserts, we have torrid Turkestan where the great rivers dash with terrific force down the heights of the Pamir, the roof of the world, gravid with potential power. Tentative calculations have put the water power resources of the Pamir at about 12 million h. p. Let us now pass from the torrid south to the country of perpetual ice and snow.

We have before us the unlimited steppes of West Siberia with scant water supplies and chiefly level land; only as we set foot closer to the Altai Mountains with their snow-clad peaks do we find more or less considerable concentration of water power. The Irtysh and Yenisei Rivers in the Altai region may be made to yield up to 600,000 h. p

Far beyond the Yenisei, in East Siberia, the Angara River is good for 700,000 h. p. at the Shaman rapids alone, while its entire capacity should be put at not less than 2 million h. p.

Generally speaking, the entire Asiatic part of the U.S.S.R. bids fair to produce a total of 41.5 million h. p. in water power, of which only about 45,000 h. p. have been put to use so far.

Such are our water power resources. However, it is generally conceded that the estimates are not based on an exhaustive study of the subject and the totals fall far short of the actual facts. Our general progress and higher level of scientific-technical equipment will in the near future double or triple the totals of our water power resources. Even now, notwithstanding the relatively very low degree of utilisation of these resources, we are already beginning to travel on the highroad of modern industrial development and will soon harness the immense potential energy stored up in our rivers and lakes awaiting the giant but skilled hand of Soviet labour to translate this wealth into a powerful factor of Socialist construction.

We have already made true the "splendid dream" of many centuries, by harnessing the ancient Volkov River, famed in the folk-lore of the free warriors of ancient Novgorod. Manacled by ferro-concrete dams and sluices, trapped by giant turbines, this Hercules now turns powerful generators and sends millions of progress-spelling electric units to the City of Lenin.

A similar song of toil will soon be sung by another great river, the ancient thoroughfare of the free Cossacks of the Ukraine, made famous by the ballads of Gogol.

When the mighty turbines and generators are at work, this stream, the Dnieper, will grind out millions of kilowatt-hours of energy.

In the distant Siberian taiga, where the tsarist government used to torture those who fought in freedom's cause, the Angara water power station will account for 2 million h. p.

The gradual harnessing of the huge resources of water power in the Caucasus already referred to is now in progress. At the confluence of the Aragva and Kura Rivers, below the ruins of the ancient monastery sung by Lermontov ("Where, like two sisters embracing, the Aragva and the Kura mingle their waters"), we see today the embodiment of our poetry of toil, the Zemo-Avchal hydroelectric power station, on which Lenin's benign, shrewd eyes are steadfastly directed from his monument nearby.

In concluding the discussion of our water power resources, I must reiterate that our study of this source of wealth so far has been entirely inadequate.

Wind Power Wealth of the U.S.S.R.

According to calculations made by Arrhenius, the world's total wind power capacity is 5,000 times the power capacity of coal consumed in a year. In the U.S.S.R. we have most powerful winds in the northwestern and southeastern parts of the Caucasus. We all know about the strong north winds of Novorossyisk and Baku.

The Central Aerodynamic Institute which has investigated the subject sets down the average annual wind power capacity available for utilisation in the European part of the U.S.S.R. alone as possibly 100 million h. p. Here again we have to deal with a question which has not been studied. Even the locale of the maximum wind power concentration has not yet been ascertained, nor have the methods for surveying these forces been worked out. What the Academy of Sciences has done in this matter is only a drop in the bucket. Still there are numerous branches of economy in this country whose development is retarded by the absence of cheap power. Such power can be supplied by the wind if proper wind motors are produced.

Forest Wealth of the U.S.S.R.

I shall now speak of our forests as a source of power, as one of the basic items in the national wealth of our Union which, by the way, plays also an important role in our export trade. Yet the question of our forest wealth has been studied even less than any other question relating to our natural resources.

In fact, our knowledge of our forest wealth is altogether meagre. It is assumed in a general way that our timber resources are enormous, that we have huge areas covered with forests in the U.S.S.R. But the available information about the forest resources at our disposal is full of contradictions.

According to some data, the U.S.S.R. possesses 640 million hectares (180 million in the European part and 460 million in the Asiatic part of our Union), out of the world's total forest area of 3,034 million hectares, or roughly speaking, we own from one-fourth to one-fifth of the world's timber supplies.

According to other data, on January 1, 1924, the forest area of the U.S.S.R. was set down as 921,838,000 ha., of which about 600 million ha. are conveniently located for lumbering.

These contradictory data are due to the feeble study of our forest resources. There was little light shed on most important questions, like the question of density of forests, which is essential for the assessment of our forest wealth, or the question of the species of trees predominating in our forests, and so on. Without possessing correct scientific data on these questions, we cannot work out a proper plan for the utilisation of our forests, or the constant renewal of our forest wealth.

It has been tentatively estimated that the total resources of the forests of the U.S.S.R. are equal to 18 billion tons of fuel, while the average annual increment has been estimated at 315 million tons, of which about 62 million tons of fuel were allocated to the European part of our Union. All these figures are of highly doubtful character, duc to the meagre scientific data available on the subject. Scientific investigation may have all kinds of surprises in store for us, upsetting all our present calculations.

Such is the state of our knowledge concerning the power resources of our Soviet Union. It is a highly unsatisfactory picture.

Mineral Wealth of the U.S.S.R.

We shall deal first with our ore resources, and then with non-ore mineral resources. As I have already taken up a good deal of time, I shall be more brief in this part of my address, which is devoted mainly to the most important ores of ferrous and non-ferrous metals.

Metal is the foundation of our present civilisation (the Iron Age). Metal is at the very root of our socialist construction, which produces not only commodities for consumption but also the means of production, machines of various kinds which, to use a metaphorical phrase of Lenin's, are the "machine slaves" of modern culture. Therefore, not only iron but also all metals connected with the metallurgy of iron, such as manganese, chromium, tungsten, nickel, molybdenum, are of tremendous importance to us. Since our present period, the Soviet period, is one of electrification and aviation, it is highly important that we possess metals used in these branches of industry (copper and aluminum). Concessions to money currency, while we are surrounded by capitalism, compel us also to pay attention to the so-called noble metals: gold, platinum, silver; but later, in communist society, these will forfeit their importance as "sacred idols" and will serve the more prosaic needs of mankind.

Iron. The smelting of pig-iron increases year by year in our Union. As late as in 1926—27 our 49 smelting plants turned out altogether about 3 million tons which was about 70 per cent of the 1913 output on the territory of the present Soviet Union. In 1930 we smelted 5 million tons of pig-iron as against 4.2 million tons in 1913; the 1931 plan provides for the smelting of 8 million tons, which is nearly twice the pre-war output, and by the end of the first Five-Year Plan an annual smelting output of 17 million tons is contemplated. Such a programme compels us to deal in all earnestness with the question of our iron ore supplies, taking the necessary steps in time to prevent any hitch in production.

The world's supplies of iron ores, tabulated in 1926 by O. R. Kuhn, are estimated at 243,361 million tons, including 65,804 million tons of probable, and 176,557 million tons of possible supplies. Our share of this total, without taking stock of the Kursk and Krivoy Rog iron-ore quartzites, amounts to 1.1 per cent, that is, our total supplies are estimated at 2,677 million tons, while with the inclusion of the Kursk and Krivoy Rog quartzites, according to the Geological Bureau's "Survey of Mineral Resources" for 1926-27, our share rises to 16 per cent, that is, to about 37 billion tons.

The investigation of the Kursk magnetic ores is still far from complete, and it is too early to base operations on definite figures; nevertheless a preliminary calculation allows us to assume that the iron ores of the Kursk magnetic anomaly will in all probability double the world's supplies, deferring by many centuries the menace of a civilisation bereft of iron.

At the present time, first place as regards probable supplies is occupied by the Kerch region, whose supplies are estimated by some geologists at 1 billion tons and by others at 1.5 billion tons. More precise prospecting has been done on the deposits of the Eltigen-Ortel molds and on the mine operated by the Kerch Metallurgical Works. The supplies here were estimated at 169.5 million tons. The Kerch ores represent brown iron-stones containing from 35 to 45 per cent of iron with a large content of phosphor, arsenic, manganese and vanadium.

Krivoy-Rog comes first as regards quantity output and quality of ore mined. Its probable stores, accurately prospected, reach 466 million tons running to a depth of 640 metres. Furthermore, at this place up to 40,900 million tons of iron ore quartzites of two types are deposited: rich ore, containing from 40 to 45 per cent of iron, and poor ore, containing from 20 to 25 per cent. According to the opinion of V. G. Mukhin, the entire deposits of these quartzites may yield as high as 7,500 million tons.

The Krivoy-Rog ore consists of red iron rocks containing from 50 to 70 per cent of iron. It used to be worked by surface methods; now underground work comprises 48.1 per cent and it grows year by year.

The next important iron ore centre is the old *Ural* ore region. The latter, according to recent data, has about 690 million tons of various iron ores: magnetites, hematites, feldspar and brown iron ores. The actual and probable supplies reach 317.3 million tons, but only 23 per cent are fit for immediate smelting; the remainder needs either simple (37.2 per cent) or even complex dressing (39.8 per cent), *i. e.,* magnetic separation, agglomeration, etc. Consequently, the future progress of the Ural iron ore industry lies along the line of dressing. Geological investigation annually necessitates modifications of our estimates, and also our ideas of the quality of the Ural ore.

Within the European part of our Union, in the *Moscow Region,* there is also a great iron ore region comprising numerous deposits of brown ore, more rarely feldspar, with an average content of about 40 per cent of iron. The total deposits of the iron ores are immense: the actual and probable supplies reach 653 million tons, and the possible supplies are estimated at about 726 million tons; but all these veins are scattered and broken up into many small units and therefore have to be operated on a small scale. The most important region is Lipetsk with its 11 million tons of actual and 680 tons of possible supplies; next in importance is Tula with its 500 million tons of probable supplies.

Ore deposits were known to exist in our northern region for many years past. There is a great future in store for the Murmansk deposits of magnetic and iron blende. The total supplies are tentatively estimated at 16 to 20 million tons. In the same district there are also lake swamp ores with a total reserve of up to 16 million tons.

Siberia is relatively poor in iron. The Telebes deposit in the Kuznetz Basin, situated 60 km. southeast of the town of Kuznetz, is the most prospected and studied district. Originally the supplies there were estimated at 50 million tons, but prospecting by Prof. M. A. Usov has resulted in reducing the supplies to 2.5 million tons. The total supplies of iron ore in Siberia to date are estimated at approximately 25.6 million tons.*

* Over the entire territory of West Siberia the iron ore supplies of the A and B groups are estimated at 23.9 million tons, and of the C group at 31.7 million tons; altogether, 55.6 million tons. Yet, the metallurgical plants to be constructed under the plans of the second Five-Year Plan will need about 12 million tons of ore annually. The existence of ore in Siberia is unquestionable. Never-

Recently there has been some progress made in Kazakstan as regards iron ores. Thus, in the Karkaralinsk district three deposits were discovered: Ken-Tube (magnetites), Togai I (iron blende), and Togai II (magnetites), whose stores are estimated at approximately 35 million tons.

The Dashkesan iron ore deposits with total supplies of 176.5 million tons of magnetites having an iron content of 50 per cent are located in Trans-Caucasia, within the confines of Azerbaijan.

Altogether, in all the principal iron ore regions enumerated above, we have an estimated total of 3,102 million tons of iron ore containing approximately 1.5 billion tons of pig-iron, thus exceeding somewhat the estimates given in the above-mentioned "Survey of Mineral Resources" for 1926-27, issued by the Geological Bureau.

Since extensive operations can be carried out only on the big deposits, it stands to reason that the operations will have to be concentrated chiefly on Krivoy-Rog and next on the Urals and partly on the Kerch ores which are of very low quality. Clearly, we shall not manage without starting operations on the Kursk magnetites, and one can only welcome the fact that upon the initiative of Comrade Stalin, work has been renewed for prospecting that remarkable storehouse of mineral wealth. Should prospecting upon a large industrial scale give satisfactory results, we shall then have a third huge metallurgical base in the proximity of Moscow which will form one of the cornerstones in the edifice of Socialism that we are erecting.

Manganese. Modern metallurgy requires great quantities of manganese, the consumption of which is ap-

theless, the plans provide only for a full supply of Siberian ore to the Abakan plant, and for a 50 per cent supply to the second Kuznetz plant (Osinovsky). The rest of the metallurgical plants will have to use imported ore.

proaching half a million tons a year. About nine-tenths of the world's output of manganese goes into various manganese compounds of steel to give it special durability, to render it malleable and to purify it of sulphurous and phosphorous admixtures. The remaining tenth enters into chemical, glass and other industrial processes. Old prerevolutionary Russia already occupied first place in world production and exporting of manganese.

Known manganese deposits exist in the Caucasus, in the Urals, Siberia and Turkestan. The total supplies of manganese ore are estimated at 210 million tons. The largest of these is at Chiatura in Georgia, whose ore supplies are estimated at 100 million tons. In magnitude and the high quality of the ore, the Chiatura ore deposits are the richest of all known and prospected manganese deposits in the world. The manganese content in the purified ore is about 60 per cent.

The Nikopol deposits situated in the district of the town of Nikopol on the Dnieper ranks second as regards resources and mining of manganese. The manganese content of this ore ranges from 35 to 57 per cent, and is, therefore, inferior in quality to the Chiatura ore. The Nikopol ore supplies are estimated at about 33 million tons.

Manganese deposits are to be found also in a number of localities in the Caucasus and in the Urals, but I am not going to dwell on those deposits. I shall merely mention the existence of large manganese deposits in the Maikop-Laban district. The colossal manganese deposits of Chiatura, Nikopol and Laban fully assure the development of the metallurgical industry of our Union.

Chromium. Chromium is another metal which plays a big role in the metallurgy of iron and steel, hardening them and reducing their malleability. Chromium is obtained from chloric magnetite, found chiefly in the Urals, where as many as 300 different deposits of this ore are known to exist. The character of these deposits requires complex and costly prospecting operations before we are able to ascertain with any degree of reliability what amount of chromium is contained in them. At any rate, these supplies should suffice to fill our wants of this essential mineral in metallurgy and chemistry for many years to come.

There are yet other metals required in metallurgical processes besides those already discussed, *viz.*, nickel, cobalt, tungsten, molybdenum, bismuth and vanadium.

Nickel. Nickel ores are found chiefly in the Urals where, in the nickel zone stretching for about 30 kilometres, there are deposits of nickel ores estimated at approximately 650 to 660,000 tons with a nickel content of 3 to 4 per cent; also from 1.5 to 2 per cent (poor ores).

Cobalt deposits of more or less industrial value are so far not known to exist on the territory of the Soviet Union.

Tungsten, which has acquired great importance in technical processes in recent years (in the production of higher grades of special steel, electric lamp filaments, X-ray electrodes, phonograph needles, etc.), is found in the Urals, in Trans-Baikalia, and in 1921 tungsten ores were discovered also in Kazakstan.

Molybdenum belongs to the group of rare metals and is used to produce durable filaments for electric lamps and appliances, and also in radio sets; its chief use, however, is in metallurgy for the production of special brands of steel. The ore is usually known as molybdenite, small quantities of which are to be found in various localities in the U.S.S.R. Of particular industrial importance are the Trans-Baikalian deposits along the River Chika and in the Ussuri region, with visible supplies of 348 tons.

Bismuth is used in smelting fusible metals, in the dyeing and glass industries and in medicine. The principal bismuth deposits are in the Sherlovaya Mountains of Trans-Baikalia and at other points in the Amur province. There are indications of bismuth blende deposits in the Caucasus, near the village of Keidy, Soviet Republic of Daghestan.

Antimony is the most brittle of metals; it is used in combination with lead and bismuth in the casting of printers' type, in vulcanising automobile tires, preparing dyes, in pharmacy, etc. The ore is found in nature as antimony blende. Deposits are located in the Urals, the Caucasus, Turkestan, and Trans-Baikalia, but none of these deposits have been much explored.

Vanadium is added to steel, considerably enhancing its resiliency. Vanadium steel finds wide application in the manufacturing of railway-car axles and tires, also fire-arms and armour. In the Soviet Union vanadium deposits are known to exist in the Perm district and in Turkestan. Of great importance is the vanadium mine located at the Tuya-Muyan Pass in Ferghana which supplies the metallurgical works of the Urals.

All the aforesaid metals are used as admixtures to other metals, chiefly to steel to which they impart highly esteemed special properties.

Copper. The rapid growth of industrialisation in our country, especially the fulfilment of our electric plans, give rise in the Soviet Union to particularly urgent need for a number of non-ferrous metals, such as copper, lead, zinc, tin, etc. In pre-revolutionary days the production of various non-ferrous metals was but poorly organised, and old Russia had to depend almost entirely on foreign imports, for which it had to pay in foreign currency. Now the Party and the government have set us the task of liberating ourselves from foreign dependence in the matter of non-ferrous metals. Consequently, the utmost attention must be given to the problem of ascertaining the extent of our non-ferrous metal resources, expediting our geological prospecting work in this direction as much as possible. Still I feel constrained to report that the situation is not quite satisfactory. Take, for instance, copper. Our chief copper-producing centre is the Urals, which yields 95 to 97 per cent of our entire copper output. How do matters stand there as regards a scientific survey of our copper resources?

In an article by B. A. Lindener on "Useful Minerals in the U.S.S.R." we read the following:

"Exclusive of the copper supplies of the Perm deposits . . . the total supplies of the Urals are estimated by the mining engineer N. P. Kuznetsov at 65,000,000 tons of ore, or 1,420,000 tons of metal. According to the geologist V. K. Kotulsky the figure given by Kolesnikov, *viz.*, 365,000,000 tons, comes nearer the truth."

In the "Survey of Mineral Resources" for 1925—26 the actual and probable copper supplies of the Ural deposits are estimated at 325,195 tons.

One can account for these contradictory statements by assuming that the figures given by Kuznetsov include also the possible supplies.

Such is the situation in a region where copper has been mined for more than a century. On other regions we have no statistics whatever summarising our copper resources. Data are available only for individual mines.

Still, the prospects for the development of copper production in the Soviet Union are good. In the first place, our attention should be turned towards the cupriferous sandstones of the Perm system running in a wide strip of territory parallel to the western Urals, which used to be worked in the past. According to preliminary surveys, they contain about one-half of all the copper supplies of the Urals. The Caucasus, which supplied 30 per cent of our entire copper output before the war, has now dropped to 2.6 to 3 per cent owing to curtailment of operations in the Kedabek copper mines.

Yet the Caucasus counts numerous districts of unquestionable interest. For instance, in the Zangezur region along the Arax River about 50 deposits were located, but we have data on only four or five of them; the Batum district contains more than 100 deposits, but what do we know about them? Next to nothing. But geologists declare that the prospecting of that region promises a great future.

There is room for extensive exploration of the local deposits of Kazakstan and of the Minusinsk district in Siberia. There are indications of copper also in Turkestan and in other parts of the Union.

It is our wish to overtake and surpass the capitalist countries technically and economically, including the development of our natural resources. This will be difficult to attain if we stay in the old rut and maintain the old tempo as regards studying our natural resources. We must bear in mind that of the world's total estimated supply of 30 to 40 million tons of copper metal about three-fourths are in America, chiefly the United States and Chile. In 1926 when we produced 10,800 tons of copper, the United States produced 791,500 tons and Chile 202,300 tons.

But we are beginning to develop our copper industry. In 1930 we produced 47,400 tons, and according to the plan for 1931 we should produce 147,500 tons, as against 32,400 tons mined by pre-revolutionary Russia in 1913.

In order to accomplish our tasks, we must devote the utmost attention to the study and exploration of our copper resources.

Polymetallic Ores. As might be expected, the situation with regard to our knowledge of our resources of other non-ferrous metals is no better. This applies to zinc, silver and lead, which are usually found in nature mixed with so-called polymetallic ores, often in combination with gold and copper. As already said, pre-revolutionary Russia depended practically entirely on imported non-ferrous metals. The domestic output of zinc was only 28 per cent, and of lead 2 per cent of the requirements; the rest had to be imported from abroad.

The feeble development of the production of these metals was due by no means to any absence of such deposits in Russia, or to the poor quality of the latter, but chiefly to the general technical and cultural backwardness of the country: first, there were bad roads, or no roads at all, and the deposits were situated far from the consuming centres; second, there was a decided lack of ability to handle the intricate processes of the dressing and metallurgical treatment of polymetallic ores, and so forth.

Some of our deposits of polymetallic ores are among the richest in the world. Thus, the Altai Mountains, according to most general estimates, hold no less than 6 million tons of ores containing zinc, lead, copper, silver and gold.

Preliminary exploring in Kazakstan resulted in an estimate sufficient for orientation purposes of 3,300,000 tons of polymetallic ores.

The total supplies for the whole Union, according to data furnished by the Chief Geological Survey Bureau, are as follows: zinc, 1,566,000 tons; lead, 1,000,000 tons; silver, 2,733 tons; these ores are calculated to contain up to 50 tons of gold, on the basis of prospecting operations. The possible supplies of Altai and Kazakstan are estimated at a total of 9,300,000 tons. It is one of our most urgent tasks to make surveys and obtain more exact data.

Without going into the question of our supplies of gold and platinum, I shall now pass on to consider the group of useful non-ore minerals.

Useful Non-Ore Minerals. I have already said that for the successful completion of our socialist construction we shall need huge quantities of materials of various kinds: metal, coal, petroleum and the consumption of huge volumes of power of various kinds. In the preceding survey of our natural power and mineral resources we indicated the sources to be worked to secure the necessary supplies of coal, natural gas, peat, water power, wind power, ores of iron, manganese and other metals.

But the country that is building Socialism requires, and will require in ever larger quantities, also materials of a different kind to which little attention was paid in the past, either because they are exceedingly common (*e. g.,* clay, sand, etc.) or because until quite lately we had little or almost no knowledge of them (thorium, vanadium, etc.). Not so long ago we issued the slogan of the *chemification* of our country, and in order to carry out this slogan we shall need: salt, soda, Glauber's salt, boracic salt, potassium salts, saltpetre, sulphur, dolomite, magnesite, limestone, alunite, fusible feldspar, bauxite, barite, celestite, apatite, gypsum, chloric magnesium, pyrites, quartz, aerial gases, carbonic acid, arsenic compounds, etc. Moreover, we have decided to build good roads and to start with overtaking at least Western Europe, if not America, but to carry out this task we shall require: sand, gravel, mortar, asphalt, clay, granite slabs, flint, fused basalt, etc.

When we say that the whole of our country is "in the very thick of building operations," it is no metaphor but a concrete statement. We are building factories, mills, workers' villages, dwellings for workers in towns and in state and collective farms. All this requires huge quantities of sand, gravel, brick, gypsum, shale, crystallic substances, marble, magnesite, talcum, rotten-stone, infusorial earth, etc.

Just now an unparalleled revolution without precedent is takinng place in our agriculture, which is becoming collectivised and industrialised; the consummation of these great tasks will require great quantities of various raw materials in addition to the products of our heavy industries. For instance, to fertilise the soil we shall need potassium salts, phosphorites, apatite, nepheline, and to destroy locusts and other pests arsenical and barium compounds and a great many other substances will be wanted.

We are also faced with another great task — to complete the electrification of the country begun upon the initiative of Lenin. This calls for a great variety of insulating materials, such as mica powder, talc, asphalt and other essential electro-technical supplies: graphite, talcum rock, marble, rotten-stone, lithium salts, pyrolusite, selenite, zircon, asbestos, etc.

Our noblest task, attended with the greatest responsibility before contemporary and future humanity, is and remains the defending of the Land of the Soviets, where the great problem of building a new society upon the principles of Communism is finding its correct solution despite all attacks by numerous foreign enemies. This purpose is served by our heroic Red Army, with the aid of our war industry and aviation.

For these supremely important branches of our national economy we need: bromine, arsenic, titanium, thorium compounds, bauxite, chloric magnesium, lithium and beryllium compounds, helium, etc. Here belong also such industries as : abrasive, pottery, roofing, etc., which require substances analogous to those enumerated above.

All these substances we call *non-ore minerals*.

This designation may not be quite exact, for the list contains also some compounds of metals, *e. g.*, compounds of vanadium, lithium, beryllium, aluminum, etc.; still these metallic compounds are treated chemically and not in the usual metallurgical way, and this brings them close enough to the group of non-ore raw materials here under consideration.

Until quite recently little attention was given to these *non-ore* raw materials. Was it worth while to bother with deposits of clay, sand, building limestone and the like? Was this not "below the dignity" of a scholarly science such as geology? It was quite a different matter to study the geology of naphtha, or of coal, or of some other legitimate member of the geological family.

But behold the *annual world* consumption now of this "step-child" of scientific research which, according to data given out by the academician A. E. Fersman, has climbed to a gross value of 5 billion dollars, which puts these non-ore raw materials on a level with the annual output of metal in point of value, while the *gross weight* of the annual output of these materials is now 750 million tons.

The *annual consumption* of some of the more common kinds of these raw materials is indicated in the following figures: (a) stones, 200 million tons; total value, 600 million gold rubles; (b) sand and gravel, 300 million tons; value, 600 million gold rubles; (c) cement, marl, etc., 120 million tons; value, 400 million gold rubles.

This gives you the world consumption figures. Let us examine now what degree of development in the exploitation and utilisation of these non-ore raw materials has been attained in our Union.

In pre-revolutionary days non-ore raw materials were entirely neglected, in the sense that we remained satisfied with taking stock of the quantities used and estimating the available supplies and their value. Numerous production processes, *e. g.*, of talcum, natural soda, sulphur, strontium compounds, etc., had not yet been introduced. It was only in the post-revolutionary period that some attempts were made at taking stock of the extraction of the commonest useful minerals. According to A. E. Fersman, the spot value of the output in 1928 amounted to something like 90 million rubles, and it should have increased by this time (1930-31) to 300 to 350 million rubles. I am sorry that I have no data at my disposal to check up whether the exploitation and utilisation of non-ore minerals did reach the figures submitted by Fersman. However, let us accept these figures.

At any rate, these figures indicate an unsatisfactory rate of development of these branches of production, in our Union, which accounts for a shortage of these materials experienced in a number of industries, *e. g.*, the building industry. To cite an instance of how a comparatively trivial circumstance may affect large operations I will state that boring for petroleum is sometimes stopped owing to a shortage of cement. Obviously, the most serious attention ought to be given to this problem, especially in view of the fact that all these raw materials may be found in abundance within the confines of our Union except a few substances, like diamond, borax, cryolite, rare earths, and thorium, which have not yet been discovered in this country.

According to the opinion of so prominent a specialist on non-ore minerals as Fersman, our minerals in some respects are classed as somewhat inferior in quality to those abroad (phosphites) with districts scattered over wide areas. Only a few of our products evince the same general properties to which both American and west European technique has been adapted.

Yet this should not discourage us by any means. On the contrary, by dint of profound and thorough application to the problem at hand we must arrive at the correct way of utilising our own raw materials instead of following the line of least resistance by importing such materials from abroad.

I deem it irrelevant to recall here our recent debates in connection with the Tikhvin bauxites which were denounced by some as utterly worthless, declaring them to be not real bauxites, but bauxite-like clays. I may also mention in this connection that one of the members of the commission of which I was chairman a couple of years ago argued, frothing at the mouth, that it was far more advantageous for us to import bauxites from abroad than utilise our own "poorer" raw materials.

On the other hand, it ought to be made clear that we also have substances in this country that are not to be found anywhere abroad. We have quite an exceptional variety of metal salts, the supplies of which are estimated at billions of tons. The absorbent qualities of our whiting clays are $1^1/_2$ times stronger than foridine, although it requires preliminary treatment. The utilisation of the Khibina rocks is also a problem which calls for special scientific approach.

The list of other non-ore raw materials we possess in addition to Glauber's salt, already mentioned, includes potash and magnesium, clays and kaolins, quartz and nepheline materials, also decorative and building stones. These form the basis of our chemical, glass and pottery industries.

According to Fersman, the problem of mineral raw materials for our industries is least of all a problem of geology or geo-chemistry, — it is rather a problem of technology and economics.

What then are the resources of non-ore raw materials throughout the vast expanses of our Union?

This cannot as yet be expressed in figures, because these deposits, as is true of the rest of our natural wealth, have been but little explored. For the present we must confine our discussion to the qualitative character of these supplies.

We possess *huge stores of salts,* limestones, quartz and quartz materials, Glauber's salt, gypsum and asbestos.

We possess *considerable supplies* of phosphorus, pyrites, sulphur, kaolin, fire-proof materials, magnesite, salts of potash and magnesium, fusible feldspar, sulphate of strontium (celestite), sulphate of barium (barite), chromite, salt of beryllium (glucin) and selenium, carborundum, pumice stone, grindstones, glauconite, graphite, colour-stones, marble, talc and talcum rock.

We have *medium supplies* of bauxite, feldspar, mineral dyes, dolomite, compounds of titanium, salts of bromine and iodine, arsenic, radium ores, cyanite, asphalt, costly gases and helium, lithographic stone, ozocerite, chromic iron, and zirconium salts.

We have *poor supplies* of soda, alunite, compounds of thorium, zirconium, bismuth and vanadium.

No supplies of saltpetre and borax.

As our exploring activities develop, we are compelled to modify this list in part and will continue to do so in future. Quite recently a considerable iodine content was discovered in the waters of the Nefte-Chala oilfields at the mouth of the Kura River. I have just received a telegram stating that the water in Pit No. 6 was found to contain 49 milligrams of iodine per litre.

Borax is contained in the hot mud springs. The matter erupted by these springs must be analysed and no doubt will prove of interest and value.

An investigation of the lakes in the Kulunda Steppe will probably soon alter the situation as regards soda, etc. It means that when it comes to non-ore raw materials, we are poor not in resources, but in knowledge of them, which is more or less the chief trouble with all our natural resources. In this domain as elsewhere we are confronted with a number of extremely urgent tasks.

First of all, it is important to make a profound technological study of the various qualities of our *non-ore raw materials,* for here *quality* plays a highly important role. Only upon such basis will it be possible to group the different kinds of our raw materials properly and institute technical utilisation in our industrial plants.

Next, we must take a detailed inventory of our non-ore raw materials, showing their geographical distribution over the territory of our Union. To this end, the geological map of our country must be supplemented by a geochemical map showing the distribution of chemical elements irrespective of their practical value. This should supply the basis upon which the map of our non-ore materials must be charted.

I believe I have adduced sufficient facts to demonstrate the truth of the old conception that our country is not only vast, but abounds in natural wealth. I believe I have also substantiated my assertion that our knowledge about the great treasures stored in our soil and strewn over its surface is but of a general character exhibiting a lamentable dearth of detail and precision. True, our Soviet country has been richly endowed by Nature, but we must make use of all this wealth not merely to boast of it, but further our stupendous task of socialist construction, the beacon light which should inspire us all.

But for a business-like approach to our natural resources we lack the requisite information. This is a handicap which must be overcome without delay.

This irksome situation opens wide the door of possibility to the All-Union Academy of Sciences to reduce to practice its theoretical experience amassed during the two centuries of its existence, to conduct and institute scientific research work and place the erudition of its scientific staff at the service of all mankind in the world's first proletarian state where a new human society is already arising on firm socialist ground. This is indeed an epoch the like of which was never known in human history. Never before have social changes penetrated so deeply into the broad masses of the people. To remain in such an epoch a mere onlooker, an "objective and dispassionate" investigator of facts, is tantamount to failing to understand the real majesty and significance that should inhere in scientific pursuit, which should be based upon studying and satisfying the requirements of life.

Generally speaking, science detached from life is defunct science, rank scholasticism, which in our generation and country is *doomed to perdition.* Life will rise above the concept "science for science's sake" and will if necessary create new seats of learning where the pulse of life will throb, where science will become the handmaid of life's complex purposes, where the scientists will not form an exclusive caste of wizards, but an organic part of the great family of toilers, and where all artificial barriers between mental and physical labour will be obliterated. Both kinds of labour should be exerted by every member of that great family to the full extent of his strength and ability.

Then only will we see the real dawn of science, and emancipated human society, each member scientifically equipped and in possession of such resources and forces of nature as we cannot even conceive now, just as our remote ancestors could have had no idea of the marvels of contemporary technical achievement.

Natural wealth sounds the keynote in developing of forces of production, and these forces can attain their highest development only in a communist order of society. Onward then along the road mapped out by our great teachers, Marx and Lenin, to a land of true liberty and real brotherhood of all men!

Hail, the intimate union of science and labour!