MINERAL RESOURCES OF GEORGIA AND CAUCASIA

D. GHAMBASHIDZE F.R.G.S.

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MANGANESE INDUSTRY *of* GEORGIA

BY

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DELEGATE OF THE GEORGIAN GOVERNMENT

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INTRODUCTION

THE Georgians are an ancient civilized race with three thousand years of existence, but in spite of that very little known, as Georgia since 1801 ceased to be an independent kingdom, was forcibly annexed by the Russian Empire in violation of the Treaty of 1783, and was never allowed to make herself known to the outside world.

GEOGRAPHY.—Georgia is situated in Transcaucasia, between the Black and the Caspian Seas (40°–49° northern latitude, and 39°-47° east of Greenwich). She is separated from the North Caucasus by the celebrated Caucasian mountain chain, which stretches for a distance of a thousand miles from the Black Sea to the Caspian, and has an average height of 10,000 feet and in some places, as in the peaks of the Elbruz and the Kasbek, even 18,000 feet.

Georgia comprises the following provinces and districts: Tiflis, Zakathal, Kutais, Sukhum, the northern part of the Black Sea Province towards Tuapse, Ardahan and Olti districts, provinces of Batum and Lazistan up to Trebizond. The total area of this territory is 43,000 square miles.

The frontiers of Georgia are: in the north, the Caucasian mountain chain; in the east, Aderbeijan; in the south, Armenia; and in the south-west, Turkey.

Among the rivers the most prominent are: Kura, 310 miles long; Ingur, 95 miles; Rion, 140 miles; Chorokh, 160 miles; Terek, 210 miles.

The climate of Georgia is very similar to that of Italy and Spain. Under the protection of the Caucasian mountains and with plenty of moisture, there is a rich vegetation, and at a height of 4,000 feet there grow vast forests of oak, beech, chestnut, pines boxwood, etc.

All along the Black Sea shore orange and lemon trees are plentiful; wonderful rhododendrons luxuriate up to a height of 9,400 feet and alpine grasses are met with even at 11,500 feet. On the high mountains there are still to be found bisons, wild goats, hogs, reindeer, antelopes, etc. There are also four hundred varieties of birds.

The climate and beautiful scenery make Georgia very attractive, the Riviera on the Black Sea.

Population.—The total population of Georgia is about 4,000,000, of whom 3,650,000 are of the Christian Greek Orthodox faith and 350,000 Mohammedans.

The capital of Georgia is Tiflis, which was founded by the Georgian king, Vakhtang in the fifth century. The town has 450,000 inhabitants.

Railways and Ports.—The total length of railway lines in Georgia is 970 miles. The trunk line, leading from Batum through Tiflis to Baku on the Caspian Sea, is 556 miles long.

The coast line of Georgia along the Black Sea measures 345 miles. The principal ports are: Batum, Poti, Anaklia, Sukhum, Goudaut, and Rizeh.

The port of Batum is the terminus of the Transcaucasian railway line and also of the petroleum pipe-line from Baku to Batum. Batum is the transit port for the whole of Georgia, Transcaucasia, Turkestan and Persia.

Agriculture.—The agricultural resources of Georgia are considerable. The following products are grown: wheat, barley, maize, cotton, rice, tobacco, tea, etc.

Wine is grown very extensively, and its quality is equal to the superior French and Italian varieties.

There is also fruit-growing on a large scale; specially of oranges, lemons, olives, peaches, plums, pears, apples, and all kinds of vegetables.

Among other branches of agriculture silk production and bee-keeping are ancient occupations.

The country contains about 12,000,000 heads of domestic animals, and has vast possibilities for cattle-breeding.

Trade and Industry.—The principal ports for the foreign trade of Georgia are Batum and Poti.

From 1884 to 1914 the following products were exported to the countries of Western Europe from the port of Batum:

Petroleum, 22,661,532 tons; manganese ore, 1,676,824 tons (the bulk of this ore was exported from the port of Poti); wool, 99,832 tons; liquorice root, 369,563 tons; grains, 406,265 tons; silk cocoons, 23,451 tons; oil cake, 76,100 tons; tobacco, 2,769 tons; albumen, 7,520 tons; hides, 5,363 tons; lucerne seed, 9,460 tons; salt, 3,650 tons; almonds, 5,692 tons; cotton seed, 40,661 tons; walnut logs and boxwood, 65,053 tons; carpets, 23,800 tons; other articles, 331,998 tons.

During the same period the following articles were imported from Western Europe into the port of Batum:

Tin plate, 526,605 tons; timber, 650,118 tons; bricks and tiles, 113,539 tons; sulphur, 52,857 tons; metals, 106,537 tons; machinery, 45,315 tons; chemicals, 30,392 tons; silkworm eggs, 55 tons; hardware, 58,518 tons; cement, 19,215 tons; tea, 14,986 tons; other articles, 195,066 tons.

From 1884 to 1900, 75 per cent. of both the export and import trades of this port were controlled by Great Britain, but she was overtaken by Germany, who for the last ten years before the war controlled 65 per cent., Great Britain only participating with 7 per cent., the other countries being Austro-Hungary, France, Italy and Turkey.

The returns of shipping of all nationalities which entered and cleared in the foreign trade of the port of Batum from 1893 to 1914 are:

	Vessels.	Tonnage.
British	4,287	7,362,320
Russian	7,375	4,487,480
French	2,002	3,324,480
Austro-Hungarian	1,914	2,271,220
German	1,074	1,760,250
Greek	2,272	1,225,345
Belgian	647	1,145,390
Italian	531	604,720
Norwegian	110	158,800
Dutch	68	146,600
Danish	125	143,540

The traffic of the port of Batum is therefore considerable. It must also be noted that for the ten pre-war years the bulk of the German trade with this port was carried in British bottoms.

The returns of the shipping of all nationalities which entered and cleared in the foreign trade of the port of Poti (during the same period) are :

	Vessels.	Tonnage.
British	1,383	2,400,800
Austro-Hungarian	215	420,000
German	132	240,820
French	150	230,470
Greek	135	190,830
Dutch	40	96,300
Italian	60	94,400
Norwegian	55	93,820
Belgian	20	50,120
Spanish	9	20,300

This shipping was exclusively devoted to the export of manganese ore.

The industry of Georgia is very small at present, with the exception of that of manganese, petroleum, and copper smelters —one of which belongs to the Caucasus Copper Co., Ltd. (British property) ; but there are vast opportunities for building up a huge industry, as raw materials are available in abundance.

EDUCATION.—The seat of the Georgian University is Tiflis : it has 35 professors and 1,000 students. There are also two Colleges of the Nobility, one in Tiflis and another in Kutais ; two Theological Colleges, 25 Grammar Schools, 3,000 so-called People's Schools, 15 Agricultural Schools, 18 Technical Schools, and 28 Ladies' Needlework and Carpet-weaving Schools. A considerable number of students receive education annually at the universities and colleges in France, Italy, Belgium, Switzerland, Germany and Austria.

LITERATURE AND THE PRESS.—Georgia possesses a very rich ancient and modern literature, and there are translations of the modern classics of all countries. Nearly all of Shakespeare's dramas are translated into Georgian. There are about twenty-four daily papers and weeklies, and about three hundred and fifty books are published every year in half-million copies. Ninety per cent. of the total population of Georgia can read and write, and the many schools and libraries satisfy the eagerness of the people for education.

Church.—The Georgian Church is one of the ancient Eastern Christian Churches of the world. It is second to the Greek Orthodox Church in antiquity. The head of the Church is the Catholikos-Patriarch, who is elected by the entire nation. The present Catholikos-Patriarch is His Holiness Leonide. The hierarchy includes three Metropolitans—the first of Tiflis, the second of Kutais, the third of Chkondidi—and twelve Bishops. The Georgian Church is independent from the State and its funds and properties are administered by the Laymen's Committee, and the clergy is elected by the parishes.

Societies.—The capital of Georgia—Tiflis—is the educational, literary, commercial, and social centre of the country. Many Georgian Societies have their head offices in that city, the most important ones amongst them being: the Georgian Literary Society, with 35 branches and 20,000 members, this Society being chiefly engaged in distributing popular literature amongst the peasants and in establishing schools; the Georgian Charitable Society, with 24 branches, was started in 1914 in connection with the war, and has done great work in helping the families of the soldiers and the poor in general; the Georgian Agricultural Society; Georgian Historical and Ethnographical Society; Georgian Geographical Society; Georgian Journalists' Society; Georgian Teachers' Society; Georgian Artists' Society; Georgian Technical Society; Georgian Mining Engineers' Society; Georgian Pharmaceutical Society; Georgian Medical and Naturalist Society, etc.

There are also various Co-operative Unions; the co-operative movement is very strong in the country. There are about four hundred co-operative societies—85 per cent. of the Georgian peasantry are organized co-operators.

Constitution of Georgia.—Georgia has been an Independent Republic since November 22, 1917. At the head of it is an elected President, and Cabinet Ministers are elected from among the Members of Parliament. The seat of Parliament is Tiflis.

Army.—The Georgian Voluntary Army has a force of 40,000 men, comprising all arms, and a fine corps of officers and experienced generals, amongst them 120 staff officers; one staff college, and two Military Schools for officers.

POLITICAL LIFE.—The different political parties are: the National Democratic, Radical, National Socialistic, and Social Democratic. All parties are strongly democratic in their attitude and the population takes a lively interest in their conduct. The election system is based on the broadest franchise for both men and women.

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Mineral Resources of Georgia and Caucasia

GEOLOGICAL DESCRIPTION

THE Caucasian mountain chain extends from the Sea of Azoff in a straight and uninterrupted line to the Apcheron Peninsula on the Caspian Sea in the direction W.N.W. to E.S.E. and has a length of about 1,000 miles.

Its western part mostly forms a single chain, while the eastern half expands in places into three or four parallel ridges and forms the mountainous region of the Daghestan.

Geologically the land between the two seas belongs to the tertiary and upper secondary orders, and was at an epoch after the deposit of the former pushed upwards by some gigantic subterraneous pressure and broken through by the igneous matter which now forms the axis and crest of the main chain, in the shape of crystalline rocks, granite, gneiss, porphyry, diorite, trachytes, etc.

This intrusion left the originally horizontal strata in a nearly vertical position, with outcrops on both sides of, and parallel with, the main ridge, their tops slightly inclined towards the south. This inclination explains why the mountains forming the main chain are generally steep on the south side, while their northern slopes cover a large area.

At a later epoch a second similar disturbance lifted the land south of the main chain, where the Lesser Caucasus was formed, also with the intrusion of the granite, porphyry, basalt, etc. which we now find in the Pontic Ridge and towards Erivan. The upright position and the direction of the strata are approximately the same as in the main chain.

Considering that all these strata were originally more or less horizontal and formed part of the bottom of a sea which then covered most of Europe, and from which the Caspian was cut off by these upheavals, it will readily be understood how fossils and minerals of undoubted marine origin are to-day found on many mountain-tops.

At the same time the age of the original strata, as shown by their fossils, proves that the two great earth movements must have taken place in the tertiary period, that is to say, at a comparatively late date of the earth's history, so that these mountains may be called young and have not yet been destroyed or considerably altered by the inevitable erosion.

As to the formations which to-day constitute the surface of the Caucasus, it must be mentioned in the first instance that the main ridge formed at the Jurassic epoch a barrier between two sea basins of quite different nature. The tertiary deposits from these waters therefore also vary considerably, according to their position north or south of the main chain.

The lower Lias, which represents the oldest bedded formations in the Caucasus and is not found anywhere else in South-eastern Europe, exists here on both slopes and in contact with the central intrusive rocks.

In the northern Caucasus it is found in the shape of schists and limestones containing vegetable imprints and the characteristic marine fossils. The latter are missing on the south side of the ridge, but the vegetable traces remain, and lead in several places to underlying coal measures.

The Oolitic system is represented on both sides of the main chain by exclusively marine formations, which, however, are not yet sufficiently explored in the central and western parts. But in the Daghestan the formation appears as a powerful series of black schists containing the characteristic fossils, and as ferruginous limestones and marls very rich in remains of a great number of animal forms, specially ammonites.

North of the central massif of the main chain the Oolitic formation crops up as sandstone covered by dolomitic limestone and tertiary sediments, while south of it in Georgia, near Kutais, limestone and marls with corals appear.

The Cretaceous formation shows important outcrops on both slopes in the shape of Senonian grey and white limestones, which are largely represented in the Daghestan to a thickness of about 1,000 metres.

Eocene nummulitic limestone and calcareous sandstone are widely known on the south slopes and contain numerous nummulites and other fossils; specially in Georgia along the Rion River this formation is well developed. But on the north side of the main chain the nummulites are entirely missing in the corresponding strata.

During the glacial period which followed the described formations the Caucasus was also covered with ice, and while the gigantic ice-sheets which had crept down from Scandinavia and covered the whole of Northern Europe to the Urals did not quite reach the Caucasian chain, the great height of the latter favoured the formation of glaciers, which radiated in all directions, covering mountains and lowlands alike, and joined in the south those descending from Mount Ararat. This period of extreme cold left its indications in numerous moraines found all over the country, and in many places on rocks marked and polished by the grinding action of the ice.

Besides the two principal earth movements which produced the main chain and the Lesser Caucasus, which run practically from east to west, later disturbances must have effected a transversal pressure and undulatory movements, resulting in depressions and elevations. A depression occurred in the basin of the Sea of Azoff, severing the Caucasus from the Carpathians, of which it was originally the continuation, while an elevation produced the Suram Ridge, running north to south, which forms a connection between the main and the Lesser Caucasus and divides eastern and western Georgia.

This ridge constitutes to-day the watershed between the Black and the Caspian Seas, cutting the territory south of the main chain into two principal valleys, one of the Kura River, which falls into the Caspian, and the other of the Rion River, which is much shorter and forms a basin open towards the Black Sea.

Similar conditions prevail in the northern Caucasus, where one of the two principal rivers, the Kuban, flows into the Sea of Azoff, and the other, the Terek, into the Caspian, both taking their sources in the central mountain stocks.

The present orographic aspect of the country is due to yet two further factors which acted upon it in recent geological times, the first one being constituted by the intrusion of eruptive rocks, which occurred independently in many places on a smaller scale. Granite and porphyry in the Erivan district have already been mentioned, while in the Daghestan mountains diabase and melaphyres are more common.

These igneous intrusions often include or are accompanied by metalliferous deposits or veins, and are therefore of the highest importance ; their frequency is, in fact, the principal cause of the richness of the country in certain minerals.

Rather remarkable intrusions in the shape of two dykes of rhyolite exist in the northern Caucasus. The principal one forms the Beshtau mountain, which reaches up to 4,200 feet above sea-level, and the Kuma mountain, which stands almost vertically like a needle to a height of 350 feet above the plain, proof that at least this thickness of tertiary deposits has been washed away. These dykes are not accompanied by any metallic deposits, but their presence is undoubtedly connected with the many mineral sources which spring up around them.

The second factor which to a certain degree influenced the present aspect of the country are the numerous volcanoes which were yet active after the great movements had taken place and whose craters are still unmistakable, principally in the eastern main chain and the Erivan district.

To-day they are extinct, and the only manifestation of seismic action are the so-called mud volcanoes, which are specially numerous in the Caucasus. They are small hills from which a dark, somewhat saline mud flows in a more or less continuous manner, driven out by subterranean gases which escape in bubbles bursting on the surface.

These flows exist mostly near both ends of the main Caucasian chain, on the Taman and Kertch Peninsulas and near Baku. The latter have in the course of time formed quite considerable hills, one of them being over 1,250 feet high. The mud is in places saturated with combustible gas and also naphtha. This flow is situated at some distance from Baku and near the sea, which itself is also often agitated by subterranean gases which eject mud and stones. In view of the volcanic nature of the Apcheron Peninsula this is not surprising.

In the Taman region the flows of mud vary considerably and have occasionally volcanic force.

FRONTIER STATION, LARS, ON THE GEORGIAN MILITARY ROAD (GEORGIA).

Similar muds, half liquid and more or less saturated with gases and of various temperatures, are also found in many other places, forming ponds without movement or apparent inlet or outlet.

Volcanic action of another kind is yet visible at the extinct volcano of Demavend, Daghestan, which appears to-day as a solfatara. It is 14,000 feet high and snow-topped, while all round it small cones have been formed from which sulphurous fumes escape.

As further secondary manifestations of volcanic activity occurring to-day in the Caucasus there are to be mentioned the numerous hot mineral sources and gaseous emanations, described in Part III, and also the frequent earthquakes.

The following descriptions of mines and mineral deposits do not claim to be a complete enumeration of all the occurrences of ores and other useful minerals existing in Georgia and the Caucasus, principally because a systematic geological survey of the country has not yet been made, in consequence of the absolute neglect by the Russian Government. The only serious investigations have been carried out by English, German, French, and Georgian geologists and engineers, who, however, mostly examined only certain mines or separate districts. Much has to be done yet to produce a complete and detailed Geological Survey of this country abounding in mineral riches.

PART I

METALS

1. Iron.

THE Caucasus contains several deposits of excellent iron ores, but it has so far been impossible to smelt them in the country, on account of the absence or inadequacy of the necessary fuel, and their export has been hindered by the difficulties and the cost of transport. The application of naphtha residues, which are the only carbonaceous material really available in quantities in the country, has apparently never been tried yet for the reduction of ores, but might be of use in connection with the electric furnace.

As they are not of immediate use, most of these deposits have not been closely examined, and in many instances only the outcrops are known. The total quantity of ore contained in them is estimated at about 13,000,000 tons, as far as ascertained until now. This ore would contain about 7,000,000 tons of metallic iron.

The only deposit where a regular, though very small, exploitation is kept going occurs at **Khamuli,** in the Province of Kutais (Georgia). Ore has also been extracted at **Ubissi** and **Shrosha** in the same district.

Hematite ore is found at **Tchatakh,** S.W. of Tiflis (Georgia), in a mass of porphyry of 72 feet thickness. The ore is disseminated in it in irregular proportions, the central part containing from 23 to 65 per cent. metallic iron.

A considerable outcrop having a length of 600 to 700 yards is visible along the River Bzibi, north of **Sukhum,** Georgia. It consists of brown hematite of good quality, produced probably by the oxidation of iron pyrites, a bed of which continues into the Apshri mountain.

In the south-western part of the country there are several good outcrops, as for instance near **Artvin** (Georgia), where rich red hematite is found in Senonian limestone, the samples from it containing from 50 to 63 per cent. of metallic iron.

Similar hematite exists also at **Nadarbazar,** and two deposits of it crop out near **Batchinsk,** at the contact of limestone and melaphyres ; this ore body is of eruptive origin.

In the northern Caucasus, in the **Maikop** district, there are several deposits of red hematite and magnetite, but they have never been properly investigated, although samples taken from the outcrops proved to be of remarkably high tenour, the hematite running up to 65·6 per cent. of metallic iron and the magnetite even to 70·91 per cent. This ore seems therefore to be purer than that produced in the Donetz Basin and will undoubtedly in time be exploited.

Another rather famous deposit of iron ore occurs in the Terek Province, near the old fortress of **Vedenoff.** It was used by the celebrated Shamil for the manufacture of cannons, although the quality is not very good, analyses of samples having given the following results :

	Per cent.
Iron oxide	41·73
Silica	27·10
Alumina	15·26
Copper	1·04
Manganous oxide	0·87
Moisture	3·27
Loss on calcination	9·14
	98·41

Near **Lenkoran,** on the Caspian Sea, there are also large deposits of sands mixed with chrome iron and magnetite, but not rich enough for treatment.

Similar magnetic-iron sands cover also part of the shore near **Poti,** on the Black Sea (Georgia).

In the Province of Elizabetpol, near **Dashkesan,** another large deposit occurs. The ore body consists of magnetite at the contact of diorite and limestone and has a thickness varying between a few feet and 20 yards. It is estimated to contain 2,000,000 tons, averaging 60 per cent. of metal, and running in parts up to 65 per cent. but no work has been done on it.

The quantities of ore extracted in the whole Caucasus during recent years were :

1910. Tons.	1911. Tons.	1912. Tons.	1913. Tons.	1914. Tons.
572	655	924	357	532

This ore was used locally, mostly for making paints, but there is no doubt that means will be found to exploit on a commercial scale specially the Georgian deposits, which contain the bulk of the ore and are easier of access and near the sea.

2. Manganese.

Manganese ore is one of the three most important mineral products existing in Georgia, the other two being oil and copper. The largest and world-known deposits of this ore occur in the valleys of the **Kvirila River** and its affluents in the Province of Kutais, Georgia, and cover an area of 400 square miles. The available ore is estimated at 200,000,000 tons.

This deposit and the industry springing from it have been separately and exhaustively dealt with in my paper on "The Georgian Manganese Industry and its World Importance," forming Part V of the present book, and the following description therefore only refers to the other occurrences of manganese ore in Georgia, which are, however, not exploited.

The most important of these deposits exists near **Akstafa** (Georgia), whence samples of exceedingly rich pyrolusite have been forthcoming, containing up to 95 per cent. of manganese peroxide (60 per cent. manganese metal) and only from 0·027 to 0·035 per cent. of phosphorus. The geological formation is similar to that of Tchiaturi, the ore existing in horizontal beds interstratified with sand, which continue at the same level through three adjacent hills, the gullies between them having been caused by erosion. This deposit has not been further explored, but is worthy of attention in view of the quality of its ore and its favourable position only a few miles from the main line of the Trans-caucasian Railway.

In the Tchorokh Valley (Georgia), manganese ore occurs in another interesting deposit near **Kartla,** on the left bank of the river and not far from it and the highroad, at about 35 miles from Batum. The ore is pyrolusite of good texture and not very friable. It exists in three layers having a total thickness of about 3 yards. The beds are horizontal and their natural outcrops make extraction easy, no expensive or complicated operations being required. Assays of samples gave 53·60 and 54·40 per cent. of manganese metal, from 0·07 to 0·09 per cent. of phosphorus, and from 6·10 to 8·52 per cent. of silica, without other objectionable elements, so that the ore seems of superior quality. An Anglo-French syndicate took an interest in this deposit some years ago, but only exploration work has so far been done in it, and the exploitation of this and other mineral occurrences in the Tchorokh Valley depends probably on the building of the projected railway through it.

Manganese ore also crops out in the valley of the **Itchkhala River** (Georgia), a tributary of the Tchorokh from the western side, about 20 miles from Batum. The ore is also pyrolusite, in places mixed with iron ore and containing up to 27 per cent. of iron. Only superficial exploration work has been done.

Other highly interesting deposits occur also in Georgian **Lazistan,** near the sea coast S.W. of Batum. This district forms the continuation of the mineralized zone of the Tchorokh Valley across the Hemshin mountain range, and most of the valleys running from the latter northwards to the sea between Rizeh and Surmeneh contain some minerals, as manganese, iron, copper or zinc.

In the **Kara-dereh Valley,** near Surmeneh, large occurrences of manganese ore have been traced over a distance of about 6 miles along the mountain-side. The outcrops, where exposed, have a width of from 4 to 10 feet and consist of high-grade pyrolusite. The nearest point of the deposit is only about 2 miles from the sea.

Similar formations exist in the **Treeboli Valley.** The outcrop stands out prominently and has a thickness of about 12 feet; the lode strikes E.–W. with a dip to the N.W., and is composed of limestone showing nodules and heavy impregnations of manganese ore. The centre of the lode carries a vein of good ore, samples of which contained 49·66 per cent.

of manganese metal. This outcrop is about 6 miles from the sea and easily accessible.

Other deposits of the same nature occur at **Gooshak,** where the quantity of available ore is estimated at 1,000,000 tons; at **Dharluk,** 2 miles from the coast, where at least five beds of rich ore are exposed; at **Sharadek, Khraklabek-tcha, Badahel-tree** and **Govanyak,** all lying in the same district and within a few miles from the sea, where loading stages can easily be built. Water is available in every valley for washing and concentrating the ore, if necessary, and the transport to the loading places would only require short tram-lines. The cost of the ore delivered on board ship would therefore be very low.

The following analyses show the excellent quality of the ores found in this region :

	I.	II.	III.	IV.	V.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Manganese metal ..	47·06	55·68	55·69	44·32	61·0
Iron metal	0·64	2·44	0·49	23·22	0·70
Sulphur	0·121	0·054	0·007	0·103	0·17
Phosphorus	0·069	0·103	0·079	0·065	0·064
Silica	4·18	1·54	3·16	1·74	2·70
Moisture	1·33	3·30	1·88	2·08	dried

The presence of manganese ore in the large mineralized zone near **Batum** (Georgia) will be mentioned with the copper deposits of that region.

3. Copper.

Copper is, after petroleum and manganese, the most important mineral product of Georgia and Caucasia. Its ores occur in a great number of places which were well known to the ancients and worked specially by the Georgians. The traces of their old workings and their slag-heaps were in most instances the guides for the present exploitations, and as they could work only near the surface, the ore bodies are practically untouched in depth.

The copper ores are generally found in fissure veins, and consist principally of chalcopyrite, mixed sometimes with malachite and other modifications, besides different non-cupreous ores. Of the latter the most common are iron pyrites, which in many places predominate, while composite zinc ores containing blende and galena form the bulk of other veins, the copper forming only an accessory part.

Generally speaking, copper ores occur almost everywhere in Georgia and form the richest inheritance of the country. If their actual exploitations are comparatively few in number and their output so far not very considerable, the reason lies principally in the absence of easy means of access to the mines, mostly situated in the mountains, and the difficulties of transporting the necessary fuel to them, while the latter itself may have to be imported by sea.

These difficulties make it imperative for new concerns to provide the means for large preliminary outlays for roads and means of transport, so that small companies have less scope of increasing their production of metal, however plentiful their ore reserves may be.

The drawback of the fuel question might be avoided by exporting the ore to foreign smelters, but this policy has not been encouraged, because Russia herself was a great consumer of copper and did not produce enough for her needs.

From the point of view of their position, the copper ore deposits of Georgia may be divided into three zones, situated (1) south of Tiflis, E. and W. of the Tiflis–Kars Railway ; (2) in the Tchorokh district, in the S.W. corner of Georgia ; (3) in the Zangesur district, in the S.E. part.

The best-known mine of the first zone is that of **Kedabek,** which formerly and for many years ranked first in the country. It is situated S.E. of Tiflis, in Georgia, about 25 miles from the station Dalliar of the Tiflis–Kars railway, and belongs to Siemens Brothers.

The ore deposit lies at Mis-Dag (Copper Hill), near the works, and consists of a succession of lenticular ore bodies of considerable dimensions, being up to 160 feet thick and 820 feet long in one instance, while the intervening spaces sometimes narrow down to a thickness of 6 feet. These lenses, of which seventeen were discovered and worked out, were filled with quartzose rock and porphyry, containing chalcopyrite and oxidized black copper, mixed with iron pyrites, also zinc blende and galena, partly with barytic gangue.

The country rock consists of quartziferous andesites which are almost completely covered by a flow of lava.

When worked by the old miners before Siemens acquired it, the mine was celebrated for its great tenour in silver, but the ores produced in recent times were almost sterile of precious metals and the principal product was copper, with some lead and zinc.

The work in the mines was taken up again in 1864, when Siemens acquired it, but for a long time its operations were not very successful, principally on account of difficulties with the fuel, until they laid a pipe line enabling them to get fuel oil from Baku for use in the smelting and refining of the copper. Other improvements were introduced at the same time, and its modern methods and labour-saving appliances made of Kedabek the most renowned metallurgical establishment of the time in the country, representing a capital outlay of about half a million £ stg. In 1890 their output exceeded 1,000 tons of copper per year, which increased to about 1,750 tons p.a. between 1900 and 1912. But after that period the ore at Mis-Dag began to get exhausted, and in 1914 only 14,400 tons were mined, producing 794 tons of metal. Since then only low-grade ores are being leached, and the production of metal amounts now to only 100 tons p.a. The days of this establishment seem therefore numbered, and its owners have already attacked another mine in the Tchorokh Valley, as will be described later.

The second copper-producer of this zone is situated at **Alaverdi** (Georgia), near the station Akhtala of the Tiflis–Kars Railway. The mines were worked 160 years ago by the Georgian kingdom, and are exploited since 1897 by a French company —Société Industrielle et Métallurgique du Caucase—on a lease expiring in 1944. As at Mis-Dag, the vein here also forms a succession of lenses, which vary considerably in thickness and frequently branch out sideways. Their average thickness is about 42 feet, but the largest one encountered so far was 36 feet thick, 120 feet wide and 600 feet long. The ore is chalcopyrite and some purple ore, mixed with iron pyrites, and its tenour varies between 3·6 and about 10 per cent.; it also contains about 4s. worth of gold and silver per ton. The capacity of the smelter is 160 tons of 5 per cent. ore per day. The mine produced in 1908 1,871 tons, and in 1913 3,735 tons of copper, the average cost being about 5½d. per lb.

Besides Alaverdi, the French Company exploits yet several other mines, two of which are situated in the same district. **Tchamluk,** which they hold on lease, lies about 9 miles N.E. of their smelter and is of analogous geological formation to the Alaverdi deposit, consisting of a series of pockets or widenings of the vein in gypsum and barytine. The ore produced here is treated at Alaverdi.

A similar mode of exploitation is carried on at **Shagali,** situated E. of Alaverdi in the upper valley of the Bortchalo River, in Georgia. A quartz vein containing chalcopyrite is being worked here, and the ore extracted is also carried to Alaverdi for treatment, although a small smelter existed on the spot in connection with this mine.

The establishments of Kedabek and Alaverdi possess the only large smelters in this district, but there are several veins in the neighbourhood either being explored only or worked in a small way, their production going to the said smelters.

One of them occurs in the **Kasakh** district (Georgia) and is worthy of notice, as the work done in it seems to promise well. It was known to the ancient miners, as there are many indications of old workings on the property and large slag-heaps, proof that at that time the ore was smelted on the spot.

Before the war small quantities of ore were extracted, but the principal work consisted in preparing the mine for more intensive extraction, and resulted in the opening-up of six galleries and two shafts of an aggregate length of about 500 feet and a depth of 60 feet respectively. The ore found during these operations is mostly chalcopyrite and also copper-glance (covelline), or a mixture of both. Copper-glance occurs in a vein about 14 inches wide and assaying 30 per cent. of copper, which has been followed over a length of 50 feet. About a dozen other veins were met with during the investigations, consisting mostly of chalcopyrite. There are also outcrops in the higher part of the property ; one of them, about 2 feet wide and carrying copper-glance and chalcopyrite, can be traced over a distance of about 150 feet, but none of these outcrops have been fully examined yet. The situation of this deposit is advantageous, and only sufficient capital seems required to make it into an important producer.

The western part of this copper belt is not less rich in metalliferous ores, but being more remote and mountainous, has apparently attracted less attention.

Two contiguous old mining fields have here to be mentioned in the first instance, situated at **Djaraior** and **Tchan-Bakhtcha,** in Georgia, S.W. of Tiflis at about 40 miles from the railway. Up to about fifty years ago they were worked by Georgian miners, and the many old workings and slag-heaps show that in more ancient times this must have been a most important centre of mining activity. This may partly have been caused by the alleged richness of the ore in silver and gold, which is said to have been considerable, but no recent confirmation of this fact is available.

The country rock is of volcanic origin, and the mountains in the western part of the field consist largely of basalt and lava, in which not only the old mines were excavated, but also human habitations. In the eastern portion diorite and porphyry predominate, and the metalliferous veins are usually located at the contact of these rocks in the fissures caused by volcanic eruptions. They are of uniform direction and inclination, approximately from W. to E., and can be traced over considerable distances; in fact, there are veins and outcrops, partly revealed by old workings, all the way between the two villages named above.

The ore is largely copper-glance and cuprite, also malachite, while chalcopyrite, which predominates in most of the other copper zones, is comparatively rare. This fact accounts for the average higher percentage of copper contained in the ores extracted here, and probably also for the great proportion of metal still contained in the slags which the old miners could afford to lose.

As some work is always going on in different parts of this large field by the inhabitants, who are the descendants of the old miners, it is possible to examine it also to a certain depth, and there is no doubt of the continuity of the veins in that direction. Thirteen of them are known and have been worked or opened up, and the old and more recent underground workings are very considerable.

The principal vein has been followed in depth by a shaft of

210 feet and worked by galleries extending about 300 feet, while its total length is ascertained over 3,850 feet. Its thickness at the outcrops is only from 6 to 9 inches, but it widens out quickly to 40 inches and attains 43 inches at the deepest point, 24 inches of which consist of compact copper ore in quartz gangue. The analysis gave 22·40 per cent. copper. In depth the centre of the vein consists of pure chalcopyrite, while the edges towards both walls are converted into iron ore, the copper which was originally combined with the latter being found again as a secondary formation in the fine joints, fissures and cavities of the vein in the form of beautiful needles and small crystals of malachite, blue and green. Iron pyrites are missing in these veins, while the upper levels, besides chalcopyrite, also contain copper-glance and purple ore.

All the other veins are of similar nature ; the average thickness of those which have been worked or well explored is 32, 18, 28, 4, 8, 23 and 15 inches respectively. Detailed calculations of the ore available above the water-level amount to about 1,750,000 tons, the average contents in copper varying from 18 to 22 per cent., and this richness will, without any doubt, sooner or later bring this mining field to life again.

To the S.E. of Djraior, in the direction of Erivan, several other deposits of copper ores are known, but no proper exploitation exists in this district. The following occurrences may be mentioned :

At **Delijan** there are considerable outcrops of a vein widening out into lenses or pockets in altered porphyry. Their ore is said to contain from 6 to 7 per cent. of copper.

At **Karavan-Sarai** in the same region a very promising vein about 24 inches thick is known in porphyritic rock.

Further south, near **Novo Bayazid,** on the western shore of the Gokcha Lake, copper veins occur in many places, but are not explored.

Near **Alexandropol** the **Sisimadan** mines are worked in a small way and have a smelter attached to them, which is, however, not of great importance. The vein is said to be about 4 feet thick, lying at the contact of diabase with limestone and gypsum, and to contain from 12 to 15 per cent. of copper.

Other mines are being explored at **Shakar-Dara** and **Tamir-Magara,** and small quantities of ore are extracted from them.

Other interesting occurrences of copper ores exist E. of the Tiflis–Kars railway in the Kazakh district of Georgia at **Varti-kegh** and **Avessi-Tchal.** They lie opposite one another on two hills, separated by the River Indja-Su, an affluent of the Kura, but are of identical formation with parallel veins. The country rock is diorite, much decomposed, specially at the former place. There are four outcrops of copper ores at Vartikegh and three at Avessi-Tchal, in the shape of important veins, two of which are over 3 feet wide. They consist of quartz with chalcopyrite, also decomposed in places and containing there copper-glance and green malachite. Only superficial exploration work has been done in this field, by small galleries and open trenches along the veins, but their result leaves no doubt that we are in presence of a highly important deposit which deserves fuller investigation.

Its environs represent a zone of remarkable mineralization. Immediately N. of the copper there are outcrops of magnetic iron ore with a great number of old workings, and W. of them we find important deposits of hematite, consisting of more than forty veins, some of which are over 3 feet thick at the outcrops. In the N.E. manganese ores crop out, and other deposits of copper again are being worked E. and S. of this field.

Further E., about 30 miles from Kedabek and 20 miles from the railway, another important deposit of copper and sulphur ores occurs at **Djiraki-dsor,** near the village Tchaikent. The ore bodies crop out in quartzite, partly covered by clay schists, at the bottom of a ravine.

They were in the first instance worked for iron pyrites, as an outcrop of this mineral, about 190 feet long, was lying open at sight along the side of the hill. It forms an enormous and compact stock whose depth into the hillside has not yet been ascertained and must be considerable. At present it is being worked in open cast and also by galleries, and sent to Baku to the sulphuric acid factories, where it replaces the brimstone formerly imported from Sicily. It is of remarkable purity, showing a tenour of sulphur of between 50·51 and 51·73 per cent. in cargoes, without objectionable elements, which is considerably superior to the Spanish ore.

In the course of this exploration chalcopyrite was found and roughly sorted out from the iron pyrites ; from time to time a few wagonloads of it were sent to the Alaverdi smelter, the bulk containing from 20 to 25 per cent. of copper.

In places the iron pyrites also contain metallic copper in the shape of small specks disseminated through them, and also lentils of pure copper-glance have been met, weighing as much as 5 to 6 tons and containing from 61·45 to 65 per cent. of copper.

This metal therefore became interesting, and following some indications, a cross gallery was driven from the pyrites works, which at 40 feet cut an important vein of chalcopyrite, of a thickness between 3 and 7 feet and containing from 12 to 20 per cent. of copper. An outcrop at the contact of granite about 400 yards from the mine was also examined and found to contain chalcopyrite and copper-glance and to continue in depth.

These minerals also contain gold, analyses having proved up to 3·9 dwt. per ton.

The work and further intended explorations in these mines were stopped by the war, but will in due time be taken up again.

The **Tchorokh Valley** in Georgia, containing the second group of copper mines now to be considered, begins a few miles S. of Batum and extends southward for about 60 miles to Lazistan (Georgia). The river receives many tributaries from both sides and is of fair size, sufficient for navigation at all seasons, if it could be tamed. But its fall is considerable, making its flow rapid and dangerous in places, on account of sudden windings and other obstacles. Transport is carried on at present in long, flat-bottomed boats, but only downstream, and the empty boats have then to be dragged up again by the boatmen. Also they cannot go right down to the sea, but must discharge at a spot about 8 miles from Batum, where their cargoes have to be carried by road. The river can therefore not be relied upon as a regular means of communication, but for power purposes it affords every opportunity. A fine macadamized road runs along it, suitable for motor traffic, but the valley will really only be opened up when the long-projected railway is built.

The Tchorokh district is eminently mineralized, chiefly with copper ores, and there is scarcely a side valley in it in which copper or other ore outcrops do not exist. The valley of the Mourgul River alone, one of the tributaries, and its immediate environs contain, according to the estimation of the best geologists, between 50 and 100 million tons of ore containing about 3 per cent. of copper. These occurrences were known and worked in antiquity by the Georgians and Romans, and also in the Middle Ages by the Genoese. The veins are generally in porphyry and cretaceous sandstone, and the ores appear in the state of sulphides.

The most important exploitation of this district, and of all Georgia, is that of **Dzansul,** belonging to the Caucasus Copper Company, Ltd., a British-American concern with the highest financial backing in both countries (Morgan group).

Their mine is situated at the top of the valley of the Mourgul River, which flows into the Tchorokh from the western side. It is reached from Batum by the highroad leading to Bortchka (30 miles), crossing the Tchorokh River by a wire-rope ferry, which will be replaced by an iron bridge to be built by the Government, and skirting the river southward for 2 miles to the entrance of the Mourgul Valley. From this point the Company had to build its own road to Dzansul, a distance of about 10 miles, where there was formerly only a precarious horse-track. This road now leads to the smelting works on the banks of the river, but the mines themselves are situated about 3,000 feet above them (and at 4,500 feet above sea-level), so that a further zigzag road about 6 miles long and adapted for wheel traffic had to be constructed. The transport of the ore from the mine down to the works is, however, effected by an aerial ropeway of about 2½ miles in length.

The mine is said to have been worked in prehistoric times, at all events under the Roman-Byzantine domination, and before the beginning of the present exploitation the old slag-heaps had been surrounded and partly hidden again by secular forests, while one of the outcrops formed an easily visible wide yellow band across a vertical cliff.

Serious exploration work was started in the year 1900, when the present Company was formed, and it resulted in the opening-up of probably the largest connected ore body known in Eastern Europe, measuring some 160 feet by 330, and 1,000 feet in length. This is covered by an overburden of clay and alluvium of between 50 and 100 feet in thickness, which is removed by mechanical and hydraulic means, so that the ore can be worked in open cast at very small expense. The ore consists of chalcopyrite and some bornite, mixed with iron pyrites in quartzite gangue and assays approximately 3 per cent. of copper in the average ; but its quantity is very considerable indeed : in 1914 there were some 4,000,000 tons of it actually in sight.

The mine and the works are provided with the most modern appliances, ample power being available in the Mourgul River, which supplies the electric current for the mines and the concentration and smelting works. The latter are situated near the river, and are able to produce about 1,000 tons of concentrates per day, which are then smelted and refined. The workmen and the staff connected with the works are housed near the river, while a great number of buildings have also been erected near the mines for offices, stores, shops, dwellings, etc.

All these installations and the making of roads, the fleet of motor transports for connection with Batum, etc., cost an enormous amount of money, but it was forthcoming because, without any doubt, the mine possesses all the elements of success. Unfortunately the treatment of the ore proved a serious problem, and the methods adopted at the beginning of the exploitation were found to be unprofitable. The initial plant was therefore scrapped in 1905 and the wet concentration method introduced, which gave satisfactory results and was afterwards increased to a daily capacity of 1,000 tons. For saving the former losses in the slimes and tailings a minerals separation plant was also added in 1913, dealing with about 400 tons per day, so that all the difficulties seemed solved, when the war broke out. The first consequence was that the Laze workmen returned across their frontier, which is only a few miles distant from Dzansul. Nevertheless, the exploitation continued until November 1914, when a Turkish force invaded the valley and the works had to be shut down. The Turks were driven out again in March 1915, without having done much damage, but the mine has been idle ever since. Nevertheless, it has all the elements for becoming in the course of time one of the largest copper-producers in Eastern Europe.

Its production during the last few years was

1911–12.	1912–13.	1913–14.
Tons.	Tons.	Tons.
3,030	2,992	3,936

About 6 miles above Dzansul, on the **Murvan River,** an affluent of the Mourgul River, another copper deposit has been located and to a certain extent explored. Its nature is the same as that of Dzansul, and the explorations, carried out by means of galleries and drill holes, disclosed so far in three different places stocks of sulphide ores existing at the contact between sedimentary rocks and quartzites. The drilling, without reaching bottom, has proved the existence of at least 100,000 tons of ore, and this only in a small part of the deposits, which are certainly highly interesting.

The following is a typical analysis of the ores coming from this region :

	Per cent.
Copper	19·80
Iron	25·70
Sulphur	28·40
Alumina	3·50
Magnesia	1·10
Lime	1·00
Silica	20·50
Gold and silver	traces
	100·00

The second mine now in exploitation and likely to acquire importance in the Tchorohk district is situated at **Kvartzkhana,** about 37 miles from Batum, and only 10 miles from Dzansul, as the crow flies. It has the advantage of being situated on the right bank of the Tchorokh and only a short distance from the highroad, so that no extensive road-making was necessary. The original outcrops occur on a high, and in places very steep hill situated between the gorges of the Betauli and Kvartzkhana Rivers, which unite below the hill and flow into the Tchorokh.

The mountains in this part of the Tchorokh Valley form a part of the Pontic Ridge, which extends westwards towards Lazistan and eastward to the sources of the Kura River. The central portion is formed of granite, which crops out near the town of Artvin, and which lower down along the river is replaced by porphyry, and then by clay slate and schists, traversed by quartz-like sandstone.

The gorges of Betauli and Kvartzkhana which open out on the Tchorokh River, and the lower slopes of the latter itself, consist of clearly defined formations of these clay schists and sandstones, while in the upper parts of the gorges chiefly porphyry formations crop up. Among the latter a large mass of quartz is noticeable, which is probably connected with a large similar outcrop occurring opposite Artvin. This mass is in many places more or less metallized, and contains chalcopyrite, copper-glance, green and blue malachite, and also galena and zinc blends. The original exploration work was executed in the clay schists containing the beds of quartzose sandstone in which the metalliferous veins are found. These strata of sandstone occur in succession at varying distances within a lode from 200 to 250 feet wide, and although the outcrops were not of great width, it was evident from their formation that they were connected with larger ore bodies.

These deposits attracted the attention of Messrs. Siemens Brothers of Kedabek, who began some preliminary exploration work in them, and as it proved satisfactory, they secured the mines in 1906 and prepared them for exploitation on a large scale. They had soon proved a considerable ore body containing about 500,000 tons of ore with a tenour of about 4½ per cent. of copper, in the shape of chalcopyrite mixed with iron pyrites, and also about 8s. worth of gold per ton.

An aerial ropeway was therefore built from the mine down to the highroad and to the river near Bortchka, where the smelter and refining works were erected, the smelter being able to deal with about 200 tons of ore per day. A considerable part of the staff from the dwindling Kedabek mines was brought over here, as mentioned elsewhere, and the whole installation had only been fully equipped and a considerable quantity of ore was ready for the smelter, when the war broke out and the works had to be closed.

On the next hill N. of the above deposits, near the village **Irsa,** more large outcrops are known, in similar geological formations, and a great deal of exploration work done on them has proved their value, but they are not yet being exploited.

The western bank of the Tchorokh River south of the Mourgul Valley is equally rich in copper ores, judging by the numerous outcrops known everywhere. For many of them preliminary permits were obtained by local parties at one time or other, but no work was done, so that the claims lapsed again. Anyhow, according to the geology of the country, these deposits, when opened up, may turn out fully as valuable as the above large exploitations.

Mention may be made here of the valley of the **Katila River,** which falls into the Tchorokh below Artvin. Within 5 miles from the Tchorokh there are at least nine very promising outcrops of chalcopyrite of the usual formation in this zone. They are at **Nadjvia, Tzild Deressi,** where a vein of about 12 inches crops out in yellow sandstone, at **Satovo Deressi,** about 1 mile from the river, at **Kepketa-Kepri, Elel Ogli, Sholab Ogli, Degir Bandi,** etc., all also near the Katila and Tchorokh Rivers, so that they could very easily be made accessible. Higher up in the valley similar conditions prevail at **Porosseti, Nirvana** and **Nakerav,** which latter village is surrounded by mountains over 9,000 and 10,000 feet high.

Copper must have been actually produced by the ancients on the **Kuapta** mountain, about 2 miles S.W. of the town of Artvin (Georgia), where the usual remains of old workings, slag-heaps, etc., abound.

In the highest and most remote part of the Tchorokh Valley, near the Turkish frontier and about 90 miles from Batum, we have the mines of **Khod-Eli,** narrowly enclosed by steep mountains of volcanic origin and partly consisting of columnar basalt. They must be of very ancient origin, judging from the slag-heaps and antiquities found there. The vein is about 30 inches wide, consists of quartz with chalcopyrite through porphyry, and contains about 5 per cent. of copper. The mine had of recent years a smelter attached to it, the ore being first roasted in heaps in the open. The matte produced was then carried on horseback to the Tchorokh River, and on it by boats, when the conditions allowed it, to a small refinery at Erghi, near the mouth of the river and about 8 miles from Batum, where the matte was finally treated. Principally on account of the difficulties of transport the mine had to be shut down, but it has lately been taken up again by new capital and a new plant has been erected, which produced between 450 and 700 tons of copper p.a. before the war.

The lower parts of the Tchorokh Valley below Dzansul are not less favoured with metalliferous riches than those described above, although no large exploitations exist yet in this district.

One of the most interesting deposits occurs about 6 miles below **Bortchka,** and only 24 miles from Batum, easily accessible. The outcrops cover an area of about 1 square mile. Some of them were worked in a small way about twenty years ago, and the ore was sent to the smelter at Erghi, mentioned above. But the owners of the concession could not provide an exploitation on a sufficient scale, and therefore continued with exploration work only, in order to test the outcrops. For this reason this deposit is now well known and merits attention. During the investigations seventeen different outcrops were followed by galleries of various lengths, the most important one being of about 150 feet. They disclosed at least thirteen separate veins, their thickness varying between 6 inches and up to 7 feet in places, but averaging mostly about 20 inches. The ore is generally chalcopyrite in quartz, in places also malachite, and the average tenour of the ore extracted from the different galleries was 8·70 per cent. of copper. All the veins in the centre of the field run in the direction of a mountain forming its N.W. corner and rising to about 1,000 feet above the level of the valley. Outcrops of the same nature are found also near the top of this mountain, and all the experts who have visited the place therefore assume that the veins converge and form an important ore body in the centre of the mountain. So far no work has been done to test this theory, but some enterprise in this direction seems indicated, as its success is almost certain, and in this case the mine has the further advantage of being more accessible and nearer the port of Batum than almost any other in the Tchorokh Valley.

About three quarters of a mile N.E. of this field there is another large outcrop of copper ores, and its direction and general geological condition make it very probable that it is connected with the central mountain described above.

The width of this lode between salbands is 10 yards, and it consists of a vein of 1 yard of quartz containing chalcopyrite, marcasite and zinc blende at the roof. The floor is formed by a vein more than 3 yards thick of quartz impregnated with chalcopyrite. In the centre between these two veins there is a third one about 40 inches thick, also of quartz with chalcopyrite. This large lode, which is visible at the bottom of a creek and again at a considerable height above it, has been explored only at the surface, but should be more closely investigated, as it seems to contain large ore bodies.

In the same valley another vein is known in which zinc predominates, at least near the surface. It is about 28 inches wide and consists of zinc blende with incrustations of chalcopyrite, and the gangue, consisting of quartz, is also impregnated with the same minerals. Analyses of samples showed 42 per cent. zinc and 1 per cent. copper. No exploration work has been done on this vein either, but it has been superficially traced at the bottom of a creek, and again 500 feet further on and 175 feet above the first outcrop, and is therefore undoubtedly interesting.

The valleys containing these deposits as well as that of the Tchalt river ending at Bortchka are all commanded by the **Kara-Shalvar Mountain,** 5,000 feet high, whose western slopes extend into Lazistan down to the Black Sea, near Khopa, Arkhavi and Veronet. As might be expected, the geological formation in the valleys of Lazistan is the same as in the Tchorokh basin and the mineral veins continue across the mountain chain, cropping out again in the same profusion. Prospecting was therefore also going on before the war near Khopa and Arkhavi, and copper and zinc outcrops are known to exist in Lazistan as far as Rize and Surmene, besides the manganese ore already mentioned, but no exploitations exist yet in this district.

Returning to the eastern bank of the lower Tchorokh basin and specially to the upper valleys of its tributaries, we find there another important copper belt between the **Imerkhevi** and **Akria Rivers** in Georgia. This must formerly also have been a busy mining centre, as most of the outcrops have been laid bare by old workings and slag-heaps abound in most places near them.

The principal ore found everywhere is chalcopyrite, sometimes also malchite, and the outcrops are in the jurassic formation. In several places great numbers of veins run in parallel direction and may be followed over hundreds of yards, their widths varying between a few inches and 6 feet. Samples taken from them gave everywhere rich assays, also some gold.

As only superficial investigations have been made of recent years, full details of all the occurrences are not available, but enough is known to show the desirability of closer investigation.

The valley of the **Adjara River,** which falls into the Tchorokh about 10 miles from Batum, contains the deposits nearest to the sea. Two mines were worked there, near **Agara** and **Merissi,** and the ore was brought down to the smelter at Erghi.

The next valleys to the south are those of the **Chaklis river,** with its tributary the **Akria River,** and contain copper outcrops and old mines at the villages **Sindiethi, Aghmarthi, Tskhemlana, Tchikunethi, Akria,** and **Ephrat,** all in Georgia, the nearest being only 13 miles, and the farthest about 30 miles from Batum.

South-east of this district and in the territory drained by the **Imerkhevi River** and its tributaries most of the villages within a radius of 10 miles can show old mines or outcrops more recently discovered. Mention may be made here only of **Inkhreul, Dioban, Kokiethi, Ivethi, Zekiethi, Badsghirethi, Daba, Surevan, Ube,** and **Andriatsminda** in the north, and **Tchikhor, Dzios, Sinkot, Dovlethi, Dzetlethi,** and **Dzkaltzimor** in the south.

Some of these mines contain also zinc and lead, and, for instance, Badsghirethi is known to have been worked for silver by the Turkish Government when the district was under their rule, and there are still many villagers living who worked there. A more recent analysis of samples drawn from there gave :

	Per cent.
Copper	19·02
Zinc	13·02
Lead	10·35

At **Ardala** on the Imerkhevi River near its fall into the Tchorokh there also exists a quartz vein with feldspatic rocks traversing porphyry, and containing about 6 per cent. of copper.

In the same neighbourhood, almost opposite **Artvin** (Georgia), a powerful quartz vein crops out at the contact of metamorphic sandstone and porphyry ; it is about 2 metres thick, and contains iron pyrites mixed with a good proportion of chalcopyrite, but no analysis is available.

Although these numerous deposits situated on both slopes of the Kartchkhal Mountain, which rises to 11,248 feet above sea level, formed once a most important copper smelting centre; they are not worked now, and not even well known, because they are not situated on the usual high-roads. Nevertheless, they could easily be made accessible for modern traffic and connected with the high-road in the Tchorokh valley, and being situated near the sea and in a well-populated district, they will undoubtedly sooner or later be brought to life again.

The **Zangesour District,** which forms the third copper mining area of Caucasia, is less important than the two former ones. It is situated in the south-eastern part of the country, towards the Persian frontier, and its position is rather unfavourable for transport as the nearest railway station, Evlakh, on the Tiflis-Baku line, is about 130 miles distant. This is the principal reason why the exploitation of this zone is less intensive, but it will undoubtedly expand as well when better means of transport are available.

Several mines are being worked at present in a comparatively small radius ; they were also known to the ancients who left the usual workings and slag-heaps, and even their tools have been found. The ore of this zone is also principally chalcopyrite, also copper glance, with admixture, in places, of zinc blende and galena.

The name of the district, " Zangesour," proves its old notoriety, as it means " sounding brass." The old exploitation was taken up again in 1845 when a small smelter was erected ; two more followed in 1851 and a further one in 1857. But the working remained in a very primitive state until 1904, when the first modern installation arose at Barabatum.

The **Synik** mine is situated at a distance of 2 miles only from the latter place, and belongs now to the Société Industrielle et Métallurgique du Caucase which also works Alaverdi. The mine contains some twenty different veins, from 7 inches to 4 feet wide, containing chalcopyrite and some purple ore in quartz gangue, also a small proportion of precious metals. A great deal of money has been spent on this mine and the smelting works which, as mentioned, are installed on modern lines, but their production has still to be developed ; it was 721 tons of metal in 1909 and 939 tons in 1913.

The neighbouring **Barabatum** mine, although under different ownership, is worked in connection with the Synik smelter and also receives the required electric current from it. It contains several veins of the same character, of a thickness varying between 6 inches and 2 feet and widening out in places even to 7 feet. The ore is hand-picked and then contains an average of 16–18 per cent. of copper. The small ore is washed in the river and concentrated by primitive means, and the roasting also only takes place in heaps in the open, whereupon the product goes to the Synik smelter. The production of ore is not considerable, some 2,000 or 3,000 tons per year, as the owners are mostly doing exploration work. The mine also contains an old dump heap of some 40,000 tons of slag containing between 2 and 3 per cent. of copper and altogether deserves to be more energetically exploited.

The **Ugurtchai** mine is worked by Tiflis owners on a fairly wide lode, but also in a primitive fashion. They also have a small smelter which in recent years produced from 500 to 800 tons of copper p.a.

Other copper mines in this district occur at the villages **Agarak, Katara,** and **Bashkent,** the first one possessing a vein about 2 feet wide between diorite and syenite, and containing about 10 per cent. of copper and some molybdenite.

The **Galisur** mines, which formerly were well known, have not been worked of later years.

On the other hand, new exploration work has been started near **Byelokan,** where an ore body of apparently considerable size has been discovered.

The district contains several other small producing properties whose only drawback lies in the transport difficulty. Although the railway from Tiflis to Persia runs at a distance from 30 to 50 miles west of the mines, there is, at present at least, no connection possible in this direction, on account of the intervening mountain chain rising to more than 10,000 feet, and the only hope of improvement lies in the building of the projected branch railway from the Baku line to the town of Shusha, from which the mines are easily accessible.

The three mining areas described above do not cover all the Caucasian copper-bearing fields, and separate deposits occur also in many other places, specially in Georgia along the main mountain chain.

The eastern part of it between Telaw and Zakatali is fairly rich in quartzose veins containing chalcopyrite and iron pyrites, notably at **Pshaveli, Zakatali,** and other places. They vary in width between a few inches and several feet, but in general seem too poor or too difficult of access for successful working and have not been touched.

The **Kasbek** group of mountains in Georgia contains at east two considerable deposits of copper ores. The first one lies on its northern slope on the left bank of the River Terek, and although situated at a high altitude, it presents no special difficulty to the extraction of the ore. The country rock is formed of nearly vertical strata of grey granites and porphyries and almost black schistose diorites, and the metalliferous veins run along the latter. Their gangue consists of quartz or calcite impregnated with chalcopyrite. Considerable exploration work has been done on the deposit and seven veins have been fully traced at different levels. Their width varies between 8 inches and 7 feet, widening in one place even to 14 feet. The extension of at least two of them has been exactly determined over a length of 940 and 700 yards respectively and at levels differing by 700 feet. The ore existing in them is estimated at 1,000,000 tons, containing an average of 9 per cent. of copper. The quantities contained in the other veins have so far not been ascertained, but all of them extend much further in depth and crop out again about 4,000 feet lower down on the mountain side.

The extraction of the ore will be easy by means of adits at different levels, and there is no difficulty in building an aerial ropeway for its transport to a smelter to be erected at the foot of the mountain. Fuel can easily be brought from Vladicaucase, a distance of 27 miles, and in this regard this mine is much better placed than those in the south of the country and is altogether fully prepared for an undoubtedly profitable exploitation.

The second deposit on the **Kasbek** (Georgia) occurs at a few miles distance from the above, in a side valley on the eastern bank of the river Terek and at about the same altitude. The geological conditions are also similar ; the metalliferous veins consist of quartz embedded in clay schists, and contain chalcopyrite with much malachite. Seven or eight of them are known and crop out at different heights, but there is not enough exploitation work done to estimate their contents. However, they extend over such a wide area that there can be no doubt of their richness in ore. This property is partly covered with forests which might be used for the purposes of a mine, and considerable water-power could be supplied by a stream flowing through it.

In the vicinity of **Vladicaucase** there are 4 more deposits of copper ores known, although not explored.

Copper ores exist also at lower altitudes in the Province of Kutais, Georgia, near the River **Rion,** and two groups of outcrops may be specially mentioned. The country rock is generally dioritic, crossed by thick veins of basalt, quartz and baryta. The quartz and baryta are mostly mineralized with chalcopyrite and malachite, also copper glance, and in many places the deposits resemble those of the Alaverdi mines. They extend over a wide area on both banks of the river, and old slag-heaps prove that they were formerly worked, but in recent times they have been lying entirely idle.

Further west a most interesting mineral district lies near the **Black Sea,** in Georgia, only about 25 miles from Batum. It covers an area of about 40 square miles and contains, besides copper, also zinc and lead, as well as manganese and iron, and it seems surprising that in spite of their favourable position these deposits were never worked, and are even scarcely known.

The surface formation consists mostly of grey or white clays, the products of the decomposition of porphyrytic rocks which on washing give galena, blende and chalcopyrite. Quartz which in other parts forms the usual gangue of the veins, is here almost entirely absent, and iron pyrites form only a very small proportion. One of the outcrops consists of two parallel veins, the upper one about 9 inches wide, the lower one from 3 to 28 inches; they are divided by a bed of kaolin and can be worked together. The mineral extracted from them is solid, and an analysis gave 8 per cent. copper, 40 per cent. zinc, and 20 per cent. lead. Other samples contained from 7 to 16 per cent. copper; in some there was more lead than zinc, even up to 60 per cent. of the former in the metallic state.

The veins from which these minerals derive, as it is clearly shown in other outcrops, can be reached by a gallery of about 140 feet driven through the kaolin; its cost would easily be paid by the ores recovered.

A further vein crops out directly about a mile from the above; it is a pure vein in porphyry of more than 15 inches in width and contains 7 per cent. copper, 48 per cent. zinc and 8·5 per cent. iron pyrites, practically without any silica. The conditions for working it are also very favourable. Several other outcrops of similar nature are known, but have not been explored.

Manganese ores are also found in this district, either in the shape of rocky outcrops, or weathered in grains mixed with the surface earth over large areas. The pyrolusite taken from the outcrops was found to contain also some iron, but its tenour in depth is not known and would be interesting, specially in view of the fact that at a distance of about half a mile from the manganese there are very considerable outcrops of magnetic iron ore of great purity and remarkable magnetic properties.

These two deposits might together form the centre of a metallurgical industry for the production of ferro-manganese, zinc and lead. In view of their proximity to the sea, only 20 and 25 miles from two ports, the fuel question would here not make any difference whatever, and there is no doubt about the presence of large quantities of ore, while several rivers could supply power.

Many other outcrops of copper veins are known between the Black Sea and the western part of the Caucasian main chain, but they are not explored. A very considerable one is said to exist above the monastery of **Novo Aphon** near Sukhum, Georgia, and samples received from there proved very rich, consisting of copper glance which contained 50·25 per cent. of copper.

The following **Statistics** give a general aspect of the copper industry in Georgia and Caucasia in recent years:

Number of Copper Mines:

	1911	1912	1913	1914
Having their own smelters	15	15	16	14
Without smelters	17	14	21	14

Copper ores extracted by the totality of the mines:

1910 Tons.	1911 Tons.	1912 Tons.	1913 Tons.	1914 Tons.
237,415	324,098	319,469	359,674	238,954

Total production of Refined Copper in Caucasia :

	Tons.		Tons.		Tons.
1901	3,989	1906	3,829	1911	8,346
1902	3,440	1907	5,003	1912	9,657
1903	4,240	1908	4,820	1913	10,136
1904	4,785	1909	6,311	1914	8,259
1905	3,707	1910	7,695		

The largest producers were :

	1911 Tons.	1912 Tons.	1913 Tons.	1914 Tons.
Société Industrielle et Métallurgique du Caucase	3,990	4,315	3,721	4,071
Caucaus Copper Co., Ltd.	2,208	3,060	3,322	2,892
Siemens Brothers	1,551	1,435	1,272	794

4. Silver—Lead and Zinc.

These ores are plentiful in Georgia and Caucasia, but in most instances the zinc blende which predominates is mixed with galena, chalcopyrite, iron pyrites and other elements which make the treatment difficult and expensive. Lead ores, as such, have so far not been found, but the compounds usually contain some silver.

Probably for this reason there is at present only one mine producing zinc and lead in Caucasia; it is owned by the Société Minière et Chimique **Alagir,** a Russo-Belgian company managed by Belgians. Their mine is situated at **Sadon** in the northern Caucasus about 50 miles west of Vladicaucase, while the smelter is near the latter town. The veins are of quartz in granite rock and contain zinc blende, argentiferous galena and iron pyrites. Before the war about 100 tons of this ore were extracted per day, containing about 16 per cent. zinc, 6 per cent. lead, 12 per cent. iron and 5 oz. silver per ton. This ore is hand-sorted and treated, and produces a concentrate containing about 63 per cent. lead and 45 per cent. zinc, but in the refining only about 60 per cent. of these contents are recovered.

In 1916 the ore reserves were estimated at 100,000 tons in the vein which is now being worked, but at short distances from it there are about 15 others of varying thickness, running up to 6 feet, but in general not very rich.

Alagir is the only establishment producing also silver in Caucasia, about half a ton per year, while its yearly production of zinc amounted to about 3,000 tons before the war, and that of lead to 1,000 tons.

Deposits of similar ores are known in many other places on the northern slopes of the Caucasian main chain, mostly in the district of **Batalpash,** near **Takhtaul-Tchalgan,** where a company formed in recent years has extracted small but increasing quantities of ore. At **Khostinsk,** in the same zone, exploration work in a small way has been going on for several years in a deposit of the same nature.

On the southern side of the mountain chain near the Black Sea in Georgia two other small exploitations exist, one on the **Akhista-Akara** mountain near **Sukhum,** and the other on the **Dzishra-Abakhu** mountain in the district of **Gudaut.** The former shows a very good outcrop over a considerable length, and contains principally rich galena, with zinc, but no silver. Both places deserve to be closely examined, because, if they come up to expectations, their position near two seaports will greatly facilitate their exploitation.

The **Tzkhinval Valley** near Gori, in Georgia, also contains outcrops of rather rich lead and zinc ore, as surface samples assayed up to 62 per cent. of lead and 25 per cent. of zinc, but no work has been done on them.

South of Tiflis a zinc mine was formerly worked at **Akhtala** on the Bortchala River in Georgia, but it was not very successful as the ore is very complex, as the following analyses show:

	Per cent.	Per cent.
Copper	3·80	5·80
Lead	15·30	11·00
Silver	0·04	0·015
Gold	trace	trace
Zinc	33·70	41·68
Iron	8·40	5·38
Sulphur	29·56	31·00
Silica	7·50	4·40

No work has been done here of late years.

In the same neighbourhood, about 40 miles south-west of Tiflis, a rather interesting occurrence is known near **Tchatakh** (Georgia). A quartz vein $4\frac{1}{2}$ feet wide traversing dioritic porphyry is richly impregnated with different ores which have been ascertained to be composed of 23 per cent. of galena, 34 per cent.

of zinc blende, 33 per cent. of chalcopyrite and 0·026 per cent. of silver. This place was formerly worked and is said to have produced also much gold.

The deposit which, although not worked and not much known seems to be most suitable for a future profitable exploitation, is situated in the Province of **Elizabetpol**, about 30 miles from the Tiflis-Baku railway and easily accessible. It covers about 2 square miles in the upper part of a valley partly covered with great forests. It must at one time have been an important centre of activity, judging from the old workings and slag-heaps of which over 100 are visible.

A great number of veins are also disclosed by outcrops, all running west to east, but only 4 veins have been really tested by the present owners of the property, who have driven galleries along them, one of 90 yards and three of about 225 yards each. The veins are well defined in quartz and from 7 to 22 inches thick, widening out in places to 40 inches. The ore is an unusually pure blende, partly brownish caramel blende, containing according to an analyses made in Belgium :

	Per cent.
Zinc	59·68
Lead	traces
Copper, antimony	nil
Cadmium	0·15
Arsenic	0·02
Sulphur	30·76
Fluorine	0·05
Iron oxide and alumina	3·00 est.
Lime and magnesia	2·00 est.
Silver	13 grms. per ton
Silica	3·40

These samples, taken from the galleries near the bottom of the valley, are therefore of a remarkable purity and the mines undoubtedly deserve closer attention, specially also because they might form the basis of spelter works in this region. There are no such works in south-eastern Europe and an installation in this district would have an enormous field of activity extending eastward to Siberia, Transcaspia and Persia.

Another outcrop of zinc-lead ores exists in the same province of Elizabetpol near **Djegam.** It is not explored, but samples taken from it have been analysed and are said to have given the following results :

	Per cent.
Zinc	48 to 53
Lead	13·40
Iron	2·50
Manganese	0·42
Sulphur	14·40
Silver	0·067

As this outcrop is only 5 miles from the railway, it should also be followed up.

The south-western region of Georgia also contains zinc and lead ores in many places, but mostly mixed with copper, and several occurrences have already been mentioned under the latter heading.

In those now to be described the zinc predominates, but only one of them has been actually worked in our time. It is situated at **Khod Eli,** at the farthest point of the Tchorokh valley near the Turkish frontier. Originally it contained two contact veins about 14 and 18 inches average thickness, composed of blende and iron and copper pyrites. Their composition near the surface was as follows :

	Per cent.	Per cent.
Zinc	56·38	57·26
Copper	6·82	6·45
Iron	2·95	2·84
Sulphur	32·85	31·95
Silica	0·85	1·36

But in depth the zinc was found to diminish to such an extent that the extraction of this metal became unprofitable and had to be given up. Copper alone is now produced in this mine, as mentioned in the precedent chapter.

In the neighbourhood of Artvin two more similar deposits occur which are, however, not worked. One of them borders on the river **Imerkhevi** (Georgia), and crops out as a quartz vein containing blende, accompanied, as usual here, by chalcopyrite, and assaying 48·56 per cent. of zinc, with 2·86 per cent. of copper. The outcrop which can be followed for some distance, is 14 inches thick.

The other outcrop occurs at quite a short distance above the town of Artvin on the **Kuapta** mountain. Only surface work has been done on it, revealing the presence of a well-formed lode, about 4 feet thick, which was followed over a length of 24 feet and continues, dipping north-east. The ore from the surface workings is rather complex and contains, besides the blende, also galena and copper and iron pyrites. An average sample gave the following results :

	Per cent.
Zinc	31·47
Lead	12·16
Iron	10·76
Copper	3·90
Cadmium	4·04
Sulphur	23·78

Copper may predominate at lower depths, as it has happened in other mines of this district. This seems all the more possible as the lower levels of the Kuapta mountain have indeed been worked for copper in ancient times, as the old slag-heaps and traces of galleries show.

The tributary valleys on the east side of the Tchorokh also contain ores of zinc and silver-lead, which, although not worked now, were at one time famous. The best-known exploitation was at **Badsghirethi**, where silver was extracted by the former Turkish rulers of the district, as already mentioned.

Further east at **Gumush-Khané**, in the Zangesur district, at about 20 miles from the railway running from Tiflis to Persia, there is a deposit of very rich galena containing silver in which an English company had done a certain amount of preparatory work which promised well, but was stopped before the war.

The total output of argentiferous lead and zinc ores in Caucasia during recent years was :

Tons. 1910	Tons. 1911	Tons. 1912	Tons. 1913	Tons. 1914
28,865	26,060	28,495	25,517	13,773

About 98 per cent. of these ores were mined by the Alagir Company. To this Co. is also due the extraction of the following metals, which form the total of the Caucasian production :

	1911	1912	1913	1914
	Tons.	Tons.	Tons.	Tons.
Zinc	2,249	2,907	2,902	2,370
Lead	1,099	1,539	1,446	1,024
	Oz. Troy.	Oz. Troy.	Oz Troy.	Oz. Troy.
Silver	67,240	135,276	127,454	71,735

While producing these metals the Alagir Company obtained at the same time as by-products :

	Tons.
Sulphuric acid	6,207
Nitric acid	70
Hydrochloric acid	280
Sulphate of iron	54
Sulphate of lead	356

The exploitation of some of the other zinc and lead mines in Caucasia would be most desirable, as, besides the local and eastern markets, Russia alone is a large buyer of these metals, and imported, for instance, in 1913, 58,000 tons of lead and 26,000 tons of zinc.

5. Gold.

The Caucasian mountains, with their great tertiary movements and numerous intrusions of granitic, dioritic and diabasic rocks might be expected to contain also gold.

According to the old legends one would look for the precious metal in the first instance in Georgia, as being the ancient Colchis where the Argonauts came from far to collect the gold in the rivers by means of sheepskins placed into them.

If we are to believe these tales, what must have happened there is only what has been repeated in many places since then : there must have been a slow enrichment of placers from poor veins, and the placers, when discovered, were quickly worked out. Nothing then remained, except the veins which are too poor for us to work.

Traces of gold in the iron and copper pyrites of the zone have been mentioned before, but their extraction would not pay and there is therefore no production of the precious metal in the country at present.

Occurrences of free gold in veins are rare. One of them is known near **Tchkhandror,** in Svanetia, Georgia, consisting of veins or pockets of corroded quartz containing incrustations of small grains of gold. The sands from the rivers in this neighbourhood usually contain some gold in flakes and seem to indicate the presence of other similar veins.

On the **Akstafa** river another quartz vein crops out, about 14 inches thick and running through porphyry. The quartz is spongy and contains native gold, mixed with iron oxide and copper, and the river sands below it, as well as those of the **Djagir-tchai** and other affluents of the Akstafa river, contain placer gold in many places, but only from 1 to 8 grammes per ton—too little to be worked.

A similar slightly auriferous zone exists also in the north-eastern Caucasus on the river Malka, near **Mosdok.** All along the banks of this river there are small outcrops of gold-bearing quartz to be found, but they assay only about 0·3 grammes of gold per ton. The placers formed by them are generally covered by only a foot or two of alluvial, and are themselves up to about 2 yards thick. They consist of greyish-yellow sand overlying a bed of blue clay, below which follows a second layer of gold-bearing sands, and finally porphyry. Unfortunately these placers are not sufficiently rich to pay for their working, nor are the quartz veins at their outcrops, but they have never been touched in depth and might there give better results.

6. Mercury.

Cinnabar exists only in two districts of the northern Caucasus, both situated at high altitudes.

The first one contains the mines of **Ganai-Vadz** and **Khpeker-Vadz**, near Kurush in Southern Daghestan. These deposits have been known from ancient times and were formerly worked, but their veins are poor and a regular exploitation has not been maintained in late years.

The other occurrence of this mineral exists in the Kuban Province at **Fikhot**, near Maikop, at an altitude of more than 9,000 feet. It is not worked, although the owner of another similar mine is said to have acquired it with a view to exploitation.

7. Molybdenum.

Molybdenite is known to exist in three places in southern Caucasia.

In the Province of Erivan near the village of **Bash-Abaran** several quartzite veins crop out on the bank of an affluent of the Bambak river. The country rock is syenite, and the veins are partly decomposed and contain molybdenite, besides iron and copper pyrites.

A somewhat similar occurrence exists near **Novo-Bayazid,** near Lake Goktcha.

On the **Agarak-tchai** in the Zangesur district a copper vein was formerly worked lying at the contact between diorite and syenite; it contains the usual iron and copper pyrites, besides a fair percentage of molybdenite, which latter was, however, thrown away as useless.

None of these deposits is worked now, although the more recent demand for molybdenum in connection with the steel industry should now give them the necessary start.

8. Cobalt and Nickel.

There are several deposits of these metals, chiefly cobalt, in the Province of Elizabetpol in the neighbourhood of the Kedabek copper mines. The most important one lies at **Dashkesan,** and belongs, like the adjoining iron mine, to Siemens Brothers.

The cobalt ore forms irregular nests with epidote, garnet and hornblende in a porphyritic rock, which encloses at the same time magnetic iron ore and occasionally galena and zinc blende. The walls of these nests are themselves coloured by the cobaltine.

Analyses of the mineral gave the following results:

	I. Per cent.	II. Per cent.
Cobalt	17·90	17·55
Nickel	0·22	0·26
Copper	0·21	–
Iron	1·44	9·85
Arsenic	35·97	31·63
Rock	44·26	40·71

The Siemens works formerly extracted the cobalt from these ores, and produced in 1887 1 ton 7 cwt. of ore, in 1888 18 cwt., in 1889 12 tons; in the last year they also produced about 2 tons 18 cwt. of cobaltiferous copper matte.

In recent years the extraction has been almost stationary, amounting to about 12 or 15 tons per year.

9. Antimony.

Antimony ores are not of frequent occurrence in Caucasia and the deposits known are not worked; all of them are found in the higher parts of the main mountain chain in Georgia.

One occurs near the **Gorbalo Mountain,** N.E. of Tiflis, and shows two veins of stibnite in clay schists, samples containing over 60 per cent. of metallic antimony.

The same kind of ore exists also near the **Kasbek Mountain,** where it was accidentally uncovered by a landslip which happened some years ago. Samples taken from it contained 68·66 per cent. of metallic antimony, no arsenic, nor lead, nor any gold. Small quantities of ore were then extracted by the peasant owners of the land, but no proper working ever took place, and an examination of the place by experts is certainly indicated.

The third deposit is known in Svanetia, near **Outzeri,** N.W. of Kutais, Georgia. The veins here also lie in clay schists, and were formerly worked in a small way, but have now been idle for many years, probably on account of the generally low prices obtained for antimony ores before the war.

Stibnite occurs also in the northern Caucasus, in the village **Kholondoi,** near Grozny. Samples from there contained 61·6 per cent. of metal, but further details about the deposit are not available.

As the value of antimony ores has enormously risen and is likely to remain at a high level in future, the exploitation of these mines could now be taken up or restarted on a very profitable basis.

10. Iron Pyrites.

Iron pyrites accompany almost all the other metalliferous deposits of Caucasia and are specially found in connection with the sulphides of copper and zinc, where they are not desired.

The large copper works, like Alaverdi, Kedabeg and the Tchorokh establishments, have installations for separating them from the copper ores during the concentration process. Between 3,000 and 4,000 tons of sulphur ores were thus saved per year by the two former concerns and sent to the sulphuric acid factories in Baku. But in most other cases the sulphur contents of the sulphide ores are lost, as they are roasted in heaps in the open.

The occurrence of iron pyrites in connection with chalcopyrite at **Djiraki-Dsor** has already been mentioned with the copper mines.

A somewhat similar, and probably the largest deposit, of pure iron pyrites suitable for the regular manufacture of sulphuric acid exists at **Tanzout,** about 6 miles from the station Karaklis of the Tiflis-Kars railway.

The ore body crops out on the side of a hill on a length of about 500 yards and a height of 80 yards above the water level of the creek. This enormous outcrop is formed of distinctly separated horizontal beds varying in thickness between 5 and 20 yards, but without the intercalation of any other mineral or foreign element. The only impurity to be found here and there between the surface beds are slight streaks of kaolin, produced by the alteration of the porphyry in contact with the pyrites.

The depth to which this enormous stock may advance into the hill has not been ascertained: a trial gallery of 20 yards driven across it did not reach the back wall. Taking this distance as its average thickness, the deposit represents a quantity of 2½ million tons of ore, but in view of the enormous other dimensions the total thickness is probably many times more than the length of this small gallery.

The ore consists of very small grains or crystals of iron pyrites, cemented together by serpentinous material, and does not present the brilliant appearance of the Spanish ore consisting of larger crystals. Without selection it contains from 39 to 40 per cent. of sulphur, but it is easy to bring the average of cargoes up to 45 per cent. and more, by throwing out the streaks of kaolin or of less mineralized serpentine which occur at certain distances.

Samples analysed at Tiflis gave the following results :

	Per cent.
Sulphur	46·334
Iron	40·530
Copper	0·028
Cobalt	0·017
Nickel	0·014
Zinc	0·007
Lead	0·015
Lime	0·095
Magnesia	0·012
Silica	11·441
Arsenic	0·0186
Gold	trace
Moisture	1·405
	99·9166

As the ore is practically everywhere uncovered, except in a few places where there is an overburden of 13/6 feet, it can be quarried and loaded directly into carts. When fresh from the mine, it forms compact lumps, but after being exposed to the atmosphere for some time it becomes very friable and falls into sand-like grains. This is an advantage as pyrites have usually to be pulverized for burning ; also this ore does not explode when fired.

This deposit has been worked for several years, the whole of its production going to Baku, where there are several factories producing together about 25,000 tons of sulphuric acid, mostly used in the refining of petroleum.

In spite of its position near the railway and cheap extraction the ore has not yet been able to compete with Spanish and Scandinavian pyrites on the western markets on account of high freights, but it can keep its own in south-eastern Europe.

While the stock of iron pyrites is practically free from other metals, the porphyrite in contact with it is impregnated with chalcopyrite and zinc blende which are visible at the outcrops, covered with iron oxide, partly in the form of red ochre. Compact lodes of copper ore have also been discovered in the porphyrite ; one of them between 20 and 24 inches wide has been followed by a small gallery and leads towards the centre of the hill which undoubtedly contains copper. This is the more certain as the opposite side of the hill was formerly worked as a copper mine and is still called **" Miskhana,"** meaning " copper works " in Tartar language. Anatolian Greeks worked there until driven away by the invasion of Agha Mahomed Khan, Shah of Persia, in 1795. A number of old Asiatic smelting furnaces have been found there, besides extensive old workings and many veins of chalcopyrite which in time may again become interesting.

In the south of the same Province of Erivan iron pyrites have also sporadically been extracted in the **Nakhitchevan** district, but no regular exploitation can be recorded.

Iron pyrites occur also in many places in Georgia, specially in the Rion valley leading towards the main chain. About 3 miles above **Kutais** large beds of bituminous shale begin, and are visible over considerable distances along the river and in places up to 150 feet thick. In numberless spots they show streaks and thick outcrops of pyrites in large crystals forming compact masses. They are specially numerous and powerful at **Ossunella,** about 10 miles from Kutais, where the ore could be mined in large blocks, as there are beds of it cropping out with a thickness of 7 feet and more, and composed of practically pure crystals.

A similar occurrence exists again higher up in the valley about 14 miles from Kutais and quite near the road leading towards **Svanetia** (Georgia). Samples from these places contained 50 to 51 per cent. of sulphur and 41 per cent. of iron.

In fact, this mineral, partly mixed with chalcopyrite, may be found in all the mountain spurs descending from the central Caucasus. In the lower part of the **Kasbek** mountain large deposits are known of exceptionally fine crystallization, and the boys sell large specimen crystals to the travellers on the Georgian Military Road.

All this richness is so far unexploited, even scarcely known. However, the deposits in this district might probably be made available for the western consumption, as they are within easy reach of the Transcaucasian Railway and the Black Sea ports.

The total production of iron pyrites in Caucasia was in

1910	1911	1912	1913	1914
Tons.	Tons.	Tons.	Tons.	Tons.
4,909	6,428	14,988	7,654	8,066

Besides the iron pyrites there is also a deposit of **Realgar** or **Arsenical Pyrites** known and being worked. It is situated at **Serni,** in the Kagisman district near Kars, and during 1913 and 1914 the extraction amounted to respectively 80 and 50 tons.

PART II

NON-METALS

1. Coal.

Coal, which forms the life-blood of most industries, is unfortunately almost absent in Caucasia. It may be said that in its stead the country possesses its enormous riches in naphtha, which may be used as fuel, and an abundance of water-power or "white coal," to be utilized for power purposes, but still, specially for metallurgical purposes, coal or coke are required and must be imported.

The imports, which in former years came mostly from Great Britain, consist now exclusively in coal from the Donetz basin, which is of good quality and, besides, protected by an import duty of 7s. 6d. per ton.

The former foreign imports dwindled away, as the following figures show :

1891 Tons.	1892 Tons.	1893 Tons.	1894 Tons.	1895 Tons.	1896 Tons.	1897 Tons.	1898 Tons.	1899 Tons.	1900 Tons.	1903 Tons.
2,381	—	1,208	1,185	480	556	659	802	880	55	50

The only deposit of coal worked in Caucasia occurs at **Tkvibul** (Georgia), about 25 miles from Kutais, with which town the collieries are connected by a railway built by the Government. The thickness of the coal seams varies between 1 and 5 feet, and their total thickness amounts in places to as much as 30 feet ; they are worked by adits driven into the mountain side.

The quality of the coal is inferior, it crumbles on exposure to the air, so that it cannot be transported without being briquetted. In this shape it is used locally for domestic purposes, but is useless for steam-raising. On account of these difficulties the exploitation has never been prosperous and has even been shut down at times, until the Government advanced the enterprise about £30,000 in order to improve the working plant and to erect the patent fuel factory. Nevertheless, these collieries are quite insufficient for supplying the needs of Georgia alone, and several times there has been great scarcity of coal, with exorbitant prices, when the supply from the Don district was interrupted by ice in the Sea of Azoff.

The output of Tkvibul during recent years was the following :

1911	1912	1913	1914	1915
Tons.	Tons.	Tons.	Tons.	Tons.
63,932	66,647	67,627	62,827	56,252

Another deposit of coal which has attracted some attention occurs at **Tkvartcheli** (Georgia), about 30 miles from the open bay of Otchemtchiri on the Black Sea. It is said to extend over a rather large area, something like 20 square miles, and to contain an enormous quantity of coal, as the principal seam which has been opened up is 14 feet thick. The quality is very good, according to an English expert equal to Monmouthshire Black Band, giving from 68 to 70 per cent. of coke and containing only 0·90 per cent. of sulphur. The deposits are situated in a mountainous district and not very accessible, but the railway which was built from Novo Senaki, on the Poti-Tiflis line, to Sukhum, on the Black Sea, was expected to help in overcoming this difficulty. An exploitation company was then formed some years ago, but so far no results are to be recorded.

Two more deposits may be mentioned in the Black Sea district of Georgia, one at **Khartala,** in the neighbourhood of Poti, and the other near **Sukhum.** The product of both has more the character of lignite, and at the latter place it lies in very thin seams separated by clay, and contains about 30 per cent. of ashes ; about 100 tons of it have lately been extracted per year and used on the spot.

At **Motzamethi** (Georgia), near the Tkvibul collieries, there is another occurrence of similar low-grade coal. Four seams crop out in jurassic sandstone, but their total thickness is not more than 4 feet. The coal is very friable and contains 25 per cent. of ashes and 1 per cent. of sulphur, and is only sporadically worked.

In the south-western part of Georgia coal has so far been discovered in one place only, namely, at **Olti,** near the Turkish frontier. It is said to be of very rich quality, somewhat like Welsh coal, but there are no efficient means of communications in those mountains, although the distance to Batum is only about 100 miles. Investigations were made during 1913 and 1914, and the small quantities of coal extracted seem to justify the high hopes entertained about this occurrence.

In the northern Caucasus in the Kuban district coal is also found at **Georgievsk** and at **Khumarinsk,** and between 1,000 and 2,000 tons are extracted in these two places per year for local use ; small quantities also occur near **Vladicaucase** and at **Naltchik,** samples from the latter place giving 56 per cent of coke, with 1·08 per cent. of sulphur.

2. Petroleum.

(By far the most important oilfields are those of **Baku,** which have been fully described in my paper " The Caucasian Petroleum Industry and its Importance for Eastern Europe and Asia.")

Besides Baku, Caucasia contains yet several other oilfields which, while having smaller outputs, are still of great importance. All of them lie in the belt formed by the slopes of the main Caucasian chain to the north as well as to the south, while no sources of oil are known in the farther districts and in the Lesser Caucasus.

The principal field after Baku occurs at **Grozny,** in northern Caucasia, about 40 miles from the crest of the main chain and 50 miles from the Caspian Sea. It is connected by railway with Vladicaucase in the west, and in the east with Derbent on the Caspian Sea, to which port also a pipe line has been laid.

Outflows of naphtha were known in this district from antiquity, but the oil was only used for greasing cartwheels. The first exploitation was started in 1855 by a Greek, Tchikaloff, who paid a yearly rent of about £1,250 and produced about 800 tons of oil per annum, which production gradually increased and reached 7,500 tons in 1891. In that year a Tartar barrister formed a company with Belgian capital under the name J. Akhverdoff & Co., and rented plots from the Cossak Military Administration, paying a rental of about £7 per acre and a royalty of 1s. 4d. per ton up to 30,000 tons, and 8d. per ton of excess. In 1896 there was a public auction of oil lands, and other firms also entered the field. Leases were granted for 24 years at a rental of about £6 per acre, but the royalty rose to 7s. 4d. per ton, and in 1899 even to 8s. 10d. per ton.

Nevertheless, the industry increased rapidly, and while Akhverdoff's Company still produces between 40 and 50 per cent. of the total output of the field, other companies have also come into prominence lately, notably those connected with Colonel Tchermoeff, the President of the Daghestan-Terek Mahomedan Republic. His estate, situated at 5 miles distance from Grozny, has been found to be a very successful field of production.

In the beginning of 1914 there were 15 firms engaged in the exploitation, working 107 plots of a total area of 2,860 acres. They had 278 boreholes, the deepest of which reached the enormous depth of 4,290 feet.

This is, in fact, the drawback of this field that boring has to be carried to great depths, but on the other hand the chemical composition of the oil obtained from it is more advantageous than in Baku, as it contains more of the valuable benzene and is easy to distil. About 20 per cent. of the production is used for fuel on the spot, the Vladicaucase Railway Company being the largest consumer, using the mazout in its engines. This Company also possesses the largest refinery in the field, able to treat 2,000 tons of naphtha per day. Nobel Brothers have erected another large establishment of a capacity of about 80,000 tons per annum. The lighting oil produced is mostly used in Russia, while the benzene is exported via Novorossisk.

The oil belt of which Grozny forms the centre extends for a rather considerable distance, principally westward, and borings have also been started at **Tchir-Urt, Belik Tchermoeff,** and **Sundja,** about 25 miles W., and **Novi Aldi,** and **Vossnessensk,** about 50 miles N.W. of Grozny, mostly with satisfactory results, while some of the operators had not reached oil yet; but soon after the outbreak of the war the work had to be stopped everywhere. The conditions of the leases in these new places are more liberal than at Grozny.

The second oil zone north of the Caucasian chain occurs near its western end, drawing eastward from the Taman Peninsula over a distance of about 120 miles in the Kuban Province.

Small flows of naphtha were known in many places, specially along the rivers, and borings were therefore tried in 1886 near the **River Gudako,** where a fountain was struck at a depth of 183 feet only, producing about 10,000 to 13,000 gallons of naphtha per day. But it soon subsided again, and nothing further was done until about 10 years ago, when fresh borings were started at **Maikop,** near the Byelaya River. They resulted in 1909 in the sudden outburst of a fountain throwing out about 50,000 tons of oil during the first fortnight, so that the whole district was flooded with it and great damage done. Only after two months' work was it possible to close the fountain down. This unexpected event caused great excitement ; speculators rushed to the spot from all parts, and between 1910 and 1912 about 30,000 claims were taken up from the Cossak Administration, and in London alone over 30 companies were formed to work Maikop oil.

Unfortunately the results of the later boring did not confirm these great expectations, and the present output is a poor remuneration for the great amount of money spent on the field and also on two pipe lines hurriedly laid to the port of Tuapse on the Black Sea.

The area under boring is 60 square miles, and the number of boreholes was :

In 1910	38	boreholes with a total depth of	2,042	yards
„ 1911	80	„ „ „ „	10,246	„
„ 1912	195	„ „ „ „	38,539	„
„ 1913	331	„ „ „ „	65,355	„

Anyhow, boring to greater depths, as it is proposed, may yet bring prosperity to this field.

Several other oilfields have been opened up in the Kuban Province, apparently with better success.

One of them lies at **Souvorov-Tcherkess,** Temriuk District, about 10 miles from the Black Sea port of Anapa. Three wells had been bored there, two to producing depths, when the war stopped further operations.

Another occurs near **Krimskaya** Station, about 30 miles from Novorossisk, where two British companies are operating and have proved three distinct oil-bearing horizons. There were four wells producing, and others in boring at the outbreak of the war.

Similar borings with good prospects had also been started near **Kapustina Balka** in the same zone.

Naphtha also occurs in Daghestan, near the Caspian Sea, where small quantities had been extracted for local purposes in various places. Before the war some of the powerful Baku firms started boring at the village of **Berekei,** only 4 miles from the sea shore. The results were excellent, as several fountains began to flow from comparatively shallow depths, producing oil of the highest quality which contains more kerosine than the Baku product. This field will probably justify the high expectations placed upon it.

On the south side of the main Caucasus chain there are also indications of naphtha in many places, in several of which borings have been begun, but the producing stage has nowhere been reached yet.

Such outflows which indicate a possible oilfield exist near the Station **Gheran,** on the Tiflis-Baku line in the Province of Elizabetpol. Besides the small wells dug by the inhabitants for obtaining oil for their own uses no work has been done on them.

In Kakhetia (Georgia), E. of Tiflis, a low chain of mountains rises between the Alazan and Iora Rivers, parallel with the main ridge, and consisting of slate and schists, with sandstone in depth. In these hills naphtha oozes out in a great number of places and was also formerly obtained by the inhabitants from hand-dug wells. The attention of foreign operators was attracted to this field only when the Kakhetian railway, which runs along three sides of this mountain spur, was built.

Two wells were then begun there near **Chatma** by a British Company, but during the Tartar-Armenian riots they were destroyed and work remained in abeyance until 1916, when boring was taken up again and pushed to 660 feet, where the oil was met.

Another British Company has taken up oil lands in **Ildokani** in the same neighbourhood. Two wells were sunk and oil was struck shortly before the outbreak of the war, when, however, further operations had to be stopped.

In both these places boring is easy as there are no floating sands, nor any influx of water, and the naphtha is very pure and light, sp. gr. 0·850. The borings are at about 4,380 feet above the sea, and boring and pumping are done on the American system, which is cheaper than that which must be used in Baku. This field seems, therefore, to have all the elements of success when normal circumstances are restored in the country.

Further west in Georgia we meet another interesting occurrence of naphtha on the **Khanis-Tzkali** River, south of Kutais. The outflows have always been known as they partly occur in the middle of the river, but they were clearly confirmed over a considerable distance in the course of some public works executed a few years ago.

The shores of the river consist of thick beds of sand and eocene sandstones which in the place where the naphtha breaks out most abundantly, are bent into the shape of an arch. This anticlinal formation of the beds in the eocene proves, as in other fields, the presence of naphtha deposits, and the outflows are caused by the pressure of water filtering through from the surface and displacing the oil upwards. The sandstone which, as it is visible in the lower parts of the valley, consists of several beds of varying composition divided by beds of sand, is quite impregnated with naphtha, as well as the sands.

The naphtha in its natural state has a brown colour with olive-green reflection and is very fluid. By distillation it gives a high percentage of light oils, benzene, petrol and kerosine; it does not contain any paraffin nor any acids, and would, therefore, be a highly valuable material.

For all these reasons it seems highly desirable that this place should be thoroughly tested; it is easily accessible and not far from the railway.

Another interesting oilfield, which has not yet reached the producing stage, occurs near **Ozurgethi,** in Gouria (Georgia), about 25 miles from Batum, and only 5 miles from the Black Sea.

Naphtha is here found superficially in grey sands and marls of the Sarmatian formation which occupies the central and western parts of the field and is partly covered by the miocene in the south. The eastern part is formed by the upper eocene, while the north-east alone shows crystalline rocks.

The district is hilly and extends from W. to E. between the Soupsa and Sepa Rivers; the heights reached in the west towards the sea are not considerable, but in the east the mountains increase sensibly and are covered with forests and bushes. The abundant rains in this zone have cut many ravines between the hills, and the naphtha appears in many places on the banks of these streams, oozing out from grey clay and marl schists, or from dark-grey soft sandstones.

Although the outflows of oil had been known for a long time, boring was begun only in 1911 by a Baku firm, and at a depth of 63 feet oil was struck. This event gave a great impetus to the field, and several British and other companies were formed to take up plots in the most promising places. Drilling was started on three spots during 1913, but the war interrupted the work before any results were obtained. The exceptionally favourable position of these fields in the neighbourhood of the Black Sea makes them specially interesting, and the work in them will undoubtedly be continued as soon as circumstances permit.

The following Table gives the comparative outputs of crude naphtha in the principal Caucasian fields:

	1911.	1912.	1913.	1914.
	Tons.	Tons.	Tons.	Tons.
Baku	7,471,017	7,770,844	7,482,318	6,921,878
Grozny	1,214,011	1,041,485	1,186,775	1,587,824
Maikop	126,407	149,207	85,238	71,154
Daghestan ..	593	560	614	1,225
Elizabetpol ..	206	279	173	75
Tiflis	—	700	724	581

3. Asphalt.

Asphalt, or Bitumen, occurs in many places in Georgia, as it usually accompanies the outflows of naphtha with the formation of which it is closely connected, forming nests or impregnating the tertiary formations which were mentioned in connection with petroleum.

There is an important zone of asphaltic outflows in the district of **Notanebi,** in the neighbourhood of the Gouria oil borings where these hydrocarbons exist in different modifications in the fluid, semi-fluid and solid state.

In several places enormous beds of alluvial sands are permeated and agglomerated by a somewhat fluid asphalt, the composition being from 13 to 18 per cent. of asphalt combined with about 80 per cent. of sand. It seems at first sight to be a natural road material, but unfortunately cannot be hardened sufficiently for that purpose by heat without destroying its binding qualities. However, the asphalt contained in it could easily be extracted by boiling the material in water, when the sand falls to the bottom while the asphalt floats and is then, according to the experiments of a specialist, equal to the best Syrian bitumen.

The same neighbourhood contains two other bituminous materials, one being the mineral called Gilsonite, resembling anthracite, or jet, but very light, being in fact natural hardened petroleum and containing 84·66 per cent. of carbon. It is found in numerous veins up to more than 1 foot thick, and in nests, but it has only sporadically been exploited, although it is a valuable product for making black varnish.

The other material is visibly of the same family as the Gilsonite, but in a semi-fluid condition, and of such tenacious nature that it can be drawn out in threads many yards in length. In this condition the material would also be useful for varnishes, but the difficulty of handling it makes it commercially impossible.

The mountains along the Goakwara River, which falls into the Black Sea near **Gagri,** Georgia, are formed of enormous beds of limestone, the lower ones of which are also impregnated with bitumen.

The bituminous outcrops are visible along the valley over a distance of about 2 miles, and although not continuous, reach everywhere to the same height, and therefore seem to derive their impregnation from a common source or reservoir inside of the mountains. Samples contained from 15 to 20 per cent. of bitumen, but were found too hard for grinding and using as paving material. They had, however, been taken from pieces lying in the open and probably do not represent the rock to be found in the interior of the mountain ; and in view of the excellent position of the deposition near the seashore it should certainly be fully examined.

STATION AND MT. KASHEK (16,346 FT.).

Bitumen in the state of a heavy liquid oozes out in several places from these outcrops and has been found to contain ichthyol, a most valuable oil used medically against rheumatism, etc. An analysis of the liquid bitumen, made in Petrograd, gave the following result :

	Per cent.
Hydrogenous matter containing ichthyol	20·34
Hydrogenous matter not containing ichthyol ..	52·80
Water	21·50
Sulphur	2·50
Lime	1·87
Alumina	0·96
	99·97

This oil could probably also be extracted from the impregnated limestone, as it is distilled out of some shale in the only other place where it is known to occur, in Seefeld, in the Austrian Tyrol. In view of its great value and scarcity (the Austrian Company sells it as a monopoly), it should be an additional incentive to test this whole deposit in which, according to the experts, the presence of naphtha is also probable.

The only district where asphalt is really being extracted for paving purposes, although in small quantities, is that of **Signakh**, in Georgia, where now also borings for oil are being made. The exploitations exist at **Murzani, Kodurnia, Eldar** and near **Chatma** and the products are used locally and in the neighbouring Tiflis, while otherwise all the asphalt employed for public works is brought from other districts.

4. Natural Gas.

This product which, like asphalt, is usually also connected with petroliferous districts, is of much rarer occurrence in Caucasia than in the American and Canadian oilfields.

While there are more or less important escapes of gas from every borehole, specially in their initial stages of production, natural gas without petroleum has so far been struck only in some places in northern Caucasia, specially at **Stavropol.** In 1909, during boring operations for water in the centre of the town, gas was discovered at a depth of 196 yards ; it was found to be a natural hydrocarbon, fit for all heating and lighting purposes, as it breaks out in many places in the United States and Canada. Other boreholes were therefore made, and the flows of gas connected with the existing canalization, with such good success that all firing and lighting in the whole town has since then been done with the aid of this gas, dispensing entirely with coal and other fuels.

As the natural gas is mostly an indication of the presence of naphtha in depth, a company was formed in 1912 for trying to reach the latter. It was estimated that this might be possible at a depth of about 700 yards, and in 1913 638 yards had been bored and the familiar signs of the presence of naphtha were observed, when the war stopped the completion of the trials.

In the district of **Labinsky** in the same neighbourhood another company was formed before the war for boring for gas and oil, and acquired full rights from the Cossak village for 5 years for the sum of about £32,000, but no results have been arrived at yet.

At **Grozny** natural gas from the oil wells is now also used to a certain extent.

5. Sulphur.

The most important deposit of native sulphur known in Caucasia occurs in the Province of **Erivan,** about 30 miles from the railway line running to Persia. It is comparatively easy of access, the greater part of the road from the railway passing through a well-cultivated plain, whence the mountains rise gradually.

The deposit has been opened up only superficially and beds of sulphur have been disclosed in two adjacent creeks through which small rivers have cut rather deep winding courses. The sulphur occurs either in the shape of crystals in beds of gypsum or as amorphous masses in metamorphic limestone. Many of the crystals are well developed, almost transparent, and up to 1 inch long, while the amorphous minerals permeate the cavities and pores of the limestone. The deposits are confined to the more recent sedimentary strata, and are specially associated with the gypsum and marls of the saliferous deposits and with similar rocks of the tertiary period.

In the first valley there is an outcrop only about 100 yards from the main road and showing on both sides of the creek: it dips vertically and forms a bed of 8 feet in thickness, carrying 40 per cent. of sulphur. At a short distance up the valley another outcrop is seen, 2 feet width of practically pure sulphur. Further up in the valley three more outcrops occur, of widths ranging between 2 feet and 5 feet; they contain about 40 per cent. sulphur, except the last one which seems very rich indeed, as clean sulphur was exposed on opening up the outcrops. Altogether in this valley there are 5 distinct outcrops, all of good workable width, with the same strike and dip, and carrying values from 40 per cent. upwards.

In the second valley we have at the bottom a very fine outcrop which strikes into the mountain with a width of over 10 feet, and carries over its whole width a value of at least 65 per cent. of sulphur. Higher up in the valley there are two more outcrops, 2 feet and 5 feet wide respectively, and containing from 35 to 40 per cent. of sulphur. East of them, in a deep cutting, there occurs what is probably the richest deposit of all. It has a width of 8 feet and contains pure sulphur over its whole width; on being uncovered it even improved. It strikes into the mountain, and from its appearance should give a very large output. Within 100 feet from it there are two more outcrops of good workable widths and carrying high values.

As all these outcrops have been examined only superficially, it is impossible to calculate their total contents with any degree of certitude, but from what has been ascertained so far about 800,000 tons of sulphur are assured at the surface. The total is undoubtedly very much higher, and other beds will probably also be found yet.

These deposits are undoubtedly much richer than those of Sicily, where ore with as little as 25 per cent. of sulphur is being extracted under great difficulties. A sulphur refinery established in connection with them could therefore easily compete with Sicily and produce all the different qualities of refined sulphur which are now being imported in south-eastern Europe and Transcaspia. The quantities received in the ports of Batum and Tuapse alone amount to about 5,000 tons of raw brimstone per year, and to about double that quantity of refined sulphur, mostly in the shape of flowers of sulphur used in the vineyards of Georgia. The raw brimstone is required for the manufacture of pure sulphuric acid, as the product obtained from iron pyrites, although cheaper, is unsuitable for many purposes of the chemical industry on account of its usual tenour of arsenic.

The use of refined mine sulphur will, therefore, increase with the expansion of the chemical industry, and specially the manufacture of wood pulp by the sulphite process, which was projected in the country before the war.

Sulphur also exists in **Daghestan,** in the Samur district, but it is difficult of access; and the same may also be said of the deposits known in the **Askhabad** district of the Transcaspian territory, which are situated far from any means of transport.

6. Salt.

Salt is produced, mostly under Government administration, as rock salt, and also as sea salt on the Azoff and Caspian Seas.

The production was as follows in 1909 :

	Tons.
Rock Salt :	
Kulpa Mines, Province of Erivan	12,350
Nakhitchevan mines, Province of Erivan	3,322
Kagisman mines, Province of Kars	4,425
Olti mines, Province of Kars	436
Sea Salt :	
Baku Province	11,123
Stavropol Province	1,024
Daghestan and Terek Provinces	304
Total	32,984

The total production from these sources in recent years amounted to

1911	1912	1913	1914
Tons.	Tons.	Tons.	Tons.
37,830	34,980	23,484	27,497

Glaubersalt, Sulphate of Soda, is extracted from the lakes in the **Batalpashinsk** district in northern Caucasia. In 1911 about 800 tons were produced, and used by the glass works near the Station Mineralnaia Voda.

This mineral also occurs near **Mukhravani,** in Georgia, but is not worked.

7. Portland Cement.

The Caucasian cement factories are mostly situated on the Black Sea shore near **Novorossisk,** where inexhaustible quantities of suitable limestone are available in the mountains bordering immediately on the sea, while the latter affords every facility for transport.

The first factory was built in 1890, and in 1896 a Franco-Russian Company erected another one at **Guelendjik,** soon to be followed by a third, the three having a total producing capacity of about 300,000 tons per year. These three companies held the field until 1912 when the Black Sea Kuban Cement Company "Beton" erected a factory near the Station **Donelny,** on the north side of the mountain chain, where soon afterwards yet several others were being laid down. At the outbreak of the war there were therefore nine factories working, or in working order, 4 on the Black Sea shore and 5 inland in the Kuban district.

The latter factories also have at their disposal huge deposits of cement stone of superior quality: its formation and composition is quite regular with scarcely any undesirable ingredients, which makes the extraction and calcination easy.

The analysis of this raw material shows it to be similar to that used for the manufacture of the celebrated hydraulic cement of Le Theil, near Marseille, which was used for the construction of the Suez Canal and for a great number of hydraulic works in the Mediterranean, as it resists the action of sea water.

All these advantages, combined with cheap transport, make it therefore probable that this part of the Caucasus will become the most important centre of the cement industry for the whole of the Black Sea and Transcaspian districts.

In the north-eastern part of Caucasia, near **Naltchi,** the manufacture of cement would also be possible, as the raw materials are also available in the shape of marl and of clay of the requisite compositions.

8. Refractory and Building Materials.

Fireclay is found in many places in Georgia, and is worked into refractory bricks, specially near **Shrosha,** in the Province of Kutais, where a company of the same name has been established for some time. It produced in 1914 954 tons of fire-bricks, and two other smaller concerns working at **Tseva** in the same zone manufactured in the same year 291 tons.

As one of the largest consumers of fire-bricks in its smelters the Société Industrielle et Métallurgique also has a plant for making them near **Alaverdi,** and produced :

	1911 Tons.	1912 Tons.	1913 Tons.	1914 Tons.
Fire-bricks	1,817	1,938	2,305	1,655
Silica bricks	4,781	8,064	805	2,382

Siemens Brothers also made their own fire-bricks at **Kedabeck** in considerable quantities.

Nevertheless there is still a certain amount of fireclay and of finished fireproof articles imported every year for special purposes.

9. Onyx Marble.

Caucasia, which contains so many metalliferous minerals, can also supply this rare marble which is of a purely ornamental use.

It is a pure carbonate of lime which was slowly deposited from hot or acid springs containing lime in solution. Such springs, saturated with carbonic acid from the depths of the earth, are most frequent in the southern parts of the country, and the deposits of onyx marble occur in the same zone.

The most important one of them lies near the village of **Djardji,** about 10 miles north of the Station Bash-Kadiklar on the Tiflis-Kars railway. It forms the bottom of a dry creek and can be worked as an open quarry, containing apparently about 80,000 cubic metres of material. The stone itself is transparent, with wavy lines or bands of all shades of grey, green, blue, pink and brown, producing very pretty effects. Blocks can be extracted up to 5 feet in length and 3 feet wide ; large slabs are used for mural decoration, smaller ones are cut up for clock cases, paper weights, etc., but there is no work done in the quarry at present.

Another deposit of onyx marble is found in the same district south of Erivan, in the village **Agbash,** on a spur descending from Mount Ararat. Here the stone is not banded, but of a more uniform bluish or whitish colour, and large blocks are rare.

A similar stone exists in the **Potzkhoff** district near Akhaltzik, in Georgia. The quarry is now covered by a landslip, but it was formerly worked by the Turks, and the former mosque of Akhaltzik is paved with slabs extracted from it.

The smaller stones and chips have also been used in Georgia by the manufacturers of carbonic acid and mineral waters, for the production of carbonic acid gas, as the material is absolutely pure, and for this purpose the stone is usually ground.

10. Infusorial Earth.

Infusorial, or diatomaceous earth, or Kieselguhr, is being worked in two places in Georgia, namely, on the **Suram** mountain, near the town of the same name, and at **Kissatib,** about 6 miles S. of Akhaltzik.

The **Kissatib** deposit crops out on three sides of a mountain spur descending from a high peak, in one part as a long white band on the steep side of a sandstone cliff. The beds are horizontal, and the principal one has a length of about 1,100 yards and an ascertained width of 770 yards, which probably extends further into the mountain. The depth is not known yet, as in the central workings, which are all in open cast, the bottom has not been reached at 90 feet.

A curious feature of this deposit is that, while it was formed at the bottom of a lake, it is now situated about 440 yards above the valley, overlaid and protected by a huge bed of green sandstone. The whole region has been disturbed by volcanic eruptions, and the bottom of the lake was formed by a flow of porous lava which, where accessible, is about 30 feet thick and reposes itself on grey basalt. The infusorial earth is then covered by a bed of sandstone of a thickness of from 50 to 100 yards, on top of which there are again several smaller layers of infusorial earth, the whole being covered by tertiary alluvium.

The infusorial earth found in these upper beds forms a quite unique material, being intersected by bands of grey and brownish colours, formed by clay and ferruginous impurities and giving it a very pretty appearance.

But the principal bed below the sandstone is of a pure white colour and consists of almost pure silica, with not more than from 2 to 4 per cent. of impurities, mostly alumina and lime, iron oxide being less than 1 per cent. This purity is undoubtedly due to the protection of the overlying sandstone, which at the same time has also had the effect of compressing the naturally soft and light deposit. The specific gravity of the material is therefore about 0·65, while that of the earth from the Scotch and Norwegian deposits, which lie on the surface or in water, is usually about 0·3 to 0·4.

The general lightness of this earth is connected with its production, as it consists of the siliceous shells of minute diatoms living in the water, which under the microscope reveal the most wonderful shapes and ornamentations; remains of fossilized fishes are also sometimes found between them.

On account of its unusual compactness the Kissatib earth can be quarried in large blocks and sawed-up into brick-shaped pieces, but the greater part of it is delivered in lumps and powder. At present it is principally used for insulating purposes in steam and heating installations, either powdered and applied like mortar, or in the shape of the above-mentioned bricks, most of it going to Baku for such purposes. The export to other parts and to Western Europe, where the purity of the material would make it useful also in the chemical and other industries, can only be undertaken when the railway to Akhalitzik has been built.

The exploitation, in which a Dutch company was at one time interested, is now carried on in a small way by the original owners, but will without doubt expand when better means of transport are available.

The whole production of the two mines is used in Caucasia, and amounted to:

1911	1912	1913	1914
Tons.	Tons.	Tons.	Tons.
590	839	411	387

11. Baryta.

The natural Barium Sulphate or Heavy Spar occurs in many places in Georgia, specially in the Province of Kutais, where the veins or beds of the mineral accompany basalts traversing the diorites. Such deposits are known at **Lekverethi**, near Kutais, at **Puti**, in the Sharopan district, and at **Ontcheishi, Ossuneli, Dertchi, Bani, Mekhveni, Gabiethi,** and **Tchashlethi,** in the Letchkhum district. Small exploitations exist in all these places, whose combined outputs during recent years were as follows :

1910	1911	1912	1913	1914
Tons.	Tons.	Tons.	Tons.	Tons.
1,763	1,255	1,229	1,824	890

Only one grinding mill exists in the neighbourhood for reducing the mineral to powder suitable for paint manufacturers ; it is situated at **Shanethi** and had the following productions :

1910	1911	1912	1913	1914
Tons.	Tons.	Tons.	Tons.	Tons.
742	863	779	782	571

All this material was used locally, but as the mineral is everywhere quite white and pure and available in huge quantities, these exploitations could advantageously be very much extended. Up-to-date grinding machinery is the only requirement for producing the powder also for the western markets at a competitive price.

Similar beds of Baryta are also known at **Buskhana, Dashalti** and **Tchovdar** in the Province of Elizabetpol, but no work whatever has been done on them.

12. Asbestos.

Asbestos occurs in several places in Transcaucasia, principally at **Vshinevi** in the Sharopan district of Georgia, where small quantities are being extracted. The mineral is there found in veins which cross the talcose schists forming the steep banks of the Bshineula River and crops out in various places at about 400 to 500 yards above the water. The veins are from 1 to 3 inches wide, and as the asbestos fibres are disposed transversely across them, their length usually varies between the same limits. Their colour is green or greenish white and they can easily be separated, but are unfortunately often brittle.

Other deposits of Asbestos also exist in the Letchkum district of Georgia, in the upper parts of the **Tskhenis-Tskali** valley; the veins also lie in schists of Devonian formation and are similar to the above, but no extraction has so far been tried.

Samples of Asbestos have also been brought from the village **Mysogorosk,** near Shusha, in the Province of Elizabetpol.

The product of all these places, although sometimes of long fibre, is mostly rather stiff, like bristles, and cannot be twisted or woven. For this reason there is not much use for it, except as a binding material in connection with infusorial earth for manufacturing insulating plaster for steam pipes, etc. But, as so far only surface work has been done, it is quite possible that the nature of the fibre may change in depth and become softer, like the product of the Urals and Siberia, and further exploration is therefore desirable.

13. Lithographic Stone.

Limestones fine and uniform enough for lithographic purposes are known to exist only in a very few places, in Southern France, Poland, Asia Minor, etc., but they have nowhere been able to replace those coming from Solenhofen, in Bavaria, which have been almost exclusively employed by the lithographers of the whole world. The discovery of a stone which really equals the Bavarian and can perfectly replace it is, therefore, of the highest importance.

A very extensive deposit of such stone exists at **Amlivi,** about 24 miles from Tiflis and 8 miles from the railway. The beds are clearly visible on the mountain side from its foot to a height of about 700 feet, and represent an enormous stock of superposed layers of limestone. Most of it would be suitable for lithographic purposes, as it is of the finest texture without inclusions of crystals or other admixtures, and of equal density all through without waviness. The colours vary between light yellow, grey, greyish blue and green, and large slabs can be extracted of any of these colours, although the light ones are the most desirable, as the contrast between their colour and the transfer ink makes the work of the lithographer easier. Perfect stones of large size, 4 by 6 feet, and corresponding thickness, have been extracted, while the smaller sizes, of 2 by 3 feet and 5 or 6 inches thick, are inexhaustible.

These stones have been practically tested by the Cartographic Establishment of the former Russian General Staff at Tiflis, which declared them equal to the best products of the Solenhofen quarries, which hitherto had no rivals in the world. Similar trials were also made in Paris by an expert professional lithographer who also declared that these stones can advantageously replace those from Bavaria and are even superior to them with regard to density. The fact that large-sized stones suitable for heavy printing machines can be obtained is also highly important, as such sizes do not exist any more at Solenhofen. This quarry has therefore a great future, and will undoubtedly become the centre of a new export industry for Georgia.

14. Pumice Stone.

In view of the great volcanic activity which characterizes the Caucasian region, it may seem surprising that Pumice Stone is almost missing in the great variety of mineral products thrown up by the volcanoes. So far it has been discovered only in one place, namely, at **Malaya-Kutma,** near Kars. This deposit is only partially opened up, and consists of several superposed beds of pumice divided by denser volcanic products and covered by a thin layer of earth, so that the extraction is easy. The pumice is of greyish-white colour and of the usual spongy vesicular consistence which, however, varies and in parts becomes almost as dense as a sandstone. The porous layers form an excellent abrasive for all the usual purposes, as it " bites " well and is resisting. Small quantities of it have been sent to this country, but the cost of transport made a regular business difficult. Before the war a small exploitation took place for Caucasia and Russia, the product being sold in lumps and also in powder for abrasives, polishing materials, soap, etc.

15. Soapstone.

Soapstone or Talc accompanies in several places in Georgia the intrusions of Serpentine, and being soft when freshly extracted is sometimes carved into kitchen utensils, etc.

A curious mineral of similar description is found near **Akhaltzik,** in Southern Georgia. It is of greyish-white colour, and soft and unctuous to the touch. With water it forms an emulsion somewhat resembling soap water, and it can also be made into a kind of paste which the local shoemakers use in their work instead of glue.

16. Mica.

Mica exists in several places of the Central Caucasian chain, but only samples have so far been extracted from them.

17. Graphite.

Deposits of Graphite are known to exist in several places in Georgia, specially on the Suram mountain, near the Station **Kharagouli**, and at the village **Tchumathelethi**, near Gori. Neither of these deposits is worked.

The one on the Suram is very extensive, but the graphite is of a very fine consistency and a dull aspect, like soot. It does not form flakes, and can therefore not be used for crucibles or similar purposes. Its analysis produced :

	Per cent.
Graphite	50·59
Ashes	47·57
Moisture	1·84

The earthy impurities are therefore considerable, but more useful material might possibly be found by exploring the deposits in depth.

A similar mineral is found near **Djimara**, in the Northern Caucasus, where a bed crops out over a length of about a mile, and contains apparently very large quantities. The quality seems about the same as on the Suram, the carbon contents being from 50 to 60 per cent. It is used locally in foundries, and also for paints.

Distribution.

As Russia herself forms an enormous market, most of the mineral and metallurgical products of Caucasia were before the war sold in that country, the exports being principally confined to manganese ore and part of the petroleum production.

Copper, to begin with, was in great demand in Russia, and the production of the country could not cope with it ; before the war about one-third of the consumption had to be imported, mostly in electrolytic copper for electrical purposes. During the war these imports rose as follows :

	Tons.
1914	4,576
1915	10,778
1916	23,548

the latter chiefly from the United States and Japan.

In order to keep the copper industry in the country the former Government imposed a duty of about £33 per ton on imported copper, and in consequence of this protection the Russian price of the metal was before the war always from £25 to £30 above the London quotations. On the other hand the export of copper ores was charged with a duty of 6s. per ton, and in view of these inducements the copper smelting and refining was entirely kept in the country.

Most of the Caucasian producers belonged to the Foreign Copper Syndicate, which was formed in 1907, and controlled about 94 per cent. of the total Russian production.

For similar reasons **Lead** and **Zinc** were also protected by heavy duties, the former being charged with about £8 and the latter with £11 per ton, and the export of their ores was prevented by the same export duty of 6s. per ton. These metals were also easily absorbed by the Russian market, which, besides, had to import large quantities, as the following figures show :

	1914 Tons.	1915 Tons.	1916 Tons.
Imports of lead	36,691	25,059	23,118
Imports of zinc	14,328	14,137	11,840

The various other non-metallic minerals, including coal, are all consumed in the country, or almost in the area of their production, although with proper transport facilities several of them, like baryta, infusorial earth, pumice stone, iron pyrite, etc. might advantageously be brought on the western markets.

As to the minerals which are being exported, **Manganese Ore** stands first in importance, by far the greatest part being shipped to foreign countries, not only in Europe, but also largely to the United States.

The portion used in Russia is quite inconsiderable, and only goes to the Donetz Basin in the Ukraine, the steelworks in the Urals using local ores. The following figures show the proportion of Georgian manganese ores used in the Ukraine (in tons):

	1905	1910	1911	1912	1913
	Tons.	Tons.	Tons.	Tons.	Tons.
Total production ..	346,233	639,285	605,013	911,699	1,079,688
Sent to Ukraine.. ..	44,620	29,938	23,683	16,899	9,959

Most of the foreign trade in the ore was before the war done by export firms established in Poti and Batum, which in some cases owned and exploited their own mines, but mostly bought the ore from the small producers and made contracts with the smelters.

The decrease of the consumption of Georgian manganese ore in the Ukraine during recent years was caused by the special favours enjoyed by the Nikopo manganese mines, in which the Russian Grand Dukes were largely interested.

In the **Petroleum** industry the proportions between export and home consumption are to-day entirely different. In the beginning the export trade was also largely preponderating, and was being fostered by the Russian Government, but since the beginning of this century it has dwindled down considerably, partly on account of the increasing foreign competition and new sources of supply, partly in consequence of the enormously increased consumption in Russia.

In fact, of the enormous quantities of petroleum products which are every year extracted in Baku, only a small percentage is now exported, the great bulk being used for home consumption. Thus, during the year 1912, Baku exported abroad only about

500,000 tons, or 5·5 per cent. of its production of kerosine,
210,000 „ 2·3 „ „ „ „ lubricating oil,
160,000 „ 1·9 „ „ „ „ benzene,

while the remaining 90 per cent. were used partly on the spot and in Caucasia, but mostly in the interior of Russia, with which Baku has excellent connections by means of the Volga River.

The products of the Maikop and Grozny petroleum fields are also mostly used in their own districts and in Russia, except the benzene and kerosine extracted from the Grozny naphtha, of which about 200,000 tons per annum were exported before the war through the port of Novorossisk.

Labour.

The miners and labourers employed in the different mine-fields are of different nationalities. While the Georgians predominate in Georgia, and specially in the manganese mines, we find in the south-western districts and the Tchorokh valley mostly Mohamedan Georgians or Lazes, and in the south-east many Tartars, Persians, etc.

Generally speaking, their economic conditions are satisfactory, and, if we except Baku, strikes have been rare. In the small mines which work only spasmodically, a primitive state of things exists yet, the men dividing their labour between the mines and the fields, but the large mining companies have in late years made enormous improvements of every description for the welfare of their men.

The Association of Manganese Producers of Tchiaturi was one of the pioneers in this direction, and provided not only a hospital with forty beds for the use of its workers, with a school, public library, etc., but also organized the public services of the district, supplying water, light, etc. The money thus spent came from the tax levied on the manganese export under Government control, but on the other hand the sums spent by the private mining companies came out of their own pockets. In order to accommodate large numbers of miners the companies had in most cases to build houses for them ; for instance, in Dzansul there are several large buildings, each with lodgings for sixty workmen, besides houses for the staff. In the neighbouring Kvartzkhana a similar building was being erected before the war. The necessities of life were provided every week from Batum and sold in the Companies' shops at prices fixed by a committee of workmen.

The Société Industrielle et Métallurgique has also made great improvements in its various establishments, almost regardless of expense. In Alaverdi the houses of the workmen have been vastly improved, and a public bath was installed. At the smelter at Maness dwellings were erected for over forty families ; a school for one hundred children was also maintained, as well as a savings bank, and when the war broke out a hospital with twenty-eight beds for wounded soldiers was installed and maintained by contributions of the Company and the workmen, amounting to about 1,500 Rbl. per month.

Hospitals are attached to almost every mine, with competent men for rendering first-aid, and doctors within call, if not permanently engaged. Such hospitals, besides those already mentioned, exist also at Kedabeg, Zangesur, Beshaul, Tkvibuli, and Alagir. The latter establishment is also much concerned with the economic welfare of its workmen, who have also established a savings bank, which in the beginning of 1915 had 110 members and deposits amounting to Rbl. 70,203.

	1911.	1912.	1913.	1914.
Total number of workmen in Georgia and Caucasia.. ..	12,508	19,125	26,345	12,911
Employed in the principal mines :				
Copper	7,089	8,159	8,414	6,688
Silver, lead and zinc	667	810	875	684
Manganese	2,135	3,287	3,269	3,097
Coal	622	658	710	690
Sulphur ores	70	99	112	60
Baryta (mines and grinding) ..	88	54	143	65
Infusorial earth	114	15	18	12
Quarries..	1,574	5,103	11,258	561
Cement stone	—	792	1,072	1,244
Number of mining accidents ..	535	490	795	652
Of which there were fatal ..	27	32	40	24
Compensations paid	£7,045	£3,845	£4,510	£3,270

The Petroleum Industry, which in Caucasia overshadows all the other mining enterprises, being mostly concentrated in Baku, where racial difficulties are very pronounced, has been much more disturbed by labour questions than the mineral ore mines, and has been seriously affected by the strikes and

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excesses of 1905 and 1913, as it was mentioned in the special monograph on this industry.

The figures in Table on p. 80 give an approximate idea of the numbers of men employed in the different mines during recent years. They do not include the oil industry, nor the men engaged in transport work.

Concerning the Petroleum Industry we give here only the following Statistics :

	1911.	1912.	1913.	1914.
Number of workmen engaged :				
In Baku district	—	—	—	40,385
In Terek Province	4,720	4,960	7,105	8,188
In Daghestan Province ..	35	33	64	32
In Kuban Province	1,199	1,252	1,079	982
In Tiflis Province	—	32	57	111
Elizabetpol	101	108	17	6
Number of accidents	582	886	977	312
Number of deaths	24	14	6	18
Compensations paid .. Rbl.	41,758	38,284	43,314	120,062

Participation of Foreign Capital.

All the large mining enterprises of Caucasia, in which boring for oil must of course be included, have almost exclusively been started and maintained by foreign capital. The total sum invested in these enterprises cannot be given, but may be approximately guessed at by the fact that over £22,000,000 have been actually spent by British companies in the petroleum industry alone. French, Belgian, and German firms were more interested in metal mining, and some of the best-known exploitations of this kind are in their hands.

The reason for this investment of foreign capital lies in the fact that mining in general requires great capitals and strong financial support in emergencies, and this was not sufficiently available in Caucasia, nor in Russia, so that foreign help was welcome.

Nevertheless, outside of the petroleum and manganese industries, large mining enterprises are comparatively few in number, although, as we have shown, there is almost no limit to untouched, or barely scratched ore deposits in the country. Specially for copper mining there are enormous possibilities, and Georgia might well become a second Montana in this regard. The Lesser Caucasus was the principal source of the copper supply for the Mediterranean countries in the antiquity and the middle ages, and to judge from the traces left by the old exploitations in scores of places, their production may at times have equalled the present-day one.

The cause of the slow progress of the mining industry in modern times was in the first instance the lack of native capital for large enterprises. The only mining operations which could be executed practically without capital, namely, the digging for manganese ore, were in fact all commenced by the Georgian landowners, which proves that they are not lacking in enterprise.

But for large undertakings on a modern scale foreign capital had to be called in. Outcrops were examined by the experts of the capitalists, more or less at hazard, as they had been offered, but mostly did not satisfy them, either because they were not sufficiently opened up, or too far from the means of communication, or the pretensions of the owners were found too high, etc. Only those companies or syndicates succeed which went beyond these apparent obstacles and made their own fuller examinations. Thus both the Dzansul and the Kvartzkhana mines, whose enormous richness is to-day clearly proved, had been offered in London for years and " turned down " by several experts before the present owners started their own prospecting works and made successes of them.

Similar opportunities abound in the country and will, no doubt, be taken advantage of after the return of normal conditions. It was remarked that just before the war, and already in 1913, a much greater number of prospecting and exploitation licenses had been claimed from the Caucasian Mining Administration, which indicated an awakening of the mining activities in the country.

The possibilities offered by the exploitation of the mineral springs and the hydraulic energy of the country have been mentioned elsewhere, and altogether Caucasia, and specially Georgia, present to-day to foreign enterprise an almost virgin and most inviting field of activity.

PART III

MINERAL SPRINGS

THE origin of by far the greatest part of the springs issuing from the earth is rainwater, or melting snow, which percolates the soil and rocks through cracks or pores, and descends until it is arrested by a non-porous stratum. The overlying porous beds will then act as a reservoir to be filled until the water finds another natural vent and issues forth as a spring.

The atmosphere slightly impregnates rainwater with ammonia, nitric, and specially carbonic acids, and thus charged the water has a considerable solvent action upon the rocks and soils which it encounters, and when finally coming again to the surface it will hold in solution a certain quantity of the mineral constituents of the formations through which it has passed.

Thus, lime or magnesium salts will have been taken up from limestone and other sedimentary formations, while the primary rocks, like granite and gneiss, will have given up sodium and potassium carbonates, or the water circulating near marine beds of salt will form a saline spring.

According to the nature of the minerals encountered complex chemical reactions take place, so that many springs may finally contain twenty and more different compounds, whose quantity in a given volume of water may also considerably vary, according to the distance and time of the underground circulation of the waters.

Every natural drinking water, therefore, contains some mineral constituents, but what is specifically called a "mineral water" is a natural water proposed for consumption or use on account of its special therapeutic or hygienic properties.

As to the hot or thermal springs, of which Caucasia has a great number, their temperature may in some instances be due to their flow through or near rocks heated by the enormous strains set up by the movements and fracturing of the earth's strata. That such movements are still at work is proved by the frequent earthquakes which sometimes shake the whole continent between the Black and Caspian Seas.

But there is no doubt that many of the Caucasian hot springs draw their water from the hot magma or molten lava existing in the deeper parts of the earth's crust. It is well known that such magmas contain gases and water which would rise as steam through the fissures of the earth, condense, and take up in solution whatever elements they may meet in their further upward course.

This origin must probably be attributed to most of the hot mineral waters springing from the eastern part of the Caucasian main chain, where hot magmas are actually flowing yet in their vicinity, forming the mud volcanoes and hot mud lakes previously described.

Besides containing a great variety of mineral compounds the Caucasian springs are also very often impregnated with gases, specially carbonic acid and sulphuretted hydrogen.

Emanations of the former are very frequent in all parts of the country, and often bubble up in streams, impregnating the water, which thus becomes capable of dissolving a certain quantity of chalk. When the gas evaporates, the chalk is deposited again, often in crystalline form, and this is in fact the origin of the onyx marble found in the Erivan district, and of other stalagmites.

Radio-activity has also been observed in several sources, but so far only a few of them in Georgia have been examined in this regard.

According to their chief constituents the mineral waters are usually classified as follows :

1. Alkaline, in which sodium carbonate or bicarbonate predominate, also bicarbonate of lime.

2. Alkaline-Saline, containing the precedent compounds, together with chloride of sodium and magnesium.

3. Saline, where the chlorides of sodium, magnesium, and calcium form the principal constituents.

4. Acid, containing sulphuric or hydrochloric acid, mostly found in volcanic neighbourhoods.

According to their secondary contents the sources may further be subdivided into—

Carbonated, containing carbonic acid,

Sulphurous, containing sulphuretted hydrogen,

Ferruginous or chalybeate, containing bicarbonate of iron, etc.

Although the number of known mineral springs in Caucasia exceeds 400, as the appended Table will show, only a small proportion of them is used for curative purposes, and most of the others have not been analysed or tested as to their value.

The following details concern the principal sources of which any use is made at present:

In the northern Caucasus mineral sources are most frequent in the Terek district, where there are nearly one hundred of them known within an area of less than 40 miles in diameter, principally in or round the four centres of **Piatigorsk, Shelesnovodsk, Essentuki,** and **Kislovodsk.** These places are situated in a very picturesque valley, through which a branch line of the North Caucasian railway has been built, so that they are easily accessible. They are surrounded by mountain spurs descending from the high peak of the Elbrus, and the waters springing from them must, according to the great variety of their composition, concentration, and temperature, have passed through many different strata. The principal elements contained in them are iron and carbonic acid, with alkaline and sulphur compounds, and some iodine and bromine.

Their medicinal properties have been known from ancient times, and the Russian Government had them examined already in 1773, and the first bathing season was opened in Kislovodsk in 1798. Numerous further investigations were then made, mostly by German doctors and scientists, who unanimously confirmed the high therapeutical value of the various sources. But the Government Departments of the Domains, and afterwards of the Interior, in whose hands their administration lay, did practically nothing to exploit them, and only is 1822 about £55,000 were advanced for building bathing establishments.

In 1846 a special Board for Watering Places was appointed, and more expert reports had to be obtained, one being made in 1874–5 by the French specialist Jules François, who brought the baths into great prominence. In the latter year the branch line ending at Kislovodsk, and connecting the four places with the Rostov railway, was completed, thus making it possible for visitors to reach the baths easily.

In 1882 another French engineer, Léon Dru, was engaged to work out a project for a larger exploitation, and in the execution of it £40,000 were spent between 1887 and 1890, and further £65,000 between 1891 and 1895. Since 1905 the management has been in the hands of a special Water Board, under the auspices of the Ministry of Commerce and Industry, but it has not succeeded in establishing and advertising these springs in a manner to compete with the German and French resorts.

Piatigorsk is situated in the lower part of the valley. Its original name was Beshtau, which means "Five Mountains," from the five peaks surrounding it, the principal one being 4,593 feet high. The environs of the town are very pretty, and the climate is dry. It contains a number of sulphurous hot springs, of temperatures varying between 28° and 48° C., partly used for drinking, partly for bathing. The principal ones of them have the following deliveries per twenty-four hours :

175,000 gallons at 46° C.	140,000 gallons at 46·7° C.
7,000 „ „ 48° C.	30,000 „ „ 35·5° C.

Essentuki lies 10 miles west of Piatigorsk, and possesses only cold springs, mostly of alkaline, also alkaline-saline nature, some being slightly sulphuretted. Sodium iodide and bromide have also been detected in some of the springs, whose total number is about 30. Some of them are used for bathing, for which purpose there exists good accommodation, others for drinking, and much of the alkaline-saline water is bottled and shipped as table water, as it is very useful against dyspepsia, gout, and rheumatism. The mineral contents of one of the sources are also made up in tablets and sold as Essentuki Salts.

Shelesnovodsk is situated at 2,100 feet above the sea, and its springs are, as the name implies, mostly of ferruginous nature, also alkaline. Their temperature varies between 18° and 50° C., and they are used for drinking as well as for bathing. There are eight establishments for the accommodation of visitors, of which there were about 6,000 in 1911.

Kislovodsk is the terminus of the branch railway, and lies 2,500 feet above sea level, entirely surrounded by mountains, and with a bracing climate. It is specially celebrated through its source "Narzan," which was first capted in 1894, and produces about 350,000 gallons in twenty-four hours. This water is not only used externally, but also as a medicinal and table water. On account of its cool temperature it contains much carbonic acid, and is therefore highly esteemed as a sparkling digestive of pleasant taste, which does not lose these desirable qualities even after being bottled for a long time. Besides carbonic acid, this water also contains sulphates of sodium, potassium, and magnesium, carbonates of sodium and calcium, also chlorides, with traces of iodide and bromide of sodium, etc. It is specially useful for diseases of the nervous system and the heart. Other sources of this resort are used for baths.

In Georgia the best-known and most frequented mineral springs are those of the upper Kura Valley round **Borjom.** This town is situated 90 miles S.W. of Tiflis, in about the same latitude as Rome, and at 2,600 feet above the sea. It is connected with the Transcaucasian railway by a branch line running through the highly picturesque Kura valley between the Imerethian and Trialethian mountain ridges, which are covered with big forests of pines, beeches, and numerous other trees. The climate of the valley is warm and very mild in winter.

Borjom, with its surroundings covering nearly 300 square miles, was formerly a State property of the Kingdom of Georgia, and was illegally confiscated by the Russian Government and given to the Grand Duke Nicholas Michaelovich in entail. To-day it is again a State property of Georgia.

Borjom is celebrated not only as a watering-place which attracts every season tens of thousands of visitors, but also through the export of large quantities of the water from one of its sources which rivals with Vichy, and is sent to Russia, France, the Mediterranean, and even as far as the United States. In 1913 9,000,000 bottles were exported, the bottles themselves being made on the spot in a glass factory, which uses a very suitable sand and basalt also found in the vicinity.

The sources of the district are characterized by the fact that they are mostly radio-active. They may be divided into the five following groups.

1. At **Borjom** itself the springs flow from the bottom of a small side valley, which seems to be only a cleft in the limestone rocks towering vertically on both sides of it. The two most important ones have a delivery of about 19,000 and 8,000 gallons per twenty-four hours respectively, much of which is bottled, the surplus being used in the bathing establishments. The water is very rich in carbonic acid, therefore its popularity as a table water. It has also been examined as to its radio-activity, which was found to be 0·80 degree Mache, and it was then also discovered that the Radium and Thorium salts contained in it continued to give off emanation, so that water bottled for nearly a year still showed the same radio-activity, while it usually disappears in a few weeks or days. This unusual behaviour merits further investigation.

The medicinal effects of these waters are very remarkable against inflammations of the mucous membrane and catarrhs, against which inhalations are used; also against rheumatism, gravel, etc.

2. The second group of sources springs up at **Tsagvery,** about 8 miles above Borjom, near the mountain railway leading to Bakuriani. There are 9 cold springs, but only two of them have so far been capted. They are very ferruginous, and much charged with carbonic acid, and generally of the nature of those of Schwalbach and Pyrmont in Germany, but contain even more bicarbonate of iron. Their radio-activity is 0·60 degrees Mache, and this fact may partly account for their efficacy against anæmia and neurasthenia. They are used for baths and for drinking, and before the war they were also bottled and shipped abroad with such good success that the bottling establishment had to be enlarged.

3. Near the village **Libani,** about 6 miles from Borjom, at approximate altitude 4,000 feet, another group of 12 cold mineral springs comes up, characterized by the large quantity of chalk dissolved in them, which is deposited as tufa in the same manner as at Carlsbad. The waters also contain sodium chloride and iron bicarbonate, and have a radio-activity of 1·2 degrees Mache. The daily outflow is about 22,000 gallons, but until to-day no arrangements have been made for utilizing them.

4. A group of warm sulphurous springs giving a considerable delivery of over 100,000 gallons per day exists at **Tsikhis-**

Djvary, a village situated about 5,000 feet above the sea and near the Bakuriani railway. Its radio-activity is high, 1·22 degrees Mache, and this, combined with the sulphur, makes the water highly curative in cases of rheumatism and skin affections. The populations of the neighbourhood use it against these kind of troubles, and a small bathing establishment exists, which has been enlarged in 1913.

5. At **Kvajari,** near the village Thimotis-Ubani, more mineral springs are known, but of a different nature, as they contain sulphur salts of magnesia, calcium, and sodium, and therefore have a purgative effect. They are very tasty to drink, and effective against constipation, and could easily rival with the world-known purgative waters.

From Borjom a small mountain railway ascends to the village **Bakuriani,** through most enchanting scenery. Near the Station Tsemi is situated the Sanatorium of Dr. W. Ghambashidze, established in 1903, chiefly for children and young people.

As these details show, the district of Borjom produces an abundance of mineral waters of great variety and curative properties, which only require modern installations and management in order to make this valley a centre of attraction for the sick and also the tourists of Russia and the East-Mediterranean countries.

Besides the amenities of nature this neighbourhood also contains a great number of highly interesting antiquities, and the remains of about 100 old monasteries and of 14 fortresses, and archæological discoveries from the bronze and even the stone age are frequent, a proof that the healing springs were known and used from the oldest times.

Of quite modern date are a botanical garden and an Alpine garden on the Tskra-Tskaro mountain, at an altitude of 8,000 feet, which is much visited by tourists. There are also meteorological and seismographic stations, besides exploitations of forestry and dairy and poultry farming on the most modern lines. But with all this, the resources of this fortunate and delightful spot are scarcely touched, and present enormous opportunities for further enterprise.

A different kind of mineral springs appears at **Abastuman,** about 30 miles W. of Borjom, in Georgia, on the Imerethian mountains, at an altitude of 4,170 feet. They are more celebrated for their physical properties than for their mineral contents, as they spring at a high temperature, the principal ones at 48·2, 43·0, and 40·0° C. respectively, and are also radio-active.

The daily capacity of the hottest spring is about 220,000 gallons. Two large basins have been installed for general bathing, besides a number of cabins in which baths at temperatures between 31 and 47° C. can be taken, if necessary with the addition of sea salt or pine extract, which latter is manufactured on the spot from the products of the surrounding pine forests. On account of their thermal properties these waters are specially used for hydro-therapeutical and hydro-electrical treatments, for which up-to-date installations exist, and which are highly effective against nervous diseases, rheumatism, and general debility. The climate and surroundings of Abastuman are beautiful; cures can also be continued during winter, when the place is much visited by consumptive patients.

Tiflis, the capital of Georgia, also contains warm sulphurous springs, which were known from the beginning of the Christian era; the name of the town, in Georgian "Thbilissi," means in fact, "warm." There are 8 different sources, containing principally sodium chloride, carbonate, sulphides, and iodides; calcium sulphate and carbonate, and magnesium sulphate and chloride, also traces of bromides. Their temperatures vary between 29 and 47° C., and their radio-activity averages 1·41° Mache, maximum 2·77 degrees. The quantity of water is considerable, and all the municipal baths are supplied from it, partly for medicinal purposes, against rheumatism, skin diseases, etc. Some of the springs have the same composition as those of Cauterets and Bareges in France, Baden near Vienna, and there are great possibilities of making Tiflis into a similarly attractive balneatory centre.

A further interesting Georgian health resort is **Tskhaltubo,** situated about 8 miles N.W. of Kutais, at an altitude of 810 feet above the sea. It possesses 9 warm springs of alkaline and sulphurous nature, issuing at temperatures between 28 and 35° C. Their delivery is very considerable, over 950,000 gallons per day, which are estimated to come from a depth of about 2,500 feet. The most remarkable quality of these waters is their high radio-activity, which varies between 3·28 and 6·79 degrees Mache on the daily averages; but it differs according to the hours of the day, being highest between noon and 2 p.m., when one source showed a maximum of 8·06 degrees. The water of theTskhaltubo River is also radio-active, the examination proving from 1·35 to 1·79 degrees, and even the air in the building erected over one group of sources shows up to 0·12 degrees.

This radio-activity closely follows that of the different springs of Teplitz-Schoenau in Bohemia, which vary between 3·13 and 6·56 degrees, and exceptionally mount up to 8·76 degrees Mache ; while it exceeds the activity of Wildbad in Würtemberg, with which the Tskhaltubo waters are identical, but whose radio-activity extends only between 1·6 and 3·3 degrees Mache.

These springs, therefore, have a great future before them, and may replace the above-mentioned baths which used to attract great numbers of gouty and rheumatic patients from all parts. At present Tskhaltubo is already favourably known in Georgia, and is visited by some 45,000 to 50,000 guests during the summer season.

Besides the described better-known bathing establishments there is a number of smaller places which are only visited by the inhabitants of their neighbourhood, and have usually not sufficient accommodation to attract visitors from a distance.

Georgia, and specially the Province of Kutais, possess many such baths, some of which may be mentioned here.

Zekari, near Kutais, Georgia ; a warm sulphurous spring of 35° C., used against rheumatism.

Chokiani, also a thermal spring of 31° C. Was known in antiquity, as a bath hewn in the rock has been discovered, dating from the time of the Argonauts.

Kursebi, 8 miles from Kutais, Georgia, on the railway to Tkvibuli, possesses a cold alkaline sulphurous source, used locally against rheumatism and skin diseases.

Khressili, in the neighbourhood of Kursebi, and with a similar spring, used in the same manner.

Utsera, 24 miles from Kutais, on the left bank of the River Rion, and 3,420 feet above sea level ; contains eleven alkaline sources, also ferruginous, within a small diameter. There is also a bathing establishment and some accommodation for visitors.

Sharopan has four sources near the River Kvirila.

In the Black Sea Province of Georgia mineral springs are not less abundant. Five are known round **Ozurgethi,** one at **Zugdidi,** another of sulphurous nature at **Kvartcheli,** and many more near **Sukhum,** one of them also supplying sulphurous and strongly radio-active water.

In the **Kuban Province** and the **Taman Peninsula** many mineral sources spring up which were known from old times. Some of them are of sulphurous nature, and contain also salts of bromine and iodine. They are used for rheumatic and neuralgic diseases, specially one flowing near Ekaterinodar.

Similar conditions prevail also in the Province of **Elizabetpol,** and in **Daghestan.** The latter district contains especially also a number of very hot springs, rising at nearly boiling point, but they are not used, and, in fact, scarcely known.

In the appended list 415 places are mentioned, which contain between 800 and 900 separate springs of different nature, but in the absence of detailed analyses it is not possible to give more than an approximate **classification** of them.

About half of the total number are of **sulphurous** nature, containing sulphuretted hydrogen, which gas is also observed in about 45 alkaline springs, and a few containing in addition carbonic acid and carbonate of iron.

The **carbonated waters** are, as explained, also very frequent, and carbonic acid is mentioned as the most noticeable gas permeating some 85 springs, while it also occurs in about 70 more ferruginous and 25 alkaline sources. It is often present in unusually large quantities, and none of the sparkling waters which are being bottled require to be strengthened by the addition of artificial carbonic acid, as it is usually the case elsewhere.

Ferruginous or **chalybeate waters** containing bicarbonate of iron spring from about 40 sources, and the iron compound forms also a valuable addition in a great number of the other springs.

As to the **alkaline and alkaline-saline sources,** they number about 150, while saline and bitter waters are produced by about 20 sources.

Concerning their **temperature** it may be added that about one-fourth of all these springs produce thermal waters, that is to say, they issue from the ground at a temperature above

13° C. About 80 of them have a temperature between 15 and 30° C., and 125 are even hotter, between 30 and 90° C.

According to the great variety of composition of the Caucasian springs their **medical uses** also extend in many directions, and are of the highest value for combating numerous ills.

The waters containing sulphuretted hydrogen are mostly used externally as baths against chronic rheumatism, gout, and skin diseases, and for healing wounds.

The ferruginous or chalybeate waters find their principal application internally in all forms of debility associated with anæmia, as they provide the blood with iron in its most agreeable and assimilable form.

Alkaline and alkaline-saline springs are the most extensively used as medicinal table waters, being a world-wide remedy against digestive derangements, and also catarrhal affections of the mucous membrane, etc.

Saline waters act as aperients, and have a general stimulating effect on the digestion; many of them also act as purgatives.

In view of the great number and usefulness of the Caucasian mineral springs it is surprising that they have not been developed to a greater degree. Their number is three or four times as great as that of all the mineral sources existing in central and western Europe combined, and yet more than nine-tenths of them are allowed to run to waste, while in Germany, France, or Italy they would be of considerable value.

The reason lies partly in the comparative remoteness of the country, but principally in the apathy of the former Government, which entirely neglected this part of the natural wealth of the Caucasus.

The altered European conditions make it opportune to draw attention to the possibilities of development of this industry. That this development is even a necessity is proved by the fact that at the outbreak of the war several hundred thousand Russians who formerly had been in the habit of taking the waters at some German or French Spa, found themselves reduced to the resources of the Caucasus, which proved utterly unprepared.

Mineral springs may be developed in two directions: either by bottling and shipping the waters suitable for table use, or by erecting bathing establishments and sanatoria and attracting visitors to them.

At Borjom and Kislovodsk some springs are already being bottled, but their names are scarcely known outside of Russia, while those of the French and German waters, like Vichy, St. Galmier, Apollinaris, Selters, etc., are world-famed. There cannot be any doubt that out of the great number of Caucasian waters some will be found to be of similar nature, if they are carefully examined and analysed.

That there is an enormous demand for such table and aperient waters all over the world is proved by the sales of the principal kinds ; for instance, the Apollinaris Company in Germany sold 37 million bottles in 1912, while Vichy exceeds this number ; the latter establishment is under the control of the French Government.

As to bathing establishments in Caucasia, very few of the existing ones are known outside of their immediate neighbourhood, or installed in such a manner as to attract visitors from a distance, or even from foreign countries. This in spite of the fact that many useful waters spring up in most delightful places as far as natural surroundings and climate are concerned, and if well-equipped hotels, baths, and sanatoria, and the usual artificial attractions were provided, and the fact well advertised, visitors would not be wanting.

Just before the outbreak of the war a movement had been started to utilize some other springs in Georgia in this direction, and it is to be hoped that the project will be executed as soon as normal circumstances prevail again. The Central-European resorts will undoubtedly lose a great part of their former regular visitors from the Allied Countries, who will have to go further afield. And there is no country in Europe which can offer such a variety of health-giving springs, combined with grand natural beauties and an interesting population as the Caucasus. The climate, specially in Western Georgia, is also very mild in winter, and suitable for pulmonary patients ; the old Romans, who had the whole Mediterranean at their disposal, placed their winter colonies on the shores of the Black Sea, near Gagri and Sukhum, etc.

All the natural conditions, therefore, exist for making the country a centre of attraction for the tourist as well as for the seeker after health, and it remains for the human effort to realize this desirable and useful end.

LIST OF THE MINERAL SPRINGS, MEDICINAL MUDS, SPAS, SEA-BATHS, AND CLIMATIC STATIONS OF GEORGIA AND CAUCASIA.

1. **Abadsekhy,** in Kuban Government, Maikop District, near the Station of the same name ; not investigated.

2. **Abano,** Province of Kutais, Georgia, 30 miles from Kutais on the right bank of the River Rion ; sulphurous waters.

3. **Abanoskhevi,** Prov. of Batum, Artvin Dist., Georgia, 5,053 ft. above sea level ; warm sulphurous sources, temperature 31° C., and near them at the village **Mikhelethi** another warm source containing carbonic acid and iron, temp. 28° C.

4. **Abanos-Chala,** 2 miles from Zekari, Prov. Kutais, Georgia ; warm sulphurous source, temp. 32–35° C.

5. **Abarani,** near Tkvartcheli, Sukhum Dist., Georgia ; warm sulphurous source, temp. 36° C.

6. **Abastuman,** Prov. Tiflis, Akhaltzik Dist., Georgia, 66 miles from Station Khashuri on the Transcaucasian Railway; hot springs and climatic station.

7. **Agara,** Prov. Batum, Georgia ; warm sulphurous spring, temp. 25° C.

8. **Agbuda,** Prov. Elizabetpol, Dist. Kasakhi; cold ferruginous spring.

9. **Agura,** Black Sea Prov., Dist. of Sotchi, Georgia, and 8 miles from that town ; warm sulphurous spring, temp. 28° C.

10. **Agidun,** Prov. Tiflis, Dist. Akhaltzik, Georgia ; warm sulphurous spring, temp. 20° C.

11. **Azoff,** Kuban Prov., Taman Dist.; saline source rich in carbonic acid.

12. **Aishkho,** Black Sea Prov., Sotchi Dist., Georgia, 4,150 ft. above sea level; cold ferruginous and gaseous source, temp. 11° C.

13. **Aigridjkar,** Prov. Erivan, 26 miles from Bayazid; ferruginous source with carbonic acid.

14. **Irichak,** Prov. Elizabetpol, Dist. Sangesur, 1 mile from village Dastgir; carbonated source.

15. **Alaghesi,** Prov. Erivan, on Alaghes Mountain, 3,600 ft. above sea level; hot sulphurous spring.

16. **Alagir,** Prov. Ter., 10 miles from town of same name on Ardon River; sulphurous and carbonated spring, temp. 16·2° C.

17. **Aladjin,** Prov. Erivan, Dist. Nakhidjevan; carbonated source.

18. **Alashin,** Prov. Baku, 20 miles from Lenkoran; cold sulphurous spring.

19. **Alpanis-Abano,** Prov. Kutais, Dist. Letchkumi, Georgia, 33 miles from Kutais on the right bank of the Rion River; cold sulphurous source.

20. **Amaglebi,** Prov. Kutais, Dist. Ozurgeti, near Station Sajchevakho, Georgia; 6 sources of sulphurous waters, temp. 24° C.

21. **Anapa,** Prov. Kuban, Dist. Teemriuk; sea and medicinal mud baths, special hospital for electrical and therapeutical treatment; source containing chloride of sodium and iodides.

22. **Apnia,** Prov. Tiflis, Dist. Akhalkalaki, Georgia; on the right bank of the Kura River, opposite the ancient monastery of Vardsia, a sulphurous source.

23. **Apsheron,** near Baku; sulphurous and calcareous springs, temp. 24° C.

24. **Apsho,** Prov. Tiflis, Dist. Thioneti, Georgia; cold spring strongly carbonised.

25. **Aravethi,** Prov. Batum, Dist. Artvin, Georgia; 4 miles from the village Ardanutch, a sulphur spring.

26. **Arsni,** Prov. Erivan, 8 miles N.E. from the town; cold saline spring.

27. **Arkevan,** Prov. Baku, Dist. Lenkoran, 6 miles from Arkevan, hot sulphurous spring.

28. **Arsen,** Prov. Baku, Dist. Shemakha and 40 miles S.E. from the latter town; a warm spring containing Glaubersalt, temp. 19° C.

29. **Arthkhmossy,** Prov. Tiflis, Dist. Dushet, Georgia, near Station Kasbek, about 6,430 ft. above sea level; cold carbonated spring, temp. 6° C.

30. **Artvin,** Prov. Batum, Georgia; ferruginous spring.

31. **Askana,** Prov. Kutais, Dist. Ozurgeti, Georgia; sulphurous springs.

32. **Aspindza,** Dist. Akhaltzik, Georgia, and 10 miles from the latter town, on the left bank of the Kura River; hot sulphurous springs, temp. 32·2° C.

33. **Astara,** Prov. Baku, Dist. Lenkoran, 5 miles from the Caspian Sea shore near the Persian frontier; a hot sulphurous spring, temp. 46° C.

34. **Atabety,** Prov. Tiflis, Dist. Tioneti, Georgia; cold carbonated spring.

35. **Atheni,** Prov. Tiflis, Dist. Gori, Georgia, and about 4 miles S.E. of Gori; a cold sulphurous spring.

36. **Athly-Boyun,** Prov. Daghestan, Dist. Temir-Khan-Shur, 8 miles S.W. of Petrovsk; a hot sulphurous source, temp. 35° C.

37. **Akhaltzik,** Prov. Tiflis, Georgia, on the left bank of Potzkhov River; a carbonated source, temp. 20° C.; and 2 miles S. of Akhaltzik, in the village.

Uraveli, Georgia; a warm sulphurous spring, temp. 21° C.

38. **Akhlatin,** Prov. Elizabetpol, Dist. Sangesur; a carbonated spring.

39. **Akhtala,** Prov. Tiflis, Dist. Signakh, Georgia; medicinal muds of a temp. of 18° C.; and also on the right bank of the Alazan River near the village Gurdjani, a carbonated source.

40. **Akhtim,** Prov. Daghestan, Dist. Samur; 5 hot sulphurous sources.

41. **Akhgel,** Prov. Daghestan, near Petrovsk; medicinal mud from the dried-up lake of the same name.

42. **Atsgara,** Prov. Sukhum, Georgia, on the right bank of the river of the same name; a cold sulphurous spring.

43. **Atskhury,** Prov. Tiflis, Dist. Akhaltzik, Georgia, on the left bank of the Kura River; a hot sulphur spring.

44. **Achipse,** Black Sea Prov., Dist. of Sotchi, Georgia, 2,370 ft. above sea level; cold carbonated source, temp. 11·25° C.

45. **Achuluk,** Ter. Prov., 17 miles from Vladicaucase; sulphurous spring.

46. **Ayar,** Prov. Erivan; sulphur springs.

47. **Aphon,** Black Sea Prov., near Novorossisk; sea bath.

48. **Bughiani,** Prov. Baku, 4 miles from Salyani; saline springs.

49. **Baba-Zanan,** Prov. Baku, also near Salyani; a warm saline mud source, temp. 33° C.

50. **Bagdadi,** Prov. and near Town of Kutais, Georgia, in Sekar valley; sulphurous source, temp. 19° C.

51. **Badamlu,** Prov. Erivan, Dist. Nakhichevan; carbonated spring.

52. **Baksan,** Prov. Ter.; cold ferruginous and carbonated source.

53. **Batalin,** Prov. Ter., 4 miles from Piatigorsk; source of bitter water, temp. 11° C.

54. **Batalpashin,** Kuban Prov.; mineral mud and bitter salt lake water.

55. **Batmak,** Prov. Daghestan, on Caspian Sea; medicinal mud from the dried-up lake Batmak.

56. **Batum,** Georgia, in neighbourhood sea baths and hydropathic institutions, climatic station, May to October.

57. **Bashin,** Gov. Terek ; cold sulphurous spring.

58. **Baindur,** Prov. Erivan, Dist. Alexandropol ; cold carbonated spring.

59. **Besobdal,** Prov. Erivan, Dist. Alexandropol ; cold carbonated spring.

60. **Beslebi,** Prov. Erivan, Dist. Nakhichevan ; ferruginous source.

61. **Bergusheti,** Prov. Elizabetpol, Dist. Zangesur ; carbonated and sulphurous springs.

62. **Berssoff,** Prov. Terek, 5 miles from Kislovodsk; cold carbonated source.

63. **Besla,** Prov. Sukhum, Georgia, 3 miles E. of Sukhum; sulphurous source, 16·2° C.

64. **Beshkilis,** Prov. Kars, Dist. Kagisman, 30 miles from Kars; a cold carbonated ferruginous source, and also a warm sulphurous spring of 26° C.

65. **Bisso,** Prov. Tiflis, Dist. Thionethi, Georgia ; cold carbonated source.

66. **Bishenessi,** Prov. Tiflis, Dist. Gori, Georgia ; cold sulphurous spring.

67. **Bolshoi-Tambukan** Lake, Gov. Terek, Dist. Piatigorsk; medicinal mud.

68. **Borjom,** Prov. Tiflis, Dist. Akhaltzik, Georgia ; 2,636 ft. above sea, cold and warm carbonated sources, the " Ekaterin " source, 29·9° C. and the " Eugenie " source, 23·6° C. containing also iodide and bromide of sodium.

In the vicinity, warm sulphurous sources at **Tskhisdjvari** and ferruginous ones at **Tsagveri.**

69. **Barisakho,** Prov. Tiflis, Dist. Thionethi, Georgia; carbonated source containing much chalk.

70. **Bragun,** Prov. Terek, Dist. Grozny; two groups of sources: (*a*) two hot sulphurous sources, temp. 40 to 60 and 90° C. used for bathing with some primitive arrangements; (*b*) on the right bank of the river Sunja also hot sulphurous sources.

71. **Bristati,** Prov. of Tiflis, Dist. Gori, Georgia, on the upper reaches of the River Didiliakhvi, 5,900 ft. above sea; cold carbonated source springing from andesite beds, 8° C.

72. **Bugas,** Kuban Prov., Tamriuk Dist.; medicinal muds on the Bugas salt lake.

73. **Bugeuli,** Prov. Kutais, Dist. Ratcha, Georgia, on the left bank of the Rion River; a sulphurous spring.

74. **Budugh,** Gov. Baku, in the Tengin valley, difficult of access; two sulphurous sources, temp. 48·1 and 46·25° C.

75. **Bum,** Prov. Baku, Dist. Nukha, two groups of sources: (*a*) 3 miles from the village there are two warm sulphurous sources, temp. 39·2 and 23·75° C.; (*b*) 12 miles from the latter, on the Kara-tchai River, another cold sulphurous source.

76. **Burdus,** Prov. Kars, Dist. Olti, ½ mile from the frontier; a hot source of unknown composition.

77. **Buik Hill** Source, Prov. Terek, 10 miles from Shelesnovodsk; alkaline sulphurous source.

78. **Beloretchensk,** Prov. Kuban, Dist. Maikop; summer resort.

79. **Barbare,** near Sukhum, Georgia, on the Eris-tskali River; a cold carbonated source, temp. 16° C., and 3 miles from it the "Claudi" source, slightly carbonated, temp. 12° C.

80. **Vartsikhe,** near Kutais, Georgia, on the left bank of the Kvirila River; a hot source of unknown composition.

81. **Vedza-Amalo,** Prov. Tiflis, Dist. Thionethi, Georgia, 2 miles from the village Amalo on the right bank of the River Alazan; a cold carbonated source.

82. **Vedza-Makartho,** Prov. Tiflis, Dist. Dushethi, Georgia, 5 miles from the Station Pasanauri on the Georgian Military Road and on the left bank of the River Aragui; a cold alkaline and carbonated source, temp. 11° C.

83. **Vedi,** near Erivan; a warm source used by the natives, composition unknown.

84. **Gagri,** Prov. Black Sea, Dist. Sotchi, Georgia; sea baths and climatic station open all the year round, mild climate, sun baths, light and electric baths. Alkaline source 6 miles from Gagri.

85. **Hadji Samlak Muradin,** Prov. Elizabetpol, Dist. Sangesur, 16 miles from Shusha, difficult of access, 7,443 ft. above the sea; the "Tur" source, cold, ferruginous and carbonated.

86. **Gamsatcheman,** Prov. Erivan, Dist. Alexandropol, 4,590 ft. above the sea; a cold source with ferrous and alkaline salts.

87. **Garula,** Prov. Kutais, Dist. Ratcha, Georgia, near the village Gari; a mineral source of unknown composition.

88. **Gnebi,** Prov. Kutais, Dist. Ratcha, Georgia, two groups of sources: (*a*) in the Tcheshura and Khvartchuli valleys several carbonated sources of unknown analysis; (*b*) at the confluence of the Gnebi and Rion Rivers several sources containing alkaline and ferrous sulphides and sulphates.

89. **Guelendjik,** on the Black Sea shore, Georgia, 25 miles from Novorossisk; sea baths, public baths of sea water and medicinal muds, hotels and boarding houses.

90. **Guel** Source, Prov. Kars, Dist. Ardahan, near village Kheva, Georgia; warm mineral source of unknown composition.

91. **Guenal-Don,** Prov. Terek, Dist. Vladicaucase, two sources: (*a*) 5 miles from village Tmeni-kau at altitude 7,140 ft., a cold slightly saline source; (*b*) 1 mile from same village at altitude 5,432 ft., a hot mineral source, temp. 31° C.

92. **Guerguethi,** Prov. Tiflis, Dist. Dushet, Georgia, on the upper Terek River, 5,595 ft. above the sea; a cold spring of carbonated ferruginous water, temp. 9° C.

93. **Guerussi,** Prov. Elizabetpol, Dist. Sangesur ; a carbonated source tasting like Selters water, but not analysed.

94. **Gueyuk,** Prov. Erivan; a carbonated source.

95. **Guedjikai,** Prov. Erivan, Dist. Novo-Bayazid, at altitude 6,350 ft. ; a cold ferruginous and alkaline source.

96. **Guilar,** Prov. Daghestan, Dist. Kurin, on the Samur River; a slightly saline warm spring of temp. 35° C., and near it a cold sulphurous one.

97. **Glasnoi,** Black Sea Prov., Sotchi Dist., Georgia ; a cold alkaline source on the sea-shore.

98. **Glasnoi,** Prov Terek, near Kislovodsk, altitude 2,700 ft.; a cold sulphurous spring of 9° C.

99. **Glola,** Prov. Kutais, Dist. Ratcha, Georgia ; several ferruginous and carbonated springs at altitudes 4,572 and 3,886 ft., temp. 11° C.; and at the confluence of the Glola and Rion Rivers another source of similar nature, temp. 12° C.

100. **Goktcha,** Prov. Erivan, Dist. Novo-Bayazid ; two springs on the Sanga River, one ferrous and carbonated, and the other at the mouth of the river, sulphurous.

101. **Galubit,** Prov. Kuban, Taman Peninsula; baths in lake of medicinal mud ; sea baths might also be organized.

102. **Goma,** Prov. Tiflis, Dist. Akhaltzik, Georgia, near village Shurdo ; a warm mineral source of 22·5 °C.

103. **Gomura,** Prov. Kutais, Dist. Ratcha, Georgia ; carbonated source springing under great pressure.

104. **Gorassu,** Prov. Terek, Dist. Nalchik ; a carbonated source issuing on the shore of a pond of ferruginous mineral water.

105. **Gorassu-tchiran,** same district, near the Elbrus, at altitude 9,700 ft. below the glacier of the same name ; a cold sulphurous source.

106. **Gori,** near Tiflis, Georgia, at altitude 1,790 ft. ; a cold sulphurous source.

107. **Gag-djur,** Prov. Erivan, Dist. Echmiadzin, on the left bank of the Abaran River, at 6,000 ft. above the sea ; a cold alkaline source, 10° C.

108. **Gareloi-Sopki** Source, Prov. Kuban, Dist. Temryuk, on the Taman Peninsula; cold sulphurous.

109. **Goriatche Vodski,** Prov. Terek, 650 ft. above sea; two groups of hot sulphurous sources: the Eastern group consisting of 18 sources producing 95,000 gallons per day, at temp. 73–75° C.; the Western of 3 sources at 80–88° C. Two bathing establishments, used by the neighbouring populations.

110. **Gubden,** Prov. Daghestan, Dist. Temir-Khan Shura; cold sulphurous spring with odour of sulphuretted hydrogen, 19° C.

111. **Gudau,** Prov. Tiflis, Dist. Thionethi, Georgia ; cold carbonated spring.

112. **Gudarakh,** same district ; a cold carbonated alkaline spring.

113. **Gudauthi,** Black Sea Prov., Dist. Sukhum, Georgia ; sea baths and climatic station, best bathing of the whole shore.

114. **Gudjarethi,** Prov. Tiflis, near Borjom, Georgia ; a warm sulphurous source.

115. **Gudamakari,** Prov. Tiflis, Dist. Dushet, Georgia ; three alkaline carbonated sources at 2 miles distance, temp. 12° C. Primitive accommodations for cures.

116. **Gulachala,** Prov. Kutais, Dist. Letchkum, Georgia; a cold carbonated and ferruginous source.

117. **Giumur,** Prov. Erivan, Dist. Nakhichevan; cold carbonated spring.

118. **Davalo,** Prov. and Dist. of Erivan; a warm carbonated source, temp. 24° C., forming a pond used as a bath against skin diseases.

119. **Darachi-tchas,** Prov. Erivan, Dist. Novo-Bayazid; 3 cold sources on the right bank of the Zanga River, carbonated, one rich in lime, called the "milk source," another tasting like Selter's water, the third ferruginous.

120. **Dargavs,** Prov. Terek, Dist. Vladicaucase, right bank of Guisal River; a hot sulphurous spring.

121. **Dash-kent,** Prov. Elizabetpol, Dist. Sangesur; several small carbonated sources.

122. **Dvalishvilebi,** near Kutais, Georgia, on the River Isrethi; 3 groups of hot sulphurous springs, temp. 35 and 22° C. respectively. Visited by Georgians living in malarial districts.

123. **Dviri,** Prov. Tiflis, Dist. Akhaltzik, Georgia; two hot slightly alkaline springs, temp. 35° C.

124. **Derbent Stanitza,** Prov. Kuban; bitter and saline sources.

125. **Derbent Sources,** on shore of the Caspian Sea, 30 miles from Derbent, in hot district; hot sulphurous sources of which three have been capted, temp. 49, 48 and 37° C. respectively, used in a bathing establishment.

Five miles N. of them there are splendid sea baths on shallow sandy shores and two lakes of mineral mud, one of 38° C. containing 50 per cent. of water, some naphtha, sulphurous and traces of phosphoric acid; the other of 27° C. has the same physical properties, but its chemical composition is different. There are no facilities for using the muds.

126. **Derbent,** Daghestan ; sea baths, water very saline on this shore.

127. **Djabani,** Prov. Baku, Dist. Shemakha ; cold sulphurous spring.

128. **Djavi,** Prov. Tiflis, Dist. Gori, Georgia ; alkaline source.

129. **Djadjira,** Prov. Elizabetpol, near Slavyanska ; cold carbonated source.

130. **Djelans,** Prov. and Dis. of Kars, altitude 5,200 ft. ; 3 sources, one sulphurous and ferruginous for bathing, two sulphurous for drinking ; frequently visited by the natives.

131. **Djamuri,** Prov. Tiflis, Dist. Dushethi, Georgia, near the village Bathini ; 2 alkaline carbonated sources, temp. 6·25° C.

132. **Djarishtio,** Prov. Terek, Dist. Nalchik ; cold, carbonated source.

133. **Djakveli,** Prov. Kutais, Dist. Sharopan ; cold, abundant sulphurous and alkaline source, temp. 12° C.

134. **Djelan-kol,** Prov. Kuban, Dist. Batalpash ; alkaline carbonated source.

135. **Djelae,** Prov. and Dist. Kars, 5,600 ft. above the sea ; several sulphurous and alkaline sources, temp. 8·5 to 13 and 25° C.

136. **Djodjora,** Prov. Kutais, Dist. Ratcha, Georgia, near Oni ; 6 cold carbonated and ferruginous sources, flowing from sandstone beds, temp. 11–13° C. The water is clear, agreeable to drink, with a slightly acid and ferrous taste.

137. **Djuma,** Prov. Kutais, Dist. Zugdidi, Georgia, near monastery of Tsaishi ; a warm sulphurous source giving off sulphuretted hydrogen abundantly, temp. 27° C.

138. **Djumukhi,** Prov. Terek, Dist. Piatigorsk ; three bitter saline sources, temp. 17·5° C.

139. **Djurauli,** Prov. Erivan, Dist. Surmalin, at altitude 5,710 ft.; a cold alkaline carbonated source, temp. 15° C.

140. **Dzicheksh,** Prov. Kuban, Dist. Maikop, at altitude 8,195 ft.; a cold ferruginous source.

141. **Dzishra-Azego,** Black Sea Prov., Dist. Sukhum, Georgia; a sulphurous spring.

142. **Doli,** Prov. Kutais, Dist. Letchkum, Georgia; cold sulphurous spring.

143. **Dugun,** Prov. and Dist. Erivan; a warm alkaline and saline source of 18° C.

144. **Ebgeniev,** in Daghestan Prov., Dist. Temir-khan Shuna; sulphurous source.

145. **Edis,** Prov. Tiflis, Dist. Gori, Georgia; a carbonated and ferruginous source.

146. **Eisk,** Prov. Kuban, port on the Sea of Azoff; cold sulphurous source giving 100,000 gallons per day. Sea baths, also medicinal muds near the salt lake of Khan.

147. **Ekaterinenfeld,** Prov. Tiflis, Dist. Bortchalo, Georgia; a carbonated source depositing chalk on the River Mashaveri.

148. **Elissu,** Prov. Zakatali, Dist. Kakhi, Georgia, at altitude 6,800 ft.; several sulphurous sources giving off slight smell of sulphuretted hydrogen, temp. from 24 to 42° C.

149. **Elissu-Nukha,** Prov. Elizabetpol, Dist. Nukha; alkaline and saline source, of temp. 37·5° C.

150. **Essentuki,** Prov. Terek, Dist. Piatigorsk, altitude 2,000 ft.; a number of saline, alkaline and sulphurous springs. For internal use are employed; Alkaline No. 17 and 18, 11·25° C. Alkaline, saline and ferruginous No. 6, at 20·38° C., containing sodium iodide and bromide, No. 4 at 10·9° C., and No. 19 at 10·6° C.

For baths there are used No. 20, alkaline-saline at 10·6° C., and No. 26, sulphurous alkaline at 11·8° C.

The Essentuki Salts are extracted from source No. 17.

151. **Shelesnovodsk,** 10 miles from Essentuki (150), altitude 2,300 ft.; numerous hot and cold ferro-alkaline sources used for drinking, temp. 18·75 to 44·4° C., and for bathing from 17 to 50° C. Well-known watering-place.

152. **Zaparosh,** Prov. Kuban, Dist. Taman, near the Vladicaucase railway; a number of sources springing up from a small area, but of different composition, some alkaline-saline, others carbonated and ferruginous, while another smells of sulphuretted hydrogen.

153. **Zargeran,** Prov. Baku, Dist. Shemakha; a cold sulphurous source.

154. **Zatsira,** Prov. Kutais, Georgia, 8 miles from the town; a sulphurous source much used by the natives, although the accommodation is primitive; the place is very healthy and protected from the east winds.

155. **Zvare,** Prov. Kutais, Dist. Sharopan, Georgia, 2 miles from Station Molithi; a warm sulphurous source, temp. 31·25° C.

156. **Zekari,** Prov. and Dist. Kutais, Georgia; warm sulphurous sources of 35–36° C., much used against rheumatism, with three bathing places, and 6 miles from them another cold, slightly sulphurous source, temp. 16° C.

157. **Zemo-Khvedurethi,** Prov. Tiflis, Dist. Gori, Georgia; cold sulphurous spring.

158. **Zmeevski Source,** Prov. Terek, 2 miles from Shelesnovodsk; a ferro-sulphurous source, temp. 12° C.

159. **Zor,** Prov. Erivan, Dist. Surmalin; a ferro-alkaline source, temp. 16° C.

160. **Zromag,** Prov. Terek, Dist. Vladicaucase; a slightly saline source.

161. **Ilsk,** Prov. Kuban, Dist. Taman; a sulphurous source.

162. **Imirlu,** Prov. Erivan, Dist. Echmiadzin, at altitude 5,800 feet; a cold alkaline and carbonated source of 11·2° C., used by the natives who consider it as the surest cure

against consumption. There is some accommodation for the summer season.

163. **Ingushli,** Prov. Terek, Dist. Nalchik, near the Elbrus Mountain, at altitude 7,000 to 8,000 ft.; a cold alkaline carbonated spring.

164. **Indjir-Su,** Prov. Baku, Dist. Lenkoran, near the Persian frontier; a carbonated source.

165. **Indish,** Prov. Kuban, Dist. Batalpash, at altitude 3,800 ft.; several warm saline-alkaline and carbonated springs, one of 30° C. has been capted; its water is effervescent like Narzan.

166. **Inja-tchai,** Prov. Elizabetpol, Dist. Kazakh; a carbonated spring.

167. **Iris-tchala,** Prov. Tiflis, Dist. Akhalkalaki, Georgia; cold carbonated spring.

168. **Istisu,** Prov. Terek, Dist. Grozny; two groups of sulphurous sources, hot, one giving 270,000 gallons per day, used for baths, the other emitting sulphuretted hydrogen abundantly and having a temperature of 75° C.

169. **Istisu-Nakhidjevan,** Prov. Erivan, Dist. Sharurs-Daralagez; several cold and hot sulphurous sources with temperatures up to 41° C.

170. **Ishkarti,** Prov. Daghestan, Dist. Temir-khan Shura; many small sulphurous sources, temp. 12° C.; healthy climate.

171. **Kasbek,** Prov. Tiflis, Dist. Dushet, Georgia, at altitude 12,000 ft.; a warm sulphurous source, 29° C.

172. **Kasikopari,** Prov. Erivan, Dist. Surmali, at altitude 5,720 ft.; a cold alkaline and carbonated source of temp. 15° C.

173. **Kainatma,** Prov. Zakatali, Georgia, near village Alibeglu; a cold sulphurous and alkaline source.

174. **Kalatchi,** Prov. Erivan, Dist. Suramli; cold ferro-alkaline source of 13° C

175. **Kalmikaev,** Prov. Terek, Dist. Piatigorsk; sulphurous alkaline source.

176. **Kalvadjar,** Prov. Erivan; hot sulphurous water, used by the natives.

177. **Kantshavethi,** Prov. Tiflis, Dist. Dushet, Georgia; sulphurous source.

178. **Karabulak,** Prov. and Dist. Tiflis, Georgia; carbonated spring.

179. **Karadjoran,** Prov. Erivan, Dist. Surmali; carbonated spring.

180. **Karmen,** Prov. Tiflis, Dist. Thionethi, Georgia; cold ferruginous source.

181. **Kastala,** Prov. Terek, Dist. Khassav-Yurt; cold carbonated ferruginous source.

182. **Katsal-Khevi,** Prov. Tiflis, Dist. Thionethi, Georgia; a cold carbonated and ferruginous source.

183. **Kayakent,** Prov. Daghestan, Dist. Kaitago-Tabassaran, on the Caspian Sea; hot sulphurous source of 32° C., and near it sulphurous mud. Hot and dry climate, sea baths and accommodation for the sick.

184. **Kvalithi,** Prov. and Dist. Kutais, Georgia, on the left bank of the Kvirila River; a cold sulphurous spring of 8° C.

185. **Kvani,** Dist. Sukhum on the Black Sea, Georgia; cold carbonated source.

186. **Kvareli,** Prov. Tiflis, Dist. Telaw, Georgia; cold sulphurous source.

187. **Kvishethi,** Prov. Tiflis, Dist. Dushet, Georgia; a cold carbonated and ferruginous source with primitive accommodation for bathers.

188. **Kert-mali,** Prov. Kuban, Dist Batalpash; carbonated spring.

189. **Kivilachvilebi,** Prov. Kutais, Distr. Sharopan, Georgia; cold sulphurous source, of 15° C.

190. **Kisel-tchakh,** Prov. and Dist. Kars; cold ferruginous source.

191. **Kirikili,** Prov. Terek, Dist. Piatigorsk; saline-alkaline source.

192. **Kislovodsk,** Prov. Terek, Dist. Piatigorsk, contains the celebrated "Narzan" source which gives about 570,000 gallons per day of carbonated mineral water at temp. 13·75° C. a large part of which is used for drinking and bottling purposes, and exported to Russia and other countries. There are also other sources used for baths.

193. **Kitch-Malka,** Prov. Terek, Dist. Nalchik; carbonated spring.

194. **Klavdi Source,** Black Sea Prov., Dist. Sukhum, Georgia, on the Tskhiri Mountain; carbonated source, temp. 10° C.

195. **Klitch Valley,** Black Sea Prov., Dist. Sukhum, Georgia; a cold ferruginous source.

196. **Kmosti,** Prov. Tiflis, Dist. Thionethi, Georgia; a cold carbonated source.

197. **Kobi,** Prov. Tiflis, Dist. Dushet, Georgia, at altitude 6,500 feet, a cold ferro-alkaline source of temp. 9° C., used for baths, and 6 other ferruginous and ferro-alkaline sources of temp. 6 to 8° C., one of which is capted in a stone basin.

198. **Kobulethi,** near Batum, Georgia; sea baths and sanatorium for nervous and heart diseases.

199. **Kodiani,** Prov. Tiflis, Dist. Gori, Georgia; a cold sulphurous source, temp. 19° C.

200. **Kodlassan,** Prov. Tiflis, Dist. Gori, Georgia; a cold sulphurous source, temp. 9° C.

201. **Kodora,** Black Sea Prov., Dist. Sukhum, Georgia ; a sulphurous source.

202. **Konstantine,** Prov. Terek, a sulphurous source, containing also some naphtha and sulphuretted hydrogen, temp. 27·5° C.

203. **Konkhidetl,** Prov. Daghestan, Dist. Andi, 3,900 ft. above the sea, in a wild and malarious country; a great number (said to be about 200) sulphurous sources, temp. 17·5° C.

204. **Koronis-Tskali,** 3 miles from Batum, Georgia ; a health station, famed for its beautiful climate.

205. **Koteli,** Prov. Tiflis, Dist. Bortshalo, Georgia ; a cold slightly saline source, temp. 7·5° C.

206. **Kotur,** Prov. Tiflis, Dist. Bortshalo, Georgia ; a carbonated source.

207. **Kotur-Gumush,** Prov. Erivan, Dist. Novo-Bayazid ; cold ferruginous source.

208. **Kotr-Istisu,** Prov. Elizabetpol, Dist. Sangesur ; a warm mineral spring, composition unknown.

209. **Krasna Poliana,** on the River Mzimta, near Sotchi, Black Sea Prov., Georgia ; mountain resort, with some hotels and accommodation for special cures. Alkaline-saline and ferruginous carbonated springs, some of them tasting like Vichy water.

210. **Kuapta,** near Artvin, Georgia ; a ferruginous carbonated spring of bitter taste.

211. **Kudara,** Prov. Kutais, Dist. Radja, Georgia ; several warm sources of carbonated water.

212. **Kulash,** Prov. Kutais, Dist. Samtredi, Georgia ; a cold ferruginous source.

213. **Kulki-Bossi,** Prov. Terek, Dist. Sundjen ; a cold sulphurous spring.

214. **Kulpi,** Prov. Erivan, Dist. Surmali ; a carbonated source.

215. **Kumogor,** Prov. Stavropol, Dist. Alexandrovsk, 1,300 ft. above the sea; 6 warm alkaline sulphurous sources.

216. **Kurmukh,** Prov. Zakatali, Georgia; a cold carbonated spring.

217. **Kunakhkent,** Prov. Baku, at altitude 2,300 ft.; hot sulphurous springs, temp. 47–39° C. used for bathing. Dry and healthy climate.

218. **Kurdjani,** Prov. Tiflis, Dist. Signakh, near Akhtala, Georgia; alkaline source.

219. **Kursebi,** Prov. and Dist. of Kutais, Georgia, on the Tkvibuli railway; a cold alkaline sulphurous source producing about 15,000 gallons per day. Baths and other accommodations for visitors have been installed.

220. **Kushtchevska,** Prov. Kuban; a ferruginous sulphurous source, of a delivery of about 8,000 gallons per day.

221. **Kushtchi,** Prov. Erivan, Dist. Sharko-Daralagel; 4 hot carbonated springs, of temp. 40° C.

222. **Kiuliutl,** Prov. Daghestan, Dist. Samur; an abundant carbonated source.

223. **Lakhamuli,** Prov. Kutais, Dist. Letchkhum, Georgia, on the River Inguri; a cold carbonated source.

224. **Latchta,** Prov. Kutais, Dist. Radja, Georgia; carbonated spring.

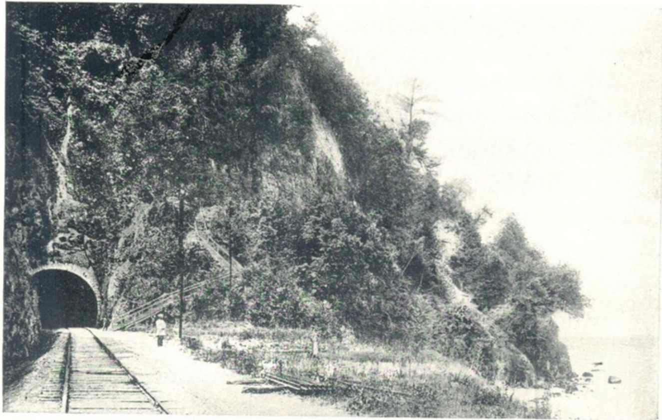
225. **Lashe,** Prov. Kutais, Dist. Ozurgheti, Georgia; a saline spring.

226. **Lashe-Mkrala,** same district; a warm sulphurous spring.

227. **Lashketi,** Prov. Kutais, Dist. Letchkhum, Georgia; a cold ferruginous and carbonated spring, temp. 13·25° C.

228. **Lashkhevi,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a cold carbonated source.

229. **Legvani,** Prov. and Dist. Kutais, Georgia; two sources, one alkaline, the other sulphurous; they have been capted and are used locally.



TSIKHIS ZIRI (NR. BATUM, GEORGIA).

230. **Lenkoran,** on the S.W. shore of the Caspian Sea; sea baths, and 8 miles from them eight hot and one cold sulphurous springs, some of which are being used by the natives.

231. **Liban,** Prov. Tiflis, Dist. Gori, Georgia, at altitude 3,900 feet, 2 miles from the Sadger Lake; twelve cold springs, ferruginous and strongly carbonated.

232. **Likoki,** Prov. Tiflis, Dist. Thionethi, Georgia; a cold carbonated source.

233. **Lonjin,** Prov. Terek, Dist. Sunja; a cold ferruginous spring.

234. **Lopota,** Prov. Tiflis, Dist. Telaw, Georgia; a cold mineral spring of unknown composition.

235. **Luspek,** Prov. Kars, Dist. Kagisman; a ferruginous spring.

236. **Lissogorsk,** Prov. Terek, Dist. Piatigorsk; a bitter saline source which has been capted and is being used in the establishments of Piatigorsk.

237. **Lissogorska,** Prov. Elizabetpol, Dist. Shusha; altitude 5,100 ft.; several cold ferruginous sources, one sparkling and resembling Selters water. This place is a health resort, and enjoys an excellent climate in which the patients can live in tents.

238. **Matchara,** Prov. Tiflis, Dist. Gori, Georgia; 3 cold ferruginous and carbonated sources, temp. 16° C.

239. **Malka,** Prov. Terek, Dist. Nalchik; a cold carbonated spring, temp. 8° C., and near it another alkaline-carbonated source. Higher up on the River Malki, at altitude 7,350 feet and 6 miles from the Elbrus Mountain, a warm carbonated ferruginous spring, temp. 20·75° C. and called "Warm Narzan." Near the latter yet another non-ferruginous source.

240. **Makaev Sources,** Prov. Terek, 2 miles from Grozny; several hot springs slightly sulphuretted, temp. from 32 to 46° C. and primitive installations for bathing.

241. **Makai-Yurt,** Prov. Terek, 12 miles N.W. of Grozny; hot sulphurous springs, temp. 72 to 79° C., and other warm springs near them.

242. **Marinska,** Prov. Kuban, Dist. Batalpash; an alkaline carbonated source.

243. **Makhindjuri,** Prov. Batum, Georgia; several alkaline, ferruginous and sulphurous sources.

244. **Matzesda,** Black Sea Prov., near Sotchi, Georgia; warm source of strongly sulphuretted water, considerable outflow, temp. 22·2° C.; also sulphurous muds near the source.

245. **Msimta,** Black Sea Prov., 25 miles from Sotchi, Georgia; in the valley of the River Msimta, at altitude 2,950 ft. there are seventeen sources, and others at 3,670 and 4,200 ft., all cold carbonated and ferruginous. On the affluents of the Msimta: at 2,220 ft. on the Pslukh River a cold alkaline and carbonated source, of temp. 10·5° C., and on the Osmitchu River, at 5,480 ft., an alkaline ferruginous spring, of temp. 7·2° C.

246. **Mikhailov,** Black Sea Prov., Dist. Novorossisk, near Guelendjik; a strongly saline spring, temp. 21·8° C.

247. **Mikhailov-Sleptsov,** Prov. Terek, Dist. Sunja; between these two places, about 850 ft. above the sea, there are several groups of warm and hot sources: (1) 3 warm sulphurous sources, temp. 35 to 36° C., used for bathing; (2) several alkaline-saline sources, sulphuretted, temp. 31 to 69° C. used for bathing and one for drinking; (3) several alkaline-saline springs of lower temperature, down to 20° C. used for drinking. The hotter the waters the more they are impregnated with sulphuretted hydrogen. One source, of temp. 17° C., also contains Glaubersalt.

248. **Miatli,** Prov. Terek, Dist. Khassav-Yurt, in a wild valley on the Sulak River, in hot climate; 5 hot sulphurous sources, temp. 44 to 70° C. Also alkaline ferruginous sources, temp. 37 to 40° C., and hot sulphurous muds.

249. **Mokhbulag,** Prov. Zakatali, Georgia; several alkaline and sulphuretted sources, temp. 16 to 20° C.

250. **Muganlo,** Prov. and Dist. Tiflis, Georgia, on the right bank of the River Iori; a cold alkaline saline spring, temp. 8° C.

251. **Murdukh,** Prov. Kuban, Dist. Batalpash; an alkaline carbonated source.

252. **Murakvali,** Prov. Tiflis, Dist. Akhaltzik, Georgia, on the right bank of the River Kura; a hot mineral spring.

253. **Mukhravani,** Prov. and Dist. Tiflis, Georgia; a sulphurous source, containing also some naphtha.

254. **Nagrakhan,** Prov. Erivan, Dist. Novo-Bayazid, on Arkhashin River; a cold alkaline carbonated source, tasting like Selters water.

255. **Nadjikho,** Prov. Zakatali, Georgia; a cold sulphurous source.

256. **Nakalakevi,** Prov. Kutais, Dist. Senak; a bathing resort with several warm sources of temp. 32 to 33° C. Between it and Akhalkalaki a warm alkaline sulphurous spring.

257. **Nakurdevi,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a cold sulphurous spring.

258. **Nalchik,** Prov. Terek, altitude 1,700 ft.; a climatic station.

259. **Holy Island,** near Baku; contains cold sulphurous sources, temp. 11 to 12° C.

260. **Nar,** Prov. Terek, Dist. Vladicaucase, at altitude 5,860 ft.; a cold mineral spring, of temp. 10·3° C.

261. **Natzaruli,** Prov. Kutais, Dist. Ratcha, Georgia; a ferruginous carbonated spring.

262. **Neut-Kutan,** Prov. Daghestan, Dist. Kaitago-Tabassaran; a cold sulphurous spring.

263. **Noa-Kai,** Prov. Terek, Dist. Vladicaucase; a cold ferruginous spring.

264. **Novorossisk,** on Black Sea; sea baths from June to October, also medicinal mud baths.

265. **Norkao,** Prov. Terek; a cold ferruginous spring.

266. **Nophti,** Prov. and Dist. Baku; cold sulphurous sources.

267. **Odokhara,** Black Sea Prov., near Sukhum, Georgia; cold sulphurous sources.

268. **Oissungur,** Prov. Terek, near Grozny; a hot sulphurous source.

269. **Okiz,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a mineral source of unknown composition.

270. **Okribi,** Prov. and Dist. Kutais, Georgia, near the village Dzunguri, at altitude 1,470 ft.; a cold sulphurous and two alkaline sources, which have been capted and are used in a bathing establishment.

271. **Oloda,** Prov. Tiflis, Dist. Akhalkalaki, Georgia; a slightly saline source.

272. **Onissi,** Prov. Kutais, Dist. Ratcha, Georgia, at altitude 3,220 ft., in good climate and picturesque surroundings; 2 groups of cold sources, alkaline-saline and alkaline-ferruginous.

273. **Otingo,** Prov. Batum, Dist. Artvin, Georgia, at altitude 6,250 ft.; a chemically neutral spring, of temp. 33° C.

274. **Oshora,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a carbonated spring.

275. **Panakethi,** same District, on the left bank of the Kura River; a mineral source of unknown composition.

276. **Panjurethi,** Prov. Kars, Dist. Olti; a carbonated source.

277. **Parsma,** Prov. Tiflis, Dist. Thionethi, Georgia; a cold carbonated source.

278. **Peklo,** Prov. Kuban, on the shore of the Sea of Azoff; a cold sulphurous source.

279. **Peniak,** Prov. Kars, Dist. Olti; a sulphurous source.

280. **Petrovsk,** Prov. Daghestan; sea baths, sulphurous sources and mud.

281. **Plate,** Prov. Tiflis, Dist. Akhaltzik, Georgia, at altitude of 5,720 ft., in good climate; many cold ferruginous and carbonated sources, some tasting bitter, others depositing oxide of iron.

282. **Podkumok,** Prov. Terek, Dist. Piatigorsk; saline and bitter sources.

283. **Polkovnitchie,** Black Sea Prov., near Tuapse; a cold sulphurous spring in a beautiful valley, and 4 miles from it the Morosoff sources, cold saline-alkaline, rich in iodine; the latter have been capted and are being used.

284. **Prishibinski,** Prov. Baku, Dist. Lenkoran; 4 groups of sources spring up in an old forest in a healthy district. They are rich in alkaline salts and sulphuretted hydrogen and have high temperatures, between 55 and 90° C., and are used for bathing.

285. **Promis-Abano,** Prov. Tiflis, Dist. Gori, Georgia; a warm sulphurous source, temp. 25° C.

286. **Osekupsa,** Prov. Kuban, Dist. Ekaterinodar; several groups of sources, sulphurous, saline, and ferruginous, cold, and near the Station Kentchevoi there are 10 hot sulphurous, temp. between 41 and 52·5° C., which are being used for baths.

287. **Pslukh,** Black Sea Prov., near Sotchi, Georgia, at altitude 2,340 ft.; an alkaline carbonated source containing much bicarbonate of iron; used for drinking.

288. **Pshaveli,** Prov. Tiflis, Dist. Telaw, Georgia; a hot sulphurous and carbonated source, temp. 37·5° C., depositing chalk.

289. **Piatigorsk,** Prov. Terek, contains a number of warm and hot sulphurous springs which are used for bathing, and partly also for drinking. Their temperatures vary between 28·5 and 46·8° C. A well-known health resort.

290. **Rashtchupin,** Prov. Terek, Dist. Sunja; a bitter saline spring.

291. **Roki,** Prov. Tiflis, Dist. Gori, Georgia, at altitude 4,430 ft.; two cold ferruginous and carbonated sources.

292. **Rua,** Prov. Kutais, Georgia; several cold sulphurous sources.

293. **Rustavi,** Prov. Tiflis, Dist. Akhaltzik; two mineral springs of unknown composition.

294. **Rutil-Goddos,** Prov. Daghestan, Dist. Gunib; a warm neutral source, temp. 35° C., very popular with the natives.

295. **Rikal-Kam,** Prov. Daghestan, Dist. Kurin, at altitude 1750 feet; two groups of alkaline-saline springs, temp. 32 to 36·5° C., and a third group of hot sulphurous springs. Some of the former are used by the natives for baths, others for drinking, and are also bottled and exported to Tiflis, etc.

296. **Sabeka,** Prov. Kutais, Georgia; a warm sulphurous spring.

297. **Sadgheri,** Prov. Tiflis, Dist. Gori, Georgia, 1180 ft. above sea level; a slightly sulphuretted source, temp. 21° C.

298. **Sadjavakho,** Prov. Kutais, Dist. Ozurgheti, Georgia; a ferruginous carbonated source.

299. **Salian Muds,** at Baba-Zanan, Prov. Baku, Dist. Djevat; consist of greenish-grey salt water mixed with slimes and semi-liquid muds of a temperature of 44° C., through which combustible gases bubble up; their froth also contains naphtha. The muds are used by the natives for baths against rheumatism, etc. About 10 miles from them a stream of cold alkaline-saline water springs from a hill.

300. **Sanib,** Prov. Terek, Dist. Vladicaucase, at altitude 7,290 ft.; several saline springs of temperature 35 to 55° C.

301. **Sarikamish,** Prov. and Dist. Kars ; a carbonated ferruginous spring.

302. **Saro,** Prov. Tiflis, Dist. Akhaltzik, Georgia ; a warm spring of 21° C.

303. **Sasashe,** Prov. Kutais, Dist. Letchkhum, Georgia ; an alkaline ferruginous spring containing Glaubersalt and strongly carbonated, temp. 13·8° C.

304. **Sasitl,** Prov. Daghestan, Dist. Andi ; two ferruginous and carbonated springs.

305. **Sinak.** Prov. Erivan, Dist. Suramli ; a cold ferruginous spring and several hot sulphurous ones, temp. 37·5° C.

306. **Simonethi,** Prov. and Dist. Kutais, Georgia ; a cold ferruginous source.

307. **Siaku,** Prov. Baku, Dist. Lenkoran ; a cold bitter saline source.

308. **Sion,** Prov. Tiflis, Dist. Dushet, Georgia, near Mount Kasbek ; a cold ferruginous and carbonated source.

309. **Sleptsov,** Prov. Terek, Dist. Sunja ; a bitter saline spring.

310. **Smada,** Prov. Tiflis, Dist. Akhaltzik, Georgia ; a bitter saline spring.

311. **Soleno-Yar,** Prov. Kuban ; a saline spring containing iodides and bromides.

312. **Sotchi,** Black Sea Prov., Georgia ; sea and mud baths, climatic health resort.

313. **Senaki,** Prov. Kutais, Georgia ; several sulphurous springs probably running through the neighbouring beds of sulphide ores.

314. **Stir-Khokh,** Prov. Terek, Dist. Vladicaucase, at altitude 8 440 ft. ; a cold sulphurous source, temp. 2° C.

315. **Sadjuk Lake,** Black Sea Prov., Georgia; a lake about half a mile long and not more than 7 feet deep, the bottom being formed of black mud with a strong smell of petroleum and ammonia. No accommodation.

316. **Sunja,** Prov. Terek; warm sulphurous sources, temp. 25° C.

317. **Supsa,** Prov. Kutais, Dist. Ozurgheti, Georgia; a ferruginous spring.

318. **Surab,** Prov. Erivan, Dist. Nakhidjevan; carbonated springs.

319. **Suram,** Prov. Tiflis, Dist. Gori, Georgia; a summer mountain resort; in the vicinity mineral sources.

320. **Surmushi,** Prov. Kutais, Dist. Letchkum, Georgia; a sulphurous source, very healthy neighbourhood.

321. **Sukhum,** Black Sea Prov., Georgia; sea baths and very mild climate which makes it one of the best health resorts on the Black Sea; 6 miles from the town a sanatorium for tuberculous patients; season October to May.

322. **Sip,** Prov. Erivan, Dist. Alexandropol; a carbonated spring.

323. **Senna Stanitza,** Prov. Kuban, Dist. Temriuk; a cold sulphurous spring.

324. **Tabassaran,** Prov. Terek, near Derbent; a ferruginous carbonated spring.

325. **Talghi,** Prov. Daghestan, Dist. Temir, at altitude 810 ft.; several warm sulphurous sources, temp. 20 to 35° C. with abundant sulphuretted hydrogen, and a flow of 270,000 gallons per day.

326. **Tambukan Lake,** Prov. Terek, Dist. Piatigorsk, at 1,830 feet above sea level, nearly $1\frac{1}{2}$ miles long, but only between 2 and 3 feet deep; the mud at the bottom is extracted for medicinal purposes. On the south shore of the lake a ferruginous source springs up.

327. **Tarikhoni,** Prov. Kutais, Dist. Letchkhum, Georgia; several sulphurous sources.

328. **Tars-tchai,** Prov. Elizabetpol, Dist. Kasakh ; a cold carbonated spring.

329. **Teberda,** Prov. Kuban, Dist. Batalpash ; a mountain resort at 4,280 ft. above sea level, with very mild and uniform climate ; season May to September. Near it the Djemaget sources of ferruginous and carbonated waters.

330. **Tedelethi,** Prov. Kutais, Dist. Sharopan, Georgia ; a cold carbonated source, of temp. 8° C. Near it outflows of naphtha.

331. **Tezeri,** Prov. Tiflis, Dist. Gori, Georgia ; a carbonated spring.

332. **Teikhtengen,** Prov. Terek, Dist. Nalchik ; a carbonated source tasting like the " Narzan " water.

333. **Teklati,** Prov. Tiflis, Dist. Senaki, Georgia ; a cold sulphurous source, temp. 12° C.

334. **Temir-Goev,** Prov. Daghestan ; hot sulphurous sources, temp. 45° C.

335. **Temriuk,** Prov. Kuban, on Taman Peninsula ; 5 groups of mud volcanoes, from 20 to 30 in each group ; much frequented sea baths, but the muds are not used.

336. **Terter,** Prov. Elizabetpol, Dist. Yevanshir, at altitude 12,450 ft. ; hot, slightly sulphurous sources, temp. 49° C.

337. **Tiflis,** at altitude 1,450 ft. ; several warm and hot sources of abundant sulphurous waters used in the municipal bath ; temp. from 30 to 47° C.

338. **Trusso,** Prov. Tiflis, Dist. Dushet, Georgia, near Kasbek Mountain ; several cold springs, one carbonated, temp. 10° C. ; at 7,000 ft. a similar one, temp. 5° C., and a sulphurous one, temp. 12° C. ; also others carbonated with ferruginous taste, temp. 10° C.

339. **Tuapse,** Black Sea Prov., good sea baths and winter climatic station.

340. **Tuslian,** Prov. Kuban, Dist. Temriuk; 5 mud lakes, one of which is used for medicinal purposes; it contains iodine and ammonia.

341. **Turtchiliaz,** Prov. Elizabetpol, Dist. Zangesour, at altitude 6,000 ft.; several cold ferruginous sources, temp. 11 to 17° C.

342. **Ubin,** Prov. Kuban, Dist. Ekaterinodar; a saline-alkaline spring, similar to Essentuki and Borjom waters; also several cold sulphurous sources, temp. 9° C.

343. **Umakhan-Yurt,** Prov. Terek, Dist. Kislar; several hot sulphurous sources, temp. 40 to 60° C.

344. **Umpir,** Prov. Kuban, Dist. Maikop; a bitter saline spring.

345. **Uraveli,** Prov. Tiflis, Dist. Akhaltzik, Georgia, at 4,870 feet above the sea; several ferruginous and carbonate springs which have been capted for bathing purposes.

346. **Uravi,** Prov. Kutais, Dist. Ratcha, Georgia; a carbonated spring.

347. **Utsera,** Prov. Kutais, Dist. Ratcha, Georgia, at altitude 3,250 ft.; three groups of cold alkaline and ferruginous springs, which are being used for bathing and drinking. Good accommodation for visitors; season July to October.

348. **Trafa-tchai,** Prov. Daghestan, Dist. Kiurin; several cold sulphurous sources, temp. 12° C.

349. **Delijan,** Prov. Elizabetpol, Dist. Kasakh; 6 miles from the town there are several ferruginous and carbonated springs, of 16° C., producing about 18,000 gallons per day.

350. **Khalkal,** Prov. Elizabetpol, Dist. Nukha; a hot sulphurous spring.

351. **Kharves,** Prov. Terek, Dist. Vladicaucase, at altitude 8,500 ft.; a ferruginous spring.

352. **Khassauti,** Prov. Terek, Dist. Naltchik, altitude 5,900 ft.; a carbonated ferruginous spring, resembling Narzan.

353. **Khas-Tchiftlik,** Prov. Kars; a mineral spring.

354. **Khakhabo,** Prov. Tiflis, Dist. Thionethi, Georgia; a cold ferruginous and carbonated spring.

355. **Khakhmati,** same district; a hot sulphurous spring.

356. **Kheledula,** Kutais Prov., Dist. Letchkhum, Georgia; a cold carbonated spring.

357. **Khertvissi,** Prov. Tiflis, Dist. Akhalkalaki, Georgia; two sulphurous sources, temp. 25° C.

358. **Khibeshlu,** Prov. Daghestan, Dist. Kiurin; a cold ferruginous source, temp. 6° C.

359. **Khidirzinde,** Prov. Baku; a cold sulphurous source.

360. **Khinalug,** Prov. Baku, Dist. Kuba, altitude 7,100 ft.; a mineral source.

361. **Khipedj,** Prov. Daghestan, Dist. Kiurin, at altitude 5,200 feet; a ferruginous spring, of temp. 6° C.

362. **Khisso,** Prov. Tiflis, Dist. Thionethi, Georgia; a hot alkaline and sulphuretted spring.

363. **Khikhata,** Prov. Kutais, Dist. Sharopan, Georgia; cold ferruginous carbonated and sulphuretted springs.

364. **Khnou,** Prov. Daghestan, Dist. Samur, altitude 3,000 ft.; an alkaline carbonated spring, temp. 45° C.

365. **Khoble,** Prov. Tiflis, Dist. Gori, Georgia; a warm sulphurous source.

366. **Khozapin,** Prov. Tiflis, Dist. Akhalkalaki, Georgia; a cold sulphurous spring.

367. **Khomur,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a cold ferruginous and carbonated spring, temp. 16° C.

368. **Khonok,** Prov. Daghestan, Dist. Andi; a carbonated spring.

369. **Khosta,** Black Sea Prov., near Sotchi, Georgia; sea baths.

370. **Khudes-Su,** Prov. Kuban, Dist. Batalpash; an alkaline carbonated spring, temp. 18° C.

371. **Tsagveri,** Prov. Tiflis, Dist. Gori, Georgia ; several cold ferruginous and carbonated sources, temp. 9·6 to 11° C. Health resort, in a very picturesque position.

372. **Tsaishi,** Prov. Kutais, Dist. Zugdidi, Georgia ; warm alkaline and sulphurous sources, containing abundant sulphuretted hydrogen, temp. 26° C.

373. **Tzismta,** Black Sea Prov., near Sotchi, Georgia, 4,000 ft. above the sea ; 2 cold carbonated sources, temp. 7° C.

374. **Tsemi,** Prov. Tiflis, Dist. Gori, Georgia ; a bathing establishment for tuberculous patients.

375. **Tsessi,** Prov. Kutais, Dist. Ratcha, Georgia ; a sulphurous spring.

376. **Tsina-Ubani,** Prov. Tiflis, Dist. Akhaltzik, Georgia ; several hot neutral sources, temp. 27 to 35° C., in very healthy climate.

377. **Tsikhis-Djvari,** Prov. Tiflis, Dist. Gori, Georgia ; several warm sulphurous sources, temp. 34° C., in a healthy picturesque spot, 7,290 ft. above the sea.

378. **Tsorkh,** Prov. Terek, Dist. Sunjen ; cold sulphurous sources.

379. **Tsotskheba,** Prov. Batum, Georgia ; an alkaline carbonated spring.

380. **Tsria,** Prov. Batum, Dist. Artvin, Georgia ; several ferruginous sources.

381. **Tskhalthbila,** Prov. Tiflis, Dist. Akhalkalaki, Georgia ; warm mineral sources, temp. 22·5° C.

382. **Tskhaltubo,** Prov. and Dist. Kutais, Georgia, at altitude 830 ft. ; warm alkaline and sulphurous sources, temp. 28 to 35° C. ; total daily outflow nearly 1 million gallons ; used for bathing and drinking ; great affluence of visitors during the summer and autumn season.

383. **Tskhmori,** Prov. Kutais, Dist. Ratcha, Georgia ; a sulphurous source.

384. **Tchagan-Mamet,** Prov. Baku, Dist. Shemakha; a hot sulphurous spring.

385. **Tchals,** Prov. Kars, Dist. Ardahan; a sulphurous spring.

386. **Lessevi,** Prov. Kutais, Georgia, altitude 3,200 ft.; several alkaline ferruginous sources, in a healthy wooded spot.

387. **Tchamarda,** Prov. Kars, Dist. Ardahan; a mineral spring of unknown composition.

388. **Tchassavali,** Prov. Kutais, Dist. Ratcha, Georgia; a mineral source.

389. **Tchvishipse,** Black Sea Prov., Dist. Sotchi, Georgia; a cold alkaline and carbonated source.

390. **Tchemgakhuar,** Black Sea Prov., near Sukhum, Georgia; a sulphurous source.

391. **Tcherek,** Prov. Terek, Dist. Nalchik; a cold carbonated source.

392. **Tchermuk,** Prov. Kars, Dist. Olti; a hot sulphurous spring, temp. 35° C.

393. **Tchermialiur,** Prov. Kuban, Temriuk Dist.; a warm sulphurous source.

394. **Tchirakh,** Prov. Daghestan, Dist. Kiurin; a ferruginous spring.

395. **Tchir-Yurt,** Prov. Terek, Dist. Khassav-Yurt; several hot springs, alkaline sulphurous, of temp. 44 to 69° C., and alkaline ferruginous, of temp. 37 to 40° C.

396. **Tchikha,** Prov. Kutais, Dist. Sharopan, Georgia; a sulphurous spring.

397. **Tchokiani,** Prov. and Dist. Kutais; several sulphurous sources of temp. 31° C., which are used for bathing; also sulphurous saline muds.

398. **Tchotchort,** Prov. Kars, Dist. Ardahan, Georgia, on the left bank of the River Kura ; a sulphurous source.

399. **Tchthili-Tskhali,** Prov. Kutais, Dist. Sharopan, Georgia ; two warm sulphurous sources near the villages Beshathubani and Zvari.

400. **Tchumathelethi,** Prov. Tiflis, Dist. Gori, Georgia, near the town Suram; a cold sulphurous source used by the inhabitants.

401. **Tchakhriani,** Prov. Tiflis, Dist. Telaw, Georgia; two sulphurous springs.

402. **Sharmiani,** Prov. Tiflis, Dist. Dushethi, Georgia, on River Aragvi, near the Station Mlethi of the Georgian Military Road ; a sulphurous spring.

403. **Shatili,** Prov. Tiflis, Dist. Thionethi, Georgia ; a cold carbonated source.

404. **Shirvan,** Dist. Maikop, in Kuban Prov. ; cold ferruginous carbonated and sulphurous sources.

405. **Shir-Shri,** near Salyani, on the Caspian Sea ; a saline spring.

406. **Shistapi,** Prov. Erivan, Dist. Alexandropol, at altitude 4,590 ft. ; a carbonated spring.

407. **Shikhliar,** Prov. Elizabetpol, Dist. Zangesour ; a carbonated spring.

408. **Shovy,** Prov. Kutais, Dist. Ratcha, Georgia, near the village Gloli ; cold ferruginous and carbonated sources ; a sanatorium has been opened here surrounded by pine forests and in beautiful climate.

409. **Dzegoba,** Black Sea Prov., near Sukhum, Georgia ; a saline spring on the left bank of the River Bzip.

410. **Stavler,** Prov. Kutais, Dist. Letchkhum, Georgia, on the right bank of the River Inguri ; a cold carbonated spring.

411. **Shurdini,** Prov. Tiflis, Dist. Akhaltzik, Georgia; a ferruginous carbonated source.

412. **Edissi,** Prov. Tiflis, Dist. Gori, Georgia, at altitude 6,360 ft. on the right bank of the River Liakhvi; a cold carbonated spring, temp. 8° C.

413. **Elssu,** Prov. Baku, Dist. Lenkoran; a carbonated spring.

414. **Erimani,** Prov. Tiflis, Dist. Gori, Georgia; a ferruginous carbonated source.

415. **Yatag-Tchai,** Prov. Daghestan, Dist. Samur; a carbonated spring.

Out of 415 springs enumerated above and registered in the whole of Caucasia more than half are on the Georgian territory, and if further scientific investigations are carried out, the number of springs will undoubtedly yet increase.

All the mineral springs on the Georgian territory are State property, and therefore their development and organisation will undoubtedly be a considerable source of revenue for Georgia and profitable for foreign capital which may be employed in that direction.

PART IV

WATER-POWER

As Caucasia is divided by one of the highest mountain chains of the globe, at several points covered by eternal snows, its great number of rivers and streams, shown by the map, might only be expected, and if nature has dealt parsimoniously with the country with regard to coal, it has lavishly made up this deficiency by substituting water-power as an inexhaustible source of energy.

Through the position of the country between the two seas the length of its rivers is somewhat limited, the longest one, the Kura, attaining 825 miles, while the Kuban and Terek run for about 300 and 400 miles respectively. But their fall is considerable, amounting in many places to rapids, and waterfalls of the smaller streams are also very numerous.

Occasions for the erection of hydraulic power-stations are therefore to be found in almost every part of the country. The river Kura, between Tiflis and Piras in Georgia, has a fall of about 300 metres, and could give 300,000 h.p. by using only 100 cubic metres of its water per second. In the Northern Caucasus the river Kuban could produce 175,000 h.p. on 350 metres fall between Batalpash and Kavkas Station, and a further 45,000 h.p. between the latter Station and Ekaterinodar. These figures result from superficial and incomplete investigations only, and do not consider the many other smaller rivers and affluents which in their higher reaches have considerable falls and abundance of water all the year round.

Unfortunately this natural store of energy has scarcely been tapped, principally through the lethargy of the former Russian Government, which did not initiate a single hydraulic enter-

DARIAL PASS AND TEREK RIVER (GEORGIA).

prise, either for private or public purposes. The power and light installations now existing in the country are all due to private capital, which is insufficient for the proper development of this kind of industry.

Hydraulic establishments generating electric current for light and power exist now at the following places:

In the Northern Caucasus, near the Station **"Mineral Waters,"** a power-station of 1,000 h.p.

In Georgia:

Tiflis, the capital, possesses 18 electric stations and sub-stations, the largest ones belonging to the Belgian Tramway Company and to the Georgian nobility.

Gori electric station belongs to Prince I. G. Amilakvari.

Kutais has two stations on the Rion River, for power and light.

Adjamethi, near Kutais, **Borjom, Akhaltzik,** and **Akhalkalaki** have local stations for lighting.

Batum is provided with current from a station built about 10 miles distant in the Tchorokh valley.

Of the Georgian coast towns **Sukhum** possesses a station of 600 h.p. about 4 miles inland; **New Athos** and the climatic station **Gagri** are also provided with current, the latter from the River Jokvara.

Considering the strenuous efforts made in other countries possessing water-power to utilize it for modern industrial purposes, the above enumeration makes a poor comparison, which must be laid at the door of the former Russian Government.

A more ambitious project was worked out a few years ago by an English engineer who proposed to supply the greater part of Caucasia with electrical current from two generating stations of large dimensions, one of them situated near the Kasbek Mountain and the other in the south near Lake Gokcha, for which purpose concessions were granted to him in 1912.

The Kasbek power-plant was to utilize the upper Terek River near the Georgian Military Road, where abundant water and a considerable fall were to produce 40,000 kilowatts, while the water from the lake was to be conducted to the second plant by means of a pipe of four miles in length and producing a fall of 2,400 feet. By means of these two installations and a network of conductors covering the whole country high-tension current for light and power was to be supplied to the railways, tramways, ports, factories, mines, municipalities, etc. Unfortunately the execution of this great plan could not be started within the stipulated time, and the concession lapsed; but in view of the general search for cheap power and current, specially also for the electro-chemical industry, it is quite certain that some similar project will soon be taken up again.

Many chemical and metallurgical industries have in recent years made enormous strides with the aid of electricity, and the countries where current can be produced cheaply, like Scandinavia, Switzerland, French Alps, etc., have greatly profited by the modern exploitations erected on their rapid rivers.

There is no doubt that the unmeasured possibilities of Caucasia will be utilized in a similar manner, specially for the manufacture of ferro-manganese, calcium carbide, and nitrogen compounds for fertilizers, etc., for which the raw materials are ready in the country.

It has also been found elsewhere that, where cheap electric current is available, all sorts of small local industries spring up, and this will undoubtedly also be the case in Georgia, which hitherto has been more an agricultural than an industrial country.

Cheap power will also be of particular importance for the south-eastern low-lying parts of Caucasia, where large tracts of otherwise suitable lands cannot be cultivated for lack of water, and where irrigation will bring forth fertile crops of cereals, rice, cotton, etc.

Situated in a region quite mountainous, where the summits are covered with snow and glaciers, Georgia possesses torrents and waterfalls which at their lowest flow in winter can produce nearly 2,500,000 h.p. and in summer over 4,000,000 h.p.

A special State Hydraulic Department exists in Tiflis (capital of Georgia) which supervises the whole utilisation of water power on Georgian territory.

PART V

THE GEORGIAN MANGANESE INDUSTRY

Its Development and World Importance

Manganese is a metal closely related to iron and resembling it in aspect, texture, and specific weight. In nature it does not exist in the metallic state, but mostly as oxidized ores, hydrated or containing also other elements. The principal ones are the following :

1. Polianite is the pure peroxide of manganese, containing 63·2 per cent. of the metal.

2. Pyrolusite, a crystalline peroxide of manganese containing more or less water, and from 60 to 63·2 per cent. of metallic manganese in its pure state.

3. Psilomelane, also a hydrated peroxide of manganese, amorphous, partly combined with potassium or barium, and containing from 45 to 60 per cent. of metallic manganese.

4. Manganite is a hydrated sesquioxide of manganese, containing in its pure state 62·4 per cent. of metallic manganese.

5. Braunite is a combination of the monoxide and sesquioxide of manganese with some silica, and contains up to 69 per cent. of metallic manganese.

All these ores are black or dark brown, or greyish and often crystalline. They are found in many places, but only in a few of them they exist in quantities large enough for commercial exploitations. Manganiferous iron ores are of great importance in the United States, but the world's consumption of manganese ores, which before the war had risen to between 1½ and 2 million tons per year, is almost exclusively covered by three countries, Georgia, India, and Brazil, the first one of which interests us specially here.

1. The Ore Deposits.

The Georgian manganese deposits are situated in the Caucasus, near Tchiaturi, in the valley of the River Kvirila, an affluent of the Rion, about 40 miles east of Kutais, in the Province of the same name.

The Kvirila River divides the deposits into two principal parts, which are again crossed by the numerous tributaries of the river, forming seven plateaux, viz., Rgani, Sedargani, Mgvemevi, and Darkveti on the right bank, and Perevisi, Shucruti, and Itkhrvisi on the left bank.

The total area of ore-bearing lands is about 400 square miles, of which one half contains good ore; and the quantity of ore available for exploitation is estimated at about 200 million tons, so that at the present rate of extraction there is enough material in the deposits for more than a century.

The outcrops of the ore are situated at about 1,000 feet above the Kvirila River, and are visible on the steep, almost vertical sides of the hills, as well as in the narrow and tortuous side valleys.

The deposits are of a sedimentary formation. The ore is stratified in successive layers of a thickness varying between 6 inches and about 30 inches, making a total thickness of from 2 to 3 yards. These strata of ore are separated by beds of eocene sands. The whole formation is horizontal, with a slight inclination towards N.E. It reposes on limestone, while the roof is formed by sandstone. The lowest layers of ore lying directly on the limestone and having usually a thickness of from 8 to 12 inches, consists of the purest peroxide of manganese, while the highest strata are often of a reddish-brown colour near contact with the over-lying sandstone, and give the lowest assays; but in general about one-third of the ore, as it comes from the mines, is directly suitable for the market.

Geologically, the formation of the ore beds must have taken place by precipitation from running waters, the thinner strata being deposited by quickly moving water, while the thicker ones would have been formed more quietly, while the sands were brought along during the intervening periods. At all events, the incrustations found in the beds prove that the deposition of the minerals must have taken place in a sea or lake of somewhat brackish water, probably on the shore of a shallow bay, where the currents often changed.

The ore is pyrolusite, partly of crystalline fibrous structure of somewhat greyish-black metallic lustre, partly amorphous of dull black or brownish-black aspect. It forms compact and rather hard masses in the continuous beds, and also occurs in granular (oolitic) form mixed with the sandstone, or in more friable masses mixed with the strata of sand and clay.

The following analyses show the great purity of the ore and the almost total absence of obnoxious elements.

TABLE I.

COMPLETE ANALYSES OF TCHIATURI ORE SAMPLES.

	Per cent.	Per cent.	Per cent.
Moisture	2·40	1·61	1·20
Silica	4·49	6·67	2·88
Alumina	1·68	2·14 }	2·34
Iron oxide	0·53	0·03 }	
Manganese peroxide	85·67	85·77	84·90
Manganese protoxide	1·98	0·80	2·50
Lime	0·76	0·87	0·33
Magnesia	0·20	0·24	0·32
Baryta	0·88	0·68	3·11
Sulphuric acid	—	—	1·19
Phosphoric acid	0·42	0·40	0·35
	99·01	99·21	99·12
Or			
Managnese metal	55·70	54·83	56·60
Phosphorus	0·18	0·17	0·15

2. EXTRACTION.

As might be expected from the description of the deposits, the extraction of the ore contained in them does not present any difficulties, as it is only a question of driving horizontal galleries along the ore beds in the comparatively soft country rock. This work can be done with picks and shovels only, no complicated mining installations being required for hoisting the ore, which is mostly carried to the pit's mouth in wheelbarrows or small trucks on rails. The mines are also quite dry and free from noxious gases, so that no better conditions could be desired in a mine. The galleries are usually from 60 to 120 yards long, some of them reach even 250 yards. The roof is mostly kept up by pillars of ore of some 2 yards in diameter, and little timbering is done as pit props are very expensive on account of high railway freight.

As mentioned, the richest ore beds are found near the Kvirila River, in the plateaux of Mgvemevi, Zeda-Rgani, and Shucruti, while in the further fields the veins get gradually thinner. This fact accounts for the great differences in the output of the various fields according to the following statistics, showing the individual outputs during the years mentioned.

TABLE II.

PRODUCTION IN TONS OF THE DIFFERENT FIELDS.

	1885–99.	1904–13	1913.
1. Mgvemevi	664,835	1,910,073	372,790
2. Zeda-Rgani	638,042	933,092	157,080
3. Shucruti	451,560	799,137	97,758
4. Perevisi	267,058	546,351	101,984
5. Rgani	157,680	518,425	65,161
6. Itkhrvisi	39,665	70,623	9,113
7. Darkveti	38,660	388,758	97,614
8. Halipauri	9,823	17,473	—
9. Tabagredi	5,068	50,177	13,145
10. Navarzeti	3,077	2,742	—
11. Sarkvelat-Ubani	503	126,855	40,000
	2,275,971	5,363,706	954,645

About three-fourths of the whole production, therefore, comes from the villages situated on the right bank of the river, which contain the most important exploitations.

The number of mines worked in 1895 was 181, containing 379 galleries, and the average production per mine was 545 tons.

In 1899 the number of mines had increased to 429, containing 820 galleries and belonging to 290 producers. The record quantity of 550,000 tons mined during that year, therefore, represented an average yearly production of only 1,900 tons per producer, and about two-thirds of the actual number of mines produced even less than this average.

In 1906 the number of mines in exploitation was 443, of which there were 106 in Mgvemevi, 92 in Zeda-Rgani, 68 in Shucruti, 68 in Perevisi, 50 in Rgani, and the rest in the other villages mentioned above.

The following Tables show the number of mines existing at various times in the district, and the number of galleries in them (generally only one or two), and further details of the light mining railways working in 1913 for the transport of the ore in the galleries and from the mines to the railhead.

TABLE III.

NUMBER OF MINES AND GALLERIES.

	1899	1900	1901	1902	1903	1904	1905	1906
Mines ..	439	348	225	277	251	211	202	443
Galleries	820	715	512	470	415	302	343	688
	1907	1908	1909	1910	1911	1912	1913	1914
Mines ..	395	114	268	191	150	206	303	192
Galleries	551	160	332	230	174	281	437	226

TABLE IV.

LIGHT RAILWAYS IN THE TCHIATURI MINING FIELDS IN 1913.

Column A. Number of mines containing railways.
,, B. Length of railways inside the galleries, in yards.
,, C. ,, ,, ,, in the open, ,, ,,
,, D. ,, ,, ,, laid during 1913, ,, ,,
,, E. Number of wagons.
,, F. Capacity of the wagons in cwt.

	A.	B.	C.	D.	E.	F.
Tabagrebi	5	2,637	3,150	2,288	88	11–23
Zeda-Rgani ..	22	8,668	2,653	4,538	74	12–16
Sarkvelat	4	3,220	1,773	817	32	16–23
Mgvimevi	49	19,938	4,576	3,547	397	10–28
Darkveti	8	3,493	1,820	1,377	59	16
Perevisa	14	8,073	2,126	3,372	367	13–18
Shucruti	27	5,917	1,811	962	52	7–28
Itkhvisi	1	70	—	58	1	13

3. Dressing and Washing of the Ore.

The natural position of the ore beds between layers of sand and clay make it in most places impossible to extract the ore alone without admixtures of the latter. The lump ore is picked out by hand, mostly in the open, but the smaller granules must be separated by water concentration in washing plants.

Primitive appliances for the purpose had been used for many years, as the washed ore easily commanded a higher price in view of its containing much less silica. In the year 1910 about one-fourth of the whole exportation consisted of washed ore, and this quality was mostly exported *via* Batum. By washing, the mixed granular ore can be concentrated up to about 90 per cent. of pure pyrolusite, containing nearly 60 per cent. of metallic manganese, but these percentages are above the average of actual cargo deliveries, which will usually assay about 53 per cent. in the dry state.

As with the increasing demand for ore the more remote mines had also to be drawn upon, the washing of ore on a larger scale became equally necessary, and plants for the purpose were enlarged and erected in various places along the River Kvirila and its tributaries. This increase of the washing soon became the cause of bitter complaints by the inhabitants of the Kvirila Valley, who also used the river for domestic purposes, for which the water now became impossible, as it was polluted by the slimes of the washeries.

Petitions were addressed to the Viceroy of the Caucasus, who first made an order to locate the washeries in the higher reaches of the river, and later forbidding to allow the slimes to run into the river on more than one day per week. But this regulation could not well be followed, and another idea was brought forward to place all the washeries near the river below Tchiaturi, and to form there a large basin for receiving all the slimes. At the same time the overflow of the basin would be used for generating electrical power for a ferro-manganese factory on the spot, etc.

This project, unfortunately, was not realized, but the question of finding some other solution became so urgent that the Association of Manganese Producers offered prices for better proposals. Several projects were submitted, but not accepted, principally because their application would have exceeded the maximum cost of the treatment, which had been stipulated at $\frac{1}{4}$ kopek per pood (about 4d. per ton).

In 1913 the Viceroy appointed a special Commission to study the matter again, and the result was an order that manganese slimes must only be discharged into the river once a week during the winter months and once every three weeks during the summer months, and that after September 1, 1914, no slimes whatever would be allowed to run into the river. These measures seemed too drastic to be enforced at such comparatively short notice, and it was expected that further time would be granted. The outbreak of the war and the cessation of work left, of course, the question in *status quo*, and it will have to be taken up again later on.

In the meantime several further large washing plants had been finished between 1912–1914, and about two-thirds of all the ore extracted was then washed. At the same time a number of additional washeries were in course of erection, the aggregate capacity of all installations being sufficient, when terminated, for washing nearly the whole output.

The washing itself, even by the best apparatus, causes a not inconsiderable loss of ore. The slimes from the washing amount to about 50 or 60 per cent. of the ore treated, and consist of about 30 per cent. of fine manganese ore and 70 per cent. of sand and clay, so that the actual loss of manganese ore amounts to about 15 or 18 per cent. of the original weight of the ore treated.

4. Transport.

The question of transport has, perhaps with the exception of the last few years, always been the greatest difficulty with which the Georgian manganese industry had to contend.

The extraction and dressing of the ore are comparatively easy and cheap, but the transport from the mines to the seaports, which was under the control of the State, was by the latter made into a source of great and excessive profit, while a less rapacious policy was the obvious duty of the former Russian Government, in order to foster this most important industry of the Caucasus, second only to that of petroleum.

The exploitation of the Tchiaturi mines began in 1878, but remained on a very limited scale until after the Russo-Turkish war, when the Transcaucasian railway line between Batum and Tiflis was opened in June 1883. The station Kvirili of this line is situated at the lower end of the manganese mining field, near the junction of the Kvirila and Rion Rivers. It formed at the time the first real improvement making a large export trade possible, but it was far from sufficient, as the ore had still to be transported for some 25 miles from the mines to the railway, for which purpose no proper roads existed then on the steep sides of the ravines and in the narrow side valleys. The ore had to be carried down on horseback or two-wheeled ox-carts ; a horse would carry about 360 lbs. in two baskets, while a cart spanned with oxen or buffaloes would take between 1–1½ tons. The cost of this cumbersome system was very high, and, besides, it could never be calculated beforehand, as it varied considerably according to the weather and seasons, and sometimes had to be suspended altogether.

The construction of a branch railway line along the Kvirila River and in the immediate vicinity of the principal mines could therefore only be a question of time, and in 1890 a project to this effect was ratified by the Government. It was to be a narrow-gauge line running from Sharopan Station to Tchiaturi, a distance of 26 miles. The line was to be constructed and worked by the Government, and was begun in 1891. The official opening took place in May 1893, running on a single track, with wagons carrying from 2–2½ tons of ore each. The cost of the line was about £150,000.

In view of later developments of the trade the narrow-gauge was a mistake under which the industry still labours to-day, as it necessitates the trans-shipment of the ore at Sharopan from the narrow-gauge trucks of the branch line to the broad-gauge ones of the Transcaucasian railway, which operation causes part of the lump ore to break up into undesirable dust.

While constructing the railway the Government also took measures for the improvement of the existing horse tracks and for constructing macadamized roads. These improvements were expected to cause a saving of about 25s. per ton on the cost of transport from the mines to Kvirili ; but such expectations were doomed to disappointment, and for various reasons the economy only amounted to about 13s. per ton, the tariff on the branch line being fixed at 15 kopek per pood, or about 19s. per ton, for a distance of 26 miles. This rate is about fifteen times as high as the charges on the other Transcaucasian railways for the same distance.

Besides, the new line did its work in a very unsatisfactory manner; it was badly constructed, and certain portions of it were continually being washed away by floods. The rolling stock was insufficient, so that a considerable part of the ore had still to be brought down on horseback, and Sharopan Station was used in preference to those situated higher up in the valley.

In consequence of these difficulties and of the general crisis in the trade, partly caused by the competition of Chile, and also of India and Japan, partly by the high tariff charged by the railway, the exporters applied to the Government for a diminution of the excessive rate, as many had made forward contracts and were in face of heavy losses; but their demand was not acceded to. The general dissatisfaction with the service of the railway continued during several years, specially as it was found that the Government made a net profit of at least 10s. per ton of ore carried, which was much more than the producers or exporters could usually expect. In fact, the whole cost of the railway was actually repaid by the profits made during the first two years of its existence. Only in 1897 a diminution of 1s. 4d. per ton was granted by the Government, and later the rate was fixed at 13s. 3d. per ton, but frequent stoppage and insufficient rolling stock still hampered the trade.

With the extension of the export another difficulty made itself more and more felt, viz., the insufficient accommodation in the port of Poti. There were only three berths for steamers loading from the quay, and almost always a number of others had to wait for their turn, lying out in the open roadstead, which in stormy weather is unsafe, so that damage by stranding, etc., often occurred. The delays frequently amounted to as much as three weeks and more, causing very heavy expense for demurrage and also stiffer freights, as the shipowners did not like the port.

The loading of the steamers was effected by workmen carrying the ore in small baskets containing about 140 lbs. In this manner from 400 to 800 tons could be loaded per day, at a cost of 8d. per ton if carried directly from the railway cars to the ship, or 1s. per ton if the ore had first been discharged in the docks.

In order to overcome this difficulty some shippers erected accommodation in the port of Batum for shipping the ore from that port, and several steamers were dispatched during 1899 in good time. But there is not much room in this port for ore shipping on a large scale, and Poti still obtained the bulk of the business.

On the repeated petitions of the shippers the rate of transport from Tchiaturi to Sharopan was lowered to 9s. 3d. per ton in the beginning of 1899, but on the other hand the sea freights rose again considerably on account of the shortage of tonnage. This acted unfavourably on the export trade, so that the Meeting of Manganese Producers decided in 1901 to petition the Government again for a further diminution of the railway tariff, but this demand was refused.

The accommodation in the port of Poti had in the meantime been improved, and the number of berths for steamers loading alongside quay was increased from three to five, and as the railway also gave a better service most of the steamers could now be loaded directly from the wagons coming from Sharopan, no stocks or deposits being required in Poti.

Nevertheless, profits of the producers were low, and in 1903 they again tried to obtain a diminution of the railway tariff from the Government, but with no better success than before. On the other hand, further improvements were introduced on the railway, and three new sidings were added on the Tchiaturi branch which made it possible to bring down 3,000 tons of ore per day to Sharopan, to be transferred to the broad-gauge trucks. Larger ore cars were also brought into use, carrying about 12 tons, and being more economical. Unfortunately, the strikes of 1905 greatly impeded the transport for some months, but after their cessation the demand from abroad increased in such proportions that the railway facilities could again not cope with them.

In 1907 this flowing tide suddenly turned, and the traffic on the railway diminished to such an extent that the shippers could obtain as many wagons as they wished, while formerly, in the busy years, they had to wait their turn and obtained wagons only in proportion to the stocks held by them at the railway platforms, viz., one wagon holding 12 tons for every 320 tons of stock. This system could now be abandoned, at least for the time being.

In view of the poor condition of the trade the Government at last in 1909 reduced the railway tariff on the branch line to 7s. 4d. per ton, but in order to compete with the Indian manganese the shippers could only petition the Government again for a further diminution. This was done in 1909 and again in 1910, but the demands fell on deaf ears, as so often before. Many exporters had made contracts for 1911, based on an expected greater reduction, and were now hard hit, and the general cry was that the export trade could only be kept up by a diminution of the transport charges. The question was considered by the Tariff Commission in 1912, but as in the meantime the trade had again revived, and was apparently prosperous, the demand was refused, although the exporters tried to prove that the high ocean freights swallowed up all the profits.

However, in order to give some satisfaction to the shippers the question of rebuilding the Tchiaturi branch line on a broad gauge was again ventilated; its necessity is recognized by everybody, but the execution of the project still remains in abeyance. The railway authorities also decided definitely to build branch lines to the mines in the side valleys.

A fall in the sea freights to Europe caused a fresh spurt in the export business in 1913, and the available rolling stock on the branch line became suddenly insufficient, so that the old method of distributing wagons to the exporters in turn and according to their stocks on the platforms had again to be resorted to. This forced many exporters who had only small stocks to buy ore on trucks at heavy sacrifices from more fortunate holders.

In order to avoid sudden rushes, as had now happened several times on quick improvements of the markets, the railway authorities now offered to unload the ore on platforms at Poti and to reload it on wagons for transport to the steamers when the latter were ready at the quay. By this means it was expected that more ore would be kept in stock at Poti, thus giving the railway a more regular traffic.

The year 1914 opened well with low rates of ocean freights, and the trade of the first six months beat all records, but the declaration of war interrupted this favourable outlook; the goods traffic was stopped on the railway, and the beasts of burden used in the mines were mostly requisitioned, so that the work had to be stopped. Some firms continued it spasmodically, and the railway also announced an increase of 1s. 4d. per ton on its tariff, but the impossibility of exporting any ore rendered all further activities in the mines useless.

Through all the fluctuations of the manganese trade during the last thirty years runs the continuous claim of the producers and exporters for cheaper railway freight. The Government could have easily granted it, as it was making enormous profits on the small branch line of 26 miles; but it preferred its own immediate gain to the welfare of the community interested in this industry. Another reason of this unfair treatment was the fact that several Grand Dukes were shareholders in the manganese enterprises working in Nikopol, which district was highly patronized by the Government to the detriment of the vast deposits of Georgia. Thus the transport of ore from Tchiaturi to Poti, and thence by sea to Rotterdam, cost 30 per cent. more than that of Nikopol ore by railway to Germany.

One improvement may yet be mentioned, although it is not due to the Government. In 1912 the municipality of Poti erected a very elaborate elevator for loading the ore, and after some breakdowns it came into proper working order and was used up to the beginning of the war. The initiative in the erection of the elevator and in other improvements in the port of Poti belongs to the distinguished Mayor of the town, Mr. N. Nikoladze, a Georgian gentleman with high European education and very greatly esteemed,

The following Tables show the Stocks of ore lying at the railway platforms at Tchiaturi at various times (V), the quantities handled by the railway (VI), the charges paid on them (VII), the income resulting from the latter (VIII).

Figures after 1914 are not always given, as in October of that year Turkey entered the war and the mainstay of the Georgian manganese industry, the exports through the Straits of the Dardanelles, was stopped until December, 1918.

TABLE V.

Stocks of Manganese Ore Lying in Tchiaturi on January 1st of Each Year.

	Tons.		Tons.
1899	129,032	1909	1,135,161
1900	300,355	1910	1,046,161
1901	560,347	1911	1,030,774
1902	668,177	1912	1,031,919
1903	454,129	1913	715,564
1904	412,081	1914	507,403
1905	315,774	1915	590,709
1906	608,081	1916	746,693
1907	1,167,371	1917	735,611
1908	1,525,661		

TABLE VI.

Transport of Manganese Ore (in Tons).

	From Tchiaturi to Sharopan by rail.	To Sharopan otherwise than by rail.	From Sharopan to Poti by main line railway.
1899	402,032	21,548	423,580
1900	492,362	24,202	516,564
1901	345,941	2,849	348,790
1902	485,873	4,402	490,275
1903	495,709	1,909	497,618
1904	544,597	2,161	546,758
1905	381,499	2,484	383,983
1906	526,923	13,742	540,665
1907	553,488	21,871	575,359
1908	358,548	28,246	386,794
1909	600,339	16,967	617,306
1910	638,819	1,611	640,430
1911	633,728	2,618	636,346
1912	957,556	1,096	958,652
1913	1,114,135	1,912	1,116,047
1914	706,907		706,907
	8,531,549	147,618	8,679,167

TABLE VII.

Railway Charges in 1913.

	Miles.	Ton.
Freight Tchiaturi to Sharopan	28	7s. 4d.
„ Sharopan to Poti	120	2s. 2d.
„ „ „ Batum	128	2s. 10d.
Total Tchiaturi to Poti	148	9s. 6d.
„ „ Batum	156	10s. 2d.
Station charges		6½d.
Unloading at Sharopan		8d.
Weighing		1¼d.
Tax for the Association of Producers		1s. 8d.

TABLE VIII.

Income of the Railway Line from Tchiaturi to Sharopan —28 Miles.

	Number of Tons carried.	Income.	Tariff.
		Roubles.	Ton.
1895	149,516	973,350	13s. 3d.
1896	149,952	976,185	13s. 3d.
1897	172,000	1,119,720	13s. 3d.
1898	250,693	1,632,015	13s. 3d.
1899	402,032	1,869,450	9s. 3d.
1900	492,362	2,390,187	9s. 3d.
1901	345,941	1,688,192	9s. 3d.
1902	485,873	2,353,201	9s. 3d.
1903	495,709	2,476,470	9s. 3d.
1904	544,597	2,643,799	9s. 3d.
1905	381,499	1,852,006	9s. 3d.
1906	526,923	2,686,960	9s. 3d.
1907	553,488	2,533,100	9s. 3d.
1908	358,548	1,740,609	9s. 3d.
1909	600,339	2,421,525	7s. 4d.
1910	638,819	2,574,435	7s. 4d.
1911	633,728	2,553,923	7s. 4d.
1912	957,556	3,858,949	7s. 4d.
1913	1,114,135	4,489,963	7s. 4d.
1914	706,907	2,835,446	7s. 4d.

MILITARY ROAD, NR. SUKHUM (GEORGIA).

5. Labour.

In the beginning of the manganese industry there were no miners in this part of the country, and Italians were imported to start the work and teach the inhabitants. However, the primitive methods employed were easily learnt, and now everybody works in the mines, so that the Council of the Association of Producers itself has called it a kind of cottage industry.

The work is usually done by small associations of three or four men, who are paid by piecework at a fixed rate per cubic sashen (12·7 cubic yards) of ore extracted and piled up on the floor of the mine.

The number of actual miners varies between 3,000 to 4,000, but besides these a great number of persons are engaged in carrying the ore from the mines to the railway platforms. Many of them carry their own ore, while others are contractors owning numbers of horses, mules, and donkeys, and undertaking to carry the ore at fixed rates.

As all this work is mostly done by the small landowners and the native population themselves, labour troubles seldom crop up in the industry. Besides, the workmen enjoy the facilities provided by the Association of Producers in the way of housing, schools, hospitals, etc.

Nevertheless, the district was also affected by the general strikes and troubles in the Caucasus during 1905 and 1913, and specially in the latter year the industry was paralyzed by a strike of the workmen during seven weeks in the busiest summer time. The result of it was an increase of 1s. per ton in the cost of production at the mines, and incidentally the trouble also helped the Indian producers to increase their shipments in that year by some 40 per cent.

The following Tables show the number of men engaged in the mining and dressing of the ore at different times (IX), their distribution in the various mining fields during 1913 (X), the wages paid to them in different years (XI), the comparatively low number of accidents happening in these mines (XII).

TABLE IX.

Number of Men Employed in the Extraction and Dressing of the Ore (Excluding Transport).

	Men.		Men.		Men.
1899	3,252	1905	3,172	1911	2,072
1900	3,702	1906	5,085	1912	2,380
1901	1,975	1907	4,004	1913	3,477
1902	2,212	1908	671	1914	3,095
1903	2,004	1909	3,123	1915	1,222
1904	2,995	1910	3,212	1916	1,059

TABLE X.

Labour Employed in the Different Mining Fields and their Production in 1913.

Villages.	Labourers Employed in Mining and Auxiliary Transport			Total.	Production.
					Tons.
Rgani	140	84	23	247	65,163
Zeda-Rgani ..	220	319	225	764	157,081
Tabagrebi	21	20	15	56	13,145
Sarkvelat-Ubani ..	101	37	9	147	40,000
Mgvimevi	711	874	613	2,198	372,790
Darkveti	180	96	80	356	97,613
Perevisa	120	179	40	339	101,984
Shucruti	176	170	129	475	97,756
Itkhvisi	11	18	19	48	9,113
	1,680	1,797	1,153	4,630	954,645

TABLE XI.

Wages Paid to Labourers in the Mines.

	1908.	1910.	1913.
Miners, per day ..	3s. 10d.	2s. 6d.	3s. 7d.
Shovellers, „ ..	—	—	3s. 2d.
Barrowmen, „ ..	3s. 2d.	1s. 8d. to 2s. 1d.	3s. 0d.
Sorters, „ ..	2s. 6d.	1s. 1d. to 1s. 8d.	2s. 6d.
Taskwork, per ton	—	2s. to 2s. 8d.	2s. 8d.

TABLE XII.

ACCIDENTS IN THE MINES.

	Number of Miners Injured.	Percentage of Miners Injured	Number of Miners Injured per 16,000 tons Production.
1905 ..	39	1·23	1·9
1906 ..	55	1·08	1·1
1907 ..	53	1·07	1·3
1908 ..	12	1·79	1·7
1909 ..	105	3·36	2·8
1910 ..	164	5·10	4·9

6. EXPORT TRADE.

The consumption of Georgian manganese in Russia itself forms only a small percentage of the trade. It started with about 10,000 tons in 1894, which rose to about 30,000 tons in 1898, and has since that time fluctuated between this figure and double its quantity, as shown in Table XVII hereafter.

All this ore is used in the Donetz Basin, which, besides, consumes about 80 per cent. of the ore extracted at Nikopol, Province of Ekaterinoslav.

The Georgian exporters do not seem to pay much attention to this trade, and, for instance, in 1906, when the demand from abroad was very pressing, several Russian steelworks could not get any supplies at all from Tchiaturi, and had to send special people there to buy from stocks, which were then forwarded with great difficulty.

The steelworks in the Urals use local manganiferous iron ores.

From the beginning of the manganese industry the export trade was its mainstay, and, in spite of the serious competition which arose in the course of time, and sometimes overwhelmed it, Georgia had before the war regained her position as the largest producer of manganese ore of the world.

Internal difficulties had much to do with the temporary setbacks of the trade. The question of transport and exorbitant railway charges by the Government, as set out in a previous chapter, gave rise to continuous complaints, and on the other hand fierce competition between the producers themselves and the entire absence, until more recent years, of any co-ordination in the export trade, made the business often enough a profitless undertaking for the miners. Much blame for this unsatisfactory state of things had at one time to be attached to some Greek exporters, who, being foreign to the interests of the country, tried to prevent the producers from combining and kept the prices in a most unsettled condition.

The United Kingdom was the first importer of Georgian Manganese on a large scale, taking about 40 per cent. of the whole quantity exported between 1885 and 1898, when in the latter year Germany took the lead in the purchases.

Prices during that period were generally not very satisfactory for the producers, and more than once did not cover their cost, although there was then only competition from Chile.

In 1898 a more successful period began, the demand for the European and American markets being brisk and at remunerative prices, which continued until 1900, when the export figures reached a record. But in the following year they took an unfavourable turn in consequence of the depression of the foreign markets, which continued for several years. In 1903 the Government was, therefore, again approached for help in view of the critical position of the trade. Fortunately at the end of 1904 a brisk demand set in again ; prices soared up to 31s. and even 36s. per ton of 50 per cent. ore f.o.b. Poti, while, for instance, in 1897 only 24s. had been paid.

The strikes of 1905 scarcely interrupted this prosperity, and in 1906 prices stood even at from 44s. to 46s. 6d. per ton f.o.b. Poti—the highest figures obtained since the railway existed.

But this unprecedented activity suddenly collapsed in the middle of 1907. The foreign demand fell off, and at the end of the year shipments had practically ceased. This stagnation continued until 1910, when the consumption rose again, even to record figures. But the Indian and Brazilian competition covered most of it, and the Georgian miners only obtained very low prices, which scarcely allowed them to make any profit at all. This was largely due to the unusually high sea freights, and lasted until the end of 1911, when the demands of the ferro-manganese works suddenly arrived again and caused prices to rise.

This favourable position was expected to continue, although the high rates of wages imposed by the strikes of the miners made things very difficult for the less favourably placed mines, but the war and the closing of the Dardanelles made an end to the prospects as well as to the difficulties.

The ups and down of the export trade are reflected in the stocks of ore lying at Tchiaturi. While at the end of 1902 they amounted to 240,000 tons, they rose to 323,000 tons in 1903 and 1904; to 1,130,000 tons in 1906, being over 1,000,000 in 1907. The heavy shipments of 1912 reduced them to 645,000 tons, and in the following year even to about 400,000 tons. In 1914 the output of the mines fully covered the quantities shipped, and at the end of the year were rather higher than a year before.

The average cost of this ore deposited at the railway platforms at Tchiaturi is approximately as follows:

	Per ton.
Extraction and dressing	4s. 0d.
Administration	4d.
Transport to station	3s. 4d.
	7s. 8d.

The item of transport varies, of course, considerably according to the distance of the mines from the railhead and their facilities and means of transport.

To the above cost must be added 1s. 4d. per ton for rent to the owner, if the ore-bearing land is held on lease.

The values of the ore at Tchiaturi platforms fluctuated between the following limits during recent years:

	Per Ton.		Per Ton.
1908	6s. to 9s. 4d.	1912	6s. to 8s. 8d.
1909	6s. 8d. to 9s. 4d.	1913	8s. to 10s. 8d.
1910	6s. to 8s.	1916	(Jan. to March) 10s. 8d. to 12s. 8d
1911	6s. to 7s. 4d.	1916	(Dec.) 26s. 8d. to 29s. 4d.

The selling price of manganese ore for metallurgical purposes is fixed according to its tenour in metallic manganese, in silica and phosphorus; the latter two elements being detrimental, must not exceed a certain maximum. For instance, the American steelworks made their contracts for Georgian ore before the war at a fixed and progressive price per unit of metallic manganese, and on condition that the ore should not contain more than 8 per cent. of silica, nor more than 0·25 per cent. of phosphorus. In case of an excess the following penalties were stipulated:

For each 1 per cent. in excess of 8 per cent. of silica 15 cents (7½d.) per ton were deducted, and for each 0·02 per cent., or fraction thereof, in excess of 0·25 per cent. of phosphorus a deduction of 2 cents (1d.) per unit of manganese and per ton was made. Ore containing less than 40 per cent. of metallic manganese, or more than 12 per cent. silica, or 0·27 per cent. of phosphorus could be refused by the buyers.

Analyses to be made on samples dried at 212° F., and all moisture found in the samples as taken to be deducted from the weight.

For ore bought f.o.b. Poti the following, or approximate, conditions are usually adopted in British Sale Contracts:

1. The Sellers will sell and undertake to deliver to the Buyers who accept .... tons or 10 per cent. more or less of merchantable Caucasian Manganese Ore of 48 per cent. average tenour, to be delivered .... at the rate of about .... per month.

2. The price of this ore shall be .. kopek per pood of ore dry weight delivered f.o.b. steamer in Poti in bulk.

3. The ore shall contain 48 per cent. of metallic manganese when dried at 212° F., and any shipment containing less than 46 per cent. can be refused by Purchasers, other tenours to be paid for proportionately. The normal tenour of silica shall be 10 per cent. with a scale of 3d. per unit and per ton above and below this tenour, the maximum allowed being 11 per cent. The maximum tenour of phosphorus shall be 0·18 per cent. All moisture shall be deducted from weight.

4. The Buyers have to provide the steamers for transport of the ore and have to inform the Sellers of the probable arrival of the same at least fifteen days in advance. The Sellers do not guarantee the turn of loading in the port. The Sellers undertake to load at the rate of 400 tons per working day, counting from the day of arrival of the steamer at the quay.

5. Sampling and weighing of the ore have to be effected at the port of discharge by the agents of the Buyers and the Sellers jointly, according to the usual rules, and the samples have to be analysed by the respective analysts of the parties and at their cost. The average results of the two analyses shall be taken as basis for the invoice, except if there is a difference of more than one per cent. in the tenours of manganese, in which case a third analysis shall be made by .... which shall be used for the invoice and paid for by the party whose first result differed most from the Umpire's.

6. The Buyers shall pay in cash 80 per cent. of the provisional invoice against the Bill of Lading in Poti, and shall to this effect open a confirmed bank credit with a bank in Poti of a sufficient amount and before the arrival of the steamers at that port. The provisional invoice shall be based upon the weight mentioned in the Bill of Lading, a supposed tenour of 48 per cent. of metallic manganese and 10 per cent. moisture. The balance of the shipment according to the final invoice has to be settled in cash not later than 14 days from the reception of the shipment and by cheque sent to the .... Bank for account of the Sellers. Each shipment is to be deemed and treated as a separate Contract.

7. In case of strikes, blockades, breakdown of railway, interdict of shipping port, prohibition of export, quarantines, war, act of God, or any other unforeseen event whatever beyond the control of the Sellers making it impossible to ship the ore, the deliveries and shipments shall be suspended until the cessation or removal of these obstacles, or for a period to be fixed, and the Sellers shall not be responsible for any damage or otherwise resulting from such causes.

8. The execution of the present Contract is guaranteed on behalf of the Sellers by the .... Bank in London, the Sellers being responsible for any actual damage or loss sustained by the Buyers through non-delivery of the ore unless it is caused by an event or events mentioned in Clause 7.

9. Any dispute concerning the execution or interpretation of the present Contract shall be submitted to two arbitrators to be chosen by the parties, and in case of their disagreement they will choose an Umpire whose decision shall be final.

TABLE XIII.

TYPICAL ANALYSES OF CARGOES.

Year.	Metallic Manganese.	Moisture.	Silica.	Analysts.
1910	51·009	9·165	9·265	Pattinson
	50·07	9·82	—	Watson & Gray
	49·85	10·08	—	Fresenius
	48·83	10·13	—	,,
	50·26	10·50	—	,,
	50·45	8·25	9·46	,,
	50·25	10·55	10·225	Pearson
1911	49·94	8·85	—	Watson & Gray
	51·50	8·87	8·29	Pattinson
	50·01	7·40	9·32	,,
	50·39	7·34	—	Watson & Gray
	49·31	6·95	10·425	Pearson
	50·28	8·54	—	Watson & Gray
	51·24	6·80	8·92	Fresenius
	49·55	9·00	9·30	Pattinson
1912	49·94	9·99	—	Watson & Gray
	50·64	10·54	—	,,
	49·98	10·36	—	,,
	50·06	7·69	—	,,
	50·37	9·54	—	,,
	50·83	8·96	—	,,
1913	49·94	9·99	—	,,
	50·30	10·36	—	,,
	50·34	8·36	—	,,

The selling price of the manganese ore depends, as mentioned, on its tenour in metallic manganese, and the quotations are noted per unit or percentage of such metal. For instance, an ore containing 50 per cent. of manganese metal at 10d. per unit is worth 41s. 8d. per ton, less the eventual deductions stipulated in the Contract, as outlined above.

The following figures give the highest and lowest prices per unit quoted in London in recent years for 50 per cent. Indian ore, in pence :

1899	10 to 12½d.		1904	7½ ,, 8d.	
1900	12 ,, 13d.		1905	9 ,, 10½d.	
1901	9 ,, 11½d.		1906	13 ,, 17d.	
1902	8½ ,, 9d.		1907	17 ,, 10d.	
1903	8 ,, 8½d.		1908	9½ ,, 8½d.	

1909	9 to 9½d.	1916		30 to 32d.
1910	9½ „ 8½d.	1917	April	36d.
1911	8½ „ 10d.	„	July	38 to 39d.
1912	9 „ 13½d.	„	October	40d.
1913	13 „ 9½d.	„	December	41½d.
1914	9¾ „ 11½d.	1918	January	42d.
1915	16 „ 18d.			

Georgian ore, with its somewhat lower tenour of from 47 to 50 per cent., is paid from 1d.–2d. less per unit, while the Brazilian ore is still less esteemed. For instance, in the summer of 1913 Indian ore was quoted 11d. to 11½d., Georgian 9d. to 9½d., and Brazilian 6½d. to 7d. The war, of course, upset all these values, and while, for instance, Brazilian ore cost 9d. per unit c.i.f. U.S.A. in the beginning of 1914, it had to be paid 2s. 4d. per unit in 1915, and up to 4s. in May 1917.

A detailed picture of the Georgian Export Trade in manganese ore is given by the following Tables Nos. XIV to XVIII.

TABLE XIV.

EXPORTS OF MANGANESE ORE FROM POTI AND BATUM ACCORDING TO BRITISH CONSULAR REPORTS.

Year.	From Poti.		From Batum.		Total.	
	Tons.	Value £.	Tons.	Value £.	Tons.	Value £.
1884	—	—	10,000	27,000	10,000	27,000
1885	22,695	—	18,702	52,000	41,397	—
1886	35,673	110,133	18,077	50,000	53,750	160,133
1887	49,519	106,700	11,600	29,000	61,119	135,700
1888	35,830	80,600	7,118	19,789	42,984	100,389
1889	49,106	90,846	11,492	28,730	60,598	119,576
1890	120,000	240,000	11,299	33,897	131,299	273,897
1891	80,016	195,000	5,222	14,570	85,238	209,570
1892	128,500	311,250	7,730	14,795	136,230	326,045
1893	122,692	245,358	7,958	18,167	130,650	263,525
1894	144,310	288,620	6,991	15,939	151,301	304,559
1895	159,636	319,272	4,324	6,702	163,960	325,974
1896	133,365	266,730	4,272	7,049	137,637	273,779
1897	166,400	210,002	5,157	8,504	171,957	218,506
1898	262,225	340,892	11,786	19,328	274,011	360,220
1899	352,245	440,305	10,040	15,600	362,285	455,905
1900	373,262	492,387	52,917	79,366	426,179	571,753
1901	263,963	329,953	16,000	18,900	279,963	349,753
1902	387,100	483,875	91,321	113,238	478,421	597,113
1903	380,930	430,557	59,927	75,031	440,857	505,588
1904	425,714	527,141	27,395	31,813	453,109	560,054
1905	297,025	371,281	16,070	19,927	313,095	391,208
1906	478,000	956,000	16,506	—	494,506	—
1907	475,600	951,200	25,159	—	500,759	—
1908	366,600	458,250	8,160	—	374,760	—
1909	544,000	—	28,238	—	572,238	—
1910	364,500	—	43,119	—	407,619	—
1911	442,460	—	129,233	—	571,693	—
1912	634,200	—	277,499	—	911,699	—
1913	649,780	—	429,900	—	1,079,680	—
1914[1]	415,016	—	372,198	—	787,214	—
1915[2]	—	—	—	—	8,750	—
1916[2]	—	—	—	—	9,769	—
1917[3]	—	—	—	—	—	—
1918[3]	—	—	—	—	—	—

[1] Six months.
[2] Poti and Batum together.
[3] No exports because of closing of the Dardanelles.

TABLE XV.

PORTS OF DESTINATION OF ORE SHIPMENTS AND QUANTITIES IN TONS.

	1899.	1900.	1901.	1902.	1903.
1. Middlesboro ..	45,241	53,124	28,932	41,478	39,730
2. Garston ..	15,978	18,051	7,950	11,540	14,960
3. Fleetwood ..	46,407	33,897	17,639	49,210	33,806
4. Newport ..	12,257	11,562	17,921	20,173	7,000
5. Liverpool ..	4,759	197	—	1,500	1,200
6. Plymouth ..	—	—	—	—	—
7. Mostyn ..	77,788	—	3,050	9,210	16,425
8. Glasgow ..	—	—	2,500	—	—
9. Hull ..	—	—	—	—	—
10. Birkenhead ..	—	—	—	—	—
11. Barrow ..	—	—	—	—	—
12. Gibraltar ..	—	—	—	—	—
13. Manchester ..	—	—	—	—	—
14. Maryport ..	—	—	—	—	—
15. London ..	—	—	—	—	—
16. Rotterdam ..	124,975	146,656	119,350	149,876	134,561
17. Amsterdam ..	—	2,050	—	4,100	—
18. Antwerp ..	7,900	47,422	37,739	71,499	85,604
19. Hamburg ..	6,611	10,777	12,390	15,497	11,788
20. Stettin ..	7,714	—	3,300	11,200	14,500
21. Emden ..	—	—	—	—	—
22. Marseilles ..	7,086	18,610	4,114	94	12,865
23. Dunkirk ..	—	—	6,281	28,834	24,739
24. Boulogne ..	—	—	—	—	—
25. Havre ..	—	—	—	—	—
26. Calais ..	—	—	—	5,765	6,660
27. St. Nazaire ..	—	—	—	—	—
28. Bayonne ..	—	—	—	—	2,080
29. Pauillac ..	—	—	—	2,730	—
30. Trieste ..	—	2,200	9,460	3,097	2,700
31. Fiume ..	—	1,800	—	—	—
32. Servoli ..	—	2,600	—	6,500	17,545
33. Pola	—	—	—	—	—
34. Livorno ..	—	—	—	—	—
35. Genoa ..	—	—	—	—	—
36. Piombino ..	—	—	—	—	—
37. Bologna ..	—	—	—	—	—
38. Naples ..	—	—	—	—	—
39. Syra	—	—	—	4,270	2,750
40. Constantinople	—	—	—	—	—
41. Galatz ..	—	—	—	—	—
42. Sydney ..	—	—	—	3,100	—
43. Philadelphia	24,881	21,500	—	—	—
44. Baltimore ..	47,112	54,324	33,582	3,141	3,950
45. New York ..	7,797	—	—	556	1,585
	366,506	424,770	304,198	443,370	434,448

TABLE XV—*Continued.*

PORTS OF DESTINATION OF ORE SHIPMENTS AND QUANTITIES IN TONS—*Continued.*

	1904.	1905.	1906.	1907.	1908.
1. Middlesboro	16,600	11,301	22,002	42,352	16,804
2. Garston ..	15,850	12,600	27,403	10,203	38,540
3. Fleetwood ..	32,004	13,451	2,500	9,600	12,900
4. Newport ..	22,997	15,903	5,750	13,100	—
5. Liverpool ..	4,400	2,476	10,098	33,545	9,918
6. Plymouth ..	—	—	—	—	—
7. Mostyn ..	7,480	10,000	11,600	14,500	15,450
8. Glasgow ..	—	—	—	—	—
9. Hull	—	—	—	5,000	—
10. Birkenhead ..	—	5,500	3,500	—	—
11. Barrow ..	—	—	—	9,000	—
12. Gibraltar ..	—	—	3,500	3,200	4,500
13. Manchester ..	—	—	9,902	—	—
14. Maryport ..	—	—	29,167	31,000	13,603
15. London ..	—	—	—	—	—
16. Rotterdam ..	164,762	122,279	212,307	206,196	157,951
17. Amsterdam ..	—	—	—	—	—
18. Antwerp ..	83,621	35,358	33,515	6,787	54,930
19. Hamburg ..	12,572	14,614	14,016	15,407	11,097
20. Stettin ..	21,950	6,600	—	12,450	4,500
21. Emden ..	3,010	—	—	—	—
22. Marseilles ..	13,164	547	9,393	7,096	6,459
23. Dunkirk ..	21,715	2,709	5,000	2,900	—
24. Boulogne ..	—	—	2,600	14,600	23,232
25. Havre ..	—	—	460	—	—
26. Calais ..	9,806	10,673	—	—	—
27. St. Nazaire ..	—	—	—	—	—
28. Pauillac ..	—	—	—	—	—
29. Bayonne ..	—	—	—	—	—
30. Trieste ..	2,500	7,050	7,180	37,021	18,176
31. Fiume ..	—	—	—	—	—
32. Servoli ..	10,110	2,600	7,500	3,800	—
33. Pola	—	—	—	—	—
34. Livorno ..	4	10	—	—	—
35. Genoa ..	—	—	—	10	—
36. Piombino ..	—	—	—	—	—
37. Bologna ..	—	—	—	—	—
38. Naples ..	—	—	—	—	—
39. Syra	—	—	—	—	—
40. Constantinople	—	3,323	—	—	402
41. Galatz ..	—	—	—	—	—
42. Sydney ..	—	—	—	—	—
43. Philadelphia	8,200	15,750	5,300	—	—
44. Baltimore ..	5,900	8,869	8,430	—	—
45. New York ..	3,749	—	—	—	—
	460,394	301,613	431,123	377,771	388,462

TABLE XV—*Continued.*

PORTS OF DESTINATION OF ORE SHIPMENTS AND QUANTITIES IN TONS—*Continued.*

	1909.	1910.	1911.	1912.	1913.
1. Middlesboro	37,069	22,120	19,206	55,627	76,757
2. Garston ..	24,005	30,225	64,703	35,496	65,410
3. Fleetwood ..	12,720	20,920	9,819	13,392	3,580
4. Newport ..	4,870	9,450	—	—	—
5. Liverpool ..	7,458	9,000	4,594	7,530	5,850
6. Plymouth ..	—	—	—	—	3,134
7. Mostyn ..	26,054	20,850	8,952	41,457	29,732
8. Glasgow ..	3,600	—	—	—	—
9. Hull	—	—	—	—	—
10. Birkenhead ..	—	—	—	—	—
11. Barrow ..	—	—	—	—	—
12. Gibraltar ..	—	—	—	8,109	—
13. Manchester ..	—	—	—	18,002	33,934
14. Maryport ..	26,563	24,695	16,747	19,301	25,007
15. London ..	—	583	—	—	—
16. Rotterdam ..	250,744	256,655	248,578	273,655	354,634
17. Amsterdam ..	—	—	—	—	—
18. Antwerp ..	65,943	88,654	65,198	190,703	180,050
19. Hamburg ..	19,892	28,795	42,213	44,330	51,389
20. Stettin ..	—	—	—	—	—
21. Emden ..	—	—	—	—	—
22. Marseilles ..	2,457	7,613	10,495	13,234	13,978
23. Dunkirk ..	—	—	—	—	—
24. Boulogne ..	17,060	30,410	27,678	25,155	30,492
25. Havre ..	—	—	—	—	—
26. Calais ..	—	—	—	—	—
27. St. Nazaire ..	—	—	—	3,261	9,852
28. Bayonne ..	—	—	—	—	—
29. Pauillac ..	—	—	3,221	—	—
30. Trieste ..	9,878	15,765	29,040	24,726	20,750
31. Fiume ..	47	—	3,566	289	109
32. Servoli ..	18,703	18,100	11,405	14,477	4,202
33. Pola	—	—	—	—	5
34. Livorno ..	10	—	—	—	—
35. Genoa ..	12	757	814	—	—
36. Piombino ..	—	2,400	3,101	—	—
37. Bologna ..	—	—	—	—	2,770
38. Naples ..	—	—	—	—	4,502
39. Syra	—	—	—	—	—
40. Constantinople	—	—	—	—	—
41. Galatz ..	29	—	—	—	—
42. Sydney ..	—	—	—	—	—
43. Philadelphia	—	4,250	5,236	—	23,885
44. Baltimore ..	12,100	18,076	10,584	88,911	108,484
45. New York ..	—	—	—	6,000	3,266
	539,185	609,347	581,150	883,655	1,051,772

TABLE XVI.

COUNTRIES OF DESTINATION OF ORE SHIPMENTS AND QUANTITIES IN TONS.

	Belgium.	Great Britain.	Holland.	Germany.	France.
1899 ..	7,900	132,430	124,975	14,325	7,086
1900 ..	47,422	116,831	148,706	10,777	18,610
1901 ..	37,729	77,992	119,350	15,690	10,395
1902 ..	71,499	133,111	153,976	26,697	37,423
1903 ..	85,604	113,121	134,561	26,288	46,344
1904 ..	83,622	99,331	164,762	37,532	44,685
1905 ..	35,358	71,232	122,279	21,214	13,944
1906 ..	33,515	125,423	212,307	14,016	17,451
1907 ..	6,788	171,597	206,102	27,857	24,596
1908 ..	54,933	111,714	157,951	15,597	29,690
1909 ..	65,943	142,339	250,744	19,892	19,517
1910 ..	88,654	137,844	256,655	28,795	38,024
1911 ..	65,198	124,023	248,578	42,213	41,394
1912 ..	190,701	198,914	273,655	44,329	41,651
1913 ..	180,050	243,405	354,634	51,389	54,324
	1,054,916	1,999,307	2,929,235	396,611	445,134

	United States.	Other Countries.	Total Abroad.	South Russia.	Grand Totals.
1899 ..	79,790	—	366,506	42,579	409,085
1900 ..	75,824	6,600	424,770	38,110	462,880
1901 ..	33,582	9,460	304,198	44,974	349,172
1902 ..	6,797	13,867	443,370	59,500	502,870
1903 ..	5,535	22,995	434,448	48,659	483,107
1904 ..	17,849	12,613	460,394	75,333	535,727
1905 ..	24,603	12,983	301,613	44,620	346,233
1906 ..	13,730	14,681	431,123	67,198	498,321
1907 ..	—	40,831	477,771	63,046	540,817
1908 ..	—	18,577	388,462	9,653	398,115
1909 ..	12,100	28,650	539,185	26,762	565,947
1910 ..	22,325	37,050	609,347	29,938	639,285
1911 ..	15,837	43,907	581,150	23,863	605,013
1912 ..	94,913	39,492	883,655	16,899	900,554
1913 ..	135,635	32,335	1,051,772	9,959	1,061,731
	538,520	334,041	7,697,764	601,093	8,298,857

It must be pointed out that all the manganese ore shipped to Holland is destined for Germany.

TABLE XVII.

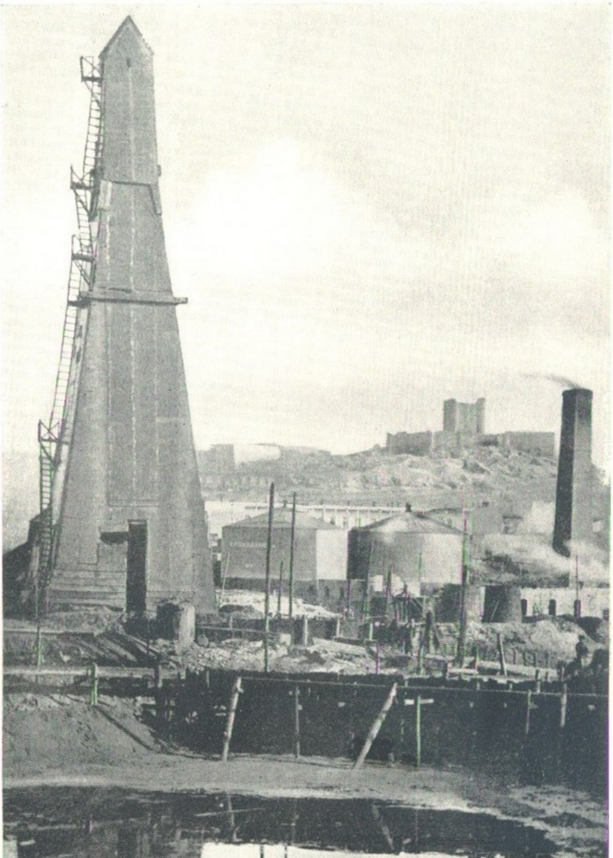
WORLD IMPORTS OF MANGANESE ORE IN TONS.

	1898.	1899.	1900.	1901.	1902.
Great Britain ..	153,927	257,680	265,757	192,654	231,864
Germany ..	128,603	196,825	204,420	222,009	204,647
United States	114,885	188,349	256,252	165,720	235,576
France	100,243	106,630	120,790	94,365	85,629
Belgium ..	124,401	150,000	180,200	123,000	160,000
Austria	5,395	5,855	7,796	6,367	6,000
Russia (Urals) ..	30,664	42,578	38,110	44,974	59,498
Italy	—	—	—	—	—
	658,118	947,845	1,073,325	849,089	984,683
	1903.	1904.	1905.	1906.	1907.
Great Britain ..	231,864	205,175	238,700	338,423	505,635
Germany ..	223,708	255,760	262,311	331,133	393,327
United States ..	146,056	108,459	257,033	221,060	268,321
France	75,000	75,000	139,764	127,615	192,448
Belgium ..	150,000	150,000	150,000	147,000	120,000
Austria	6,000	15,000	15,000	14,681	69,774
Russia (Urals) ..	48,659	75,332	44,620	67,198	63,045
Italy	—	—	—	—	—
	881,287	884,726	1,107,428	2,247,210	1,612,550
	1908.	1909.	1910.	1911.	1912.
Great Britain ..	344,170	330,690	482,209	538,915	387,733
Germany ..	334,133	384,445	487,870	420,709	523,125
United States ..	181,054	261,169	246,226	200,000	300,661
France	168,509	177,814	188,292	295,396	224,555
Belgium ..	100,000	176,616	94,033	249,258	395,630
Austria	29,020	44,970	59,951	78,790	62,082
Russia (Urals) ..	9,653	26,762	29,937	23,862	16,899
Italy	—	12	3,915	7,365	—
	1,166,539	1,302,478	1,592,433	1,574,295	1,909,685

TABLE XVIII.

World Consumption of Manganese Ore, in Tons.

	1898.	1899.	1900.	1901.	1902.
Great Britain ..	154,348	258,992	267,105	194,300	234,611
Germany ..	173,856	258,154	262,436	277,874	261,338
United States ..	166,180	232,701	321,620	296,847	390,568
Belgium ..	140,841	162,120	191,020	131,510	174,440
France	132,178	146,527	149,782	116,669	98,165
Austria	24,883	21,504	30,283	24,406	22,405
Italy	3,002	4,356	6,014	2,181	2,477
Sweden	2,358	2,622	2,650	2,276	2,850
Russia	90,994	139,591	126,946	115,031	119,245
	888,640	1,226,567	1,357,856	1,161,094	1,306,099
	1903.	1904.	1905.	1906.	1907.
Great Britain ..	232,682	213,931	253,174	361,549	521,733
Germany ..	260,564	302,309	309,658	381,108	464,520
United States ..	253,335	208,459	357,033	391,881	457,588
Belgium ..	160,000	156,100	165,000	162,000	120,120
France	81,583	80,000	146,018	135,060	305,482
Austria	23,027	30,000	35,500	35,734	88,258
Italy	1,930	436	5,384	3,060	3,654
Sweden	2,244	2,297	2,500	2,680	362
Russia	69,633	188,128	190,102	148,455	246,050
	1,084,998	1,111,660	1,464,369	1,631,537	2,108,676
	1908.	1909.	1910.	1911	1912.
Great Britain ..	350,478	333,502	487,676	363,902	391,903
Germany ..	399,042	456,699	563,919	498,391	608,482
United States ..	337,296	361,169	396,226	370,000	498,661
Belgium ..	107,130	82,886	99,033	153,258	398,630
France	183,369	186,040	197,570	242,496	231,285
Austria	52,576	67,920	79,360	97,756	78,615
Italy	2,750	4,712	8,115	10,725	241
Sweden	4,616	5,212	2,771	4,448	1,120
Russia	143,578	29,690	133,660	208,729	178,357
	1,580,835	1,527,830	1,968,330	2,049,705	2,387,294



OIL WELL IN BAKU.

7. Foreign Competition with Georgian Manganese.

Of the various countries producing manganese ore only India and Brazil have to be considered as serious competitors with Georgia for the world's supply of this ore. Chile, which in the beginning of the Georgian trade ran it rather closely, fell out of it altogether in the first years of this century, principally on account of the very onerous sea freights; and, besides, the exports from that country never reached 50,000 tons in their best years.

Brazil is a more serious competitor. Its principal manganese mining fields are situated in the Province of Minas Geraes, in the districts of Miguel Burnier and Queluz, about 300 miles N.W. of Rio de Janeiro, which is the shipping port for all the ore from this region. The ore is usually pyrolusite, also manganite, of good quality, containing an average of from 48 to 52 per cent. of manganese metal, 3 per cent. iron, 1 per cent. silica, and very little phosphorus—in many cases only from 0·03 to 0·09 per cent.; but its drawback is its great hardness, which makes it difficult to fuse and accounts for its usually lower value than the Georgian and Indian products.

The district of Queluz contains the Morro de Mina deposit, which is estimated to contain an ore reserve of 10 million tons and produced 200,000 tons in 1915. It is worked by Brazilian owners, while other mines belong to Belgian and other companies. The arrangements for the export of the ore are fairly satisfactory, and the trade is generally prosperous. In 1914 the mining costs amounted to 2s. 6d. per ton, railway freight to Rio and export duty to 6s., sea freight from Rio to U.S.A. to 20s., making total cost of about 28s. 6d. per ton c.i.f. U.S.A.

The American steel works are now the largest buyers of this ore; in 1914 40 per cent. of their imports came from this source, and in 1915 even 90 per cent., despite the difficulties of freight. During the first 11 months of 1916 the total imports of the U.S. amounted to 526,525 tons, about 95 per cent. of which came from Brazil.

That country contains yet other deposits of manganese ore in the Provinces of Bahia and Matto Grosso. One of them is in exploitation in the former district, and cost of mining, transport, export duty, and loading on steamers in the port of Bahia amount there to 11s. 3d. per ton. But probably the largest deposit in the world known at present occurs in Matto Grosso, near Corumba. It has the shape of a steep mountain, consisting of iron ore interstratified by several enormous horizontal manganese veins of pure quality and sufficient for the world's requirements for several centuries. But the place is difficult of access, and so far from the sea or a railway that this occurrence will not have any influence on the world's trade as long as other deposits can give any supply.

The most serious competition against which the Georgian ore has to contend comes from India. The good quality of its ores, combined with cheap labour and railway freights, have often brought the market prices down to a level which proved ruinous to the Georgian producers, and during the years 1910 and 1911 the Indian production even exceeded that of the Georgian mines, which formerly had always kept the first place.

The mining of Indian manganese began in 1892, near Vizagapatam in the Madras Presidency; but in 1900 the Central Provinces also started exploitations and now supply the bulk of the exports. The greater part of the ore found is not pyrolusite as in Georgia, but psilomelane and braunite—it is hard and compact, easily broken, but without forming dust, which is an advantage in the handling and transport.

The ore is mostly extracted by open-out methods with coolie labour, but later, no doubt, deep mining will have to be resorted to. The deposits are scattered over wide areas and their depths have not yet been ascertained, so that no estimate can be formed of the available ore; but the reserves are not inexhaustible. At present large quantities of ore are lost and thrown upon the dumps because proper concentration plants do not exist and it does not pay to ship the low-grade ore.

The cost of mining varies between 2s. 9d. and 5s. 6d. per ton ; the railway charges to Vizagapatam (55 miles) are about 2s. per ton ; to Bombay (500 miles) 9s. 6d. per ton, and to Calcutta (700 miles) 13s. per ton. The sea freight from India to Europe and the U.S.A. varies in normal times between 16s. and 18s. per ton, or about 5s. more than from the Black Sea ; but as the railway charges are low, although the distances are four or six times longer than in the Caucasus, the cost price compares favourably with the Georgian and Brazilian ores.

Besides, as the assays usually give higher averages of metal, the basis prices for Indian ore have in recent years always been about 1d. or 2d. higher per unit than those for ore from other sources. Nevertheless, the shipments generally tend to show an increasing percentage of phosphorus, which now averages 0·15 and even more per cent., as the high-grade ores, which were exclusively worked in the beginning, are becoming scarce, and the preferential price may therefore in time disappear.

A typical complete analysis of a sample of Indian ore gave the following results (by Pattinson & Stead):

Dried at 212° F.	Per cent.
Peroxide of manganese	66·357
Protoxide of manganese	11·786
Peroxide of iron	2·928
Alumina	2·847
Lime	0·975
Magnesia	0·036
Silica	8·100
Potash	0·770
Soda	0·610
Baryta	1·564
Sulphuric acid	0·021
Phosphoric acid	0·375
Oxide of zinc	Trace
Oxide of copper	,,
Oxide of nickel and cobalt	,,
Oxide of lead	Nil
Arsenic	0·010
Carbonic acid	0·900
Combined water	2·675
	99·954

Corresponding with:

Manganese metal	51·08
Iron metal	2·05
Phosphorus	0·164
Moisture	0·35

In order to show the relative position of the three principal producing countries and of the other smaller producers we add Tables XIX to XXIV, which explain themselves.

They show, at the same time, that the Georgian manganese industry has kept its own in spite of the rapacious treatment it had to suffer from the former Russian Government. But if it had been under an orderly administration as the Indian industry enjoys, its development would undoubtedly have been much more rapid and rational. Unfortunately, in this as in many other industries the old Russian regime was a great hindrance.

TABLE XIX.

COMPARATIVE TABLE OF PRODUCTION OF THE THREE PRINCIPAL PRODUCING COUNTRIES (IN TONS).

Year.	Georgia.	India.	Brazil.
1899	549,234	86,964	—
1900	651,024	127,814	108,244
1901	369,428	162,057	105,710
1902	418,147	144,037	163,000
1903	370,558	171,804	163,319
1904	326,714	150,297	208,308
1905	336,717	237,767	233,950
1906	809,193	496,697	201,500
1907	658,597	898,332	236,778
1908	112,875	674,315	182,509
1909	588,817	642,675	240,774
1910	545,242	800,907	254,177
1911	461,855	672,762	173,941
1912	569,758	423,464	154,886
1913	954,645	674,315	122,300
1914	652,354	815,047	188,330
1915[1]	258,220	682,898	288,671
1916[1]	247,000	—	503,130
1917[1]	201,380	—	—
1918[1]	150,000	—	—

[1] Sharp decrease in production is due to closing of Dardanelles and stoppage of exports.

TABLE XX.

Comparative Table of Exports of the Three Principal Producing Countries (in Tons).

Year.	Georgia.	India.	Brazil.
1899	404,410	92,000	74,238
1900	462,877	130,654	93,127
1901	349,170	133,170	105,710
1902	502,869	144,037	157,295
1903	483,107	171,804	161,926
1904	535,727	154,880	208,260
1905	346,233	282,334	224,337
1906	498,321	310,446	201,500
1907	540,817	641,692	271,375
1908	398,115	509,246	182,508
1909	565,947	467,274	240,774
1910	639,285	587,327	252,564
1911	605,013	553,623	173,941
1912	900,554	621,826	154,870
1913	1,061,731	772,366	122,000
1914	787,214	—	183,630
1915	9,750	418,733	288,671
1916	9,769	580,328	350,000 (est.)

TABLE XXI.

Participation of Georgia and Ukraine in the World's Production of Manganese Ore (in Percentages).

Year.	Georgia.	Ukraine.	Consuming Countries.	Non-consuming Countries.
1898	30·13	6·93	21·91	41·03
1899	42·23	7·46	15·56	34·75
1900	44·33	6·05	13·60	36·02
1901	30·25	5·74	20·02	43·99
1902	31·53	4·52	21·40	42·55
1903	33·39	3·33	18·37	44·91
1904	29·34	5·65	18·15	46·86
1905	25·14	11·46	16·85	46·54
1906	38·21	7·52	14·13	40·14
1907	26·06	10·76	12·72	50·46
1908	7·62	12·49	18·72	61·17
1909	31·56	3·69	12·93	51·82
1910	26·42	8·39	13·45	51·74
1911	24·29	12·27	15·92	47·52
1912	31·79	13·28	18·54	36·39

TABLE XXII.

World Production of Manganese Ore (in Tons).

	1898.	1899.	1900.	1901.	1902.
Great Britain	421	1,384	1,348	1,646	1,278
United States	51,295	44,352	65,368	131,127	154,992
Germany	50,062	68,661	60,737	61,448	49,812
France	44,164	52,186	37,384	22,304	12,536
Belgium	16,440	12,120	10,820	8,510	14,440
Austria	21,455	16,776	22,949	18,436	21,405
Italy..	3,002	4,356	8,484	2,181	2,477
Sweden	5,358	2,622	2,650	2,271	2,850
Spain	145,055	138,419	131,250	112,879	46,069
Portugal	907	2,049	2,200	1,000	1,235
Greece	15,214	17,600	16,050	14,166	14,960
Turkey	50,050	48,689	38,050	38,100	52,890
India	64,352	87,126	127,814	162,057	144,037
Japan	9,905	11,447	15,228	16,298	15,000
Brazil	27,441	74,238	108,244	155,710	163,000
Chile	29,837	40,930	25,715	31,477	20,000
Cuba	—	15,000	20,582	25,183	39,522
Columbia	11,176	10,160	8,610	700	1,000
Other countries	8,220	6,303	22,169	26,345	25,000
	554,354	654,418	728,652	781,838	782,413
Georgia	262,245	549,233	651,024	369,428	418,147
Ukraine	60,330	97,013	88,836	70,057	59,747
	876,929	1,300,664	1,468,512	1,221,323	1,260,307

TABLE XXII—*Continued.*

WORLD PRODUCTION OF MANGANESE ORE (IN TONS)—*Continued.*

	1903.	1904.	1905.	1906.	1907.
Great Britain	818	8,756	14,474	23,126	16,098
United States	107,279	100,000	100,000	170,621	189,267
Germany	47,994	52,085	51,463	52,485	74,683
France	11,580	10,000	11,254	11,180	18,200
Belgium	10,000	6,100	15,000	15,000	2,100
Austria	23,205	20,000	25,500	21,053	23,756
Italy..	1,930	2,836	5,384	3,060	3,654
Sweden	2,244	2,297	2,500	2,680	4,334
Spain	26,299	18,732	26,020	62,822	41,504
Portugal	1,000	1,851	—	24,000	26,492
Greece	9,340	10,000	6,800	10,040	11,140
Turkey	49,100	50,000	28,600	30,000	14,000
India	171,804	150,297	253,896	495,729	898,335
Japan	15,300	15,000	15,000	11,000	10,410
Brazil	163,319	208,260	233,950	201,500	236,778
Chile	20,000	5,000	5,000	—	—
Cuba	21,070	32,628	24,000	13,937	35,123
Columbia	—	10,000	10,000	—	—
Other countries	20,000	20,000	20,000	15,000	1,116
	702,282	723,842	848,841	1,163,293	1,606,990
Georgia	440,857	326,714	336,717	809,193	658,596
Ukraine	37,400	62,792	153,524	159,327	271,863
Total	1,180,539	1,113,348	1,339,082	2,131,813	2,537,449

TABLE XXII—*Continued.*

WORLD PRODUCTION OF MANGANESE ORE (IN TONS)—*Continued.*

	1908.	1909.	1910.	1911.	1912.
Great Britain	6,308	2,812	5,467	4,987	4,170
United States	156,242	100,000	150,000	170,000	198,000
Germany	67,241	76,741	80,325	87,297	92,474
France	15,800	9,375	7,925	8,000	10,000
Belgium	7,130	6,270	5,000	4,000	3,000
Austria	23,556	23,737	19,694	19,554	17,067
Italy	2,750	4,700	4,200	3,515	2,641
Sweden	4,616	5,212	5,752	5,377	5,100
Spain	16,945	14,500	8,607	33,266	29,761
Portugal	8,502	—	—	—	10,000
Greece	10,750	5,374	—	—	4,750
Turkey	14,349	7,700	12,200	3,207	850
India	674,315	642,675	800,907	673,762	423,464
Japan	4,348	6,660	5,496	5,000	8,632
Brazil	182,509	240,774	254,177	173,941	154,870
Chile	—	—	—	—	—
Cuba	1,492	2,976	—	—	—
Columbia	—	—	—	—	—
Other countries	1,400	610	1,000	15,000	20,000
	1,198,253	1,150,016	1,360,750	1,205,906	984,779
Georgia	112,177	558,806	545,241	461,854	569,758
Ukraine	184,117	65,341	173,195	233,057	237,978
	1,494,547	1,774,263	2,079,186	1,900,817	1,792,515

TABLE XXIII.

Comparative Table of Production of Manganese Ore by various Countries (in Percentages).

		Average of 10 years 1903–1912.		During the year 1912.
Great Britain ..		0·53		0·24
United States.. ..		8·35		11·04
Germany		3·95		5·16
France..		0·65		0·55
Belgium		0·42		0·17
Austria		1·25		0·95
Italy		0·20		0·15
Sweden		0·23		0·28
Spain		1·61		1·66
Portugal		0·42		0·56
Greece		0·39		0·26
Turkey		1·22		0·05
India		30·01		23·62
Japan		0·57		0·48
Brazil		11·98		8·64
Chile		0·18		—
Cuba		0·77		—
Columbia		0·12		—
Other countries ..		0·62		1·12
Georgia	27·49	36·63	31·79	45·07
Ukraine	9·14		13·28	

TABLE XXIV.

World Exports of Manganese Ore (in Tons).

From	1898.	1899.	1900.	1901.	1902.
France	12,229	12,289	8,392	5,647	1,948
Germany	4,809	7,332	2,721	5,583	4,528
Sweden	3,000	—	—	—	—
Austria	1,967	1,127	462	4,548	6,037
Italy	—	—	2,470	2,181	—
Spain & Portugal	1,139,664	140,816	130,716	91,672	68,500
Greece & Turkey	64,420	65,129	58,500	52,266	67,720
India	62,875	95,225	130,670	133,170	144,037
Japan	9,905	9,320	12,699	8,811	2,625
Chile	29,851	40,930	25,715	31,477	25,000
Brazil	27,441	74,238	93,127	105,710	157,295
Cuba	—	15,000	20,582	25,183	39,522
Columbia	11,176	10,160	700	700	12,038
Other countries	8,220	6,303	22,169	26,785	20,000
	375,457	477,869	508,923	493,733	549,250
Georgia	233,359	361,830	424,766	304,196	443,370
Ukraine	5,468	20,107	17,300	10,129	8,818
	614,284	959,806	950,989	808,058	1,001,438

TABLE XXIV—*Continued.*

WORLD EXPORTS OF MANGANESE ORE (IN TONS)—*Continued.*

From	1903.	1904.	1905.	1906.	1907.
France	5,000	5,000	5,000	3,635	5,166
Germany	11,138	5,536	4,116	2,510	3,490
Sweden	—	2,400	—	—	1,440
Austria	6,178	5,000	5,000	—	5,272
Italy	—	2,400	—	—	—
Spain & Portugal	54,540	18,732	38,417	86,676	67,998
Greece & Turkey	58,440	59,000	35,400	40,040	15,193
India	171,804	154,880	282,334	310,446	641,692
Japan	3,258	3,109	3,500	8,411	5,500
Chile	10,000	4,045	2,000	—	—
Brazil	161,926	208,260	224,337	201,500	271,375
Cuba	21,070	21,074	24,000	13,907	35,123
Columbia	—	10,000	10,000	—	—
Other countries	20,000	5,000	5,000	15,000	15,882
	523,354	504,436	639,104	682,215	1,068,131
Georgia	434,448	460,394	301,613	431,123	377,769
Ukraine	12,760	17,170	8,042	68,070	87,949
	970,562	982,000	948,759	1,181,408	1,633,849

TABLE XXIV—*Continued.*

WORLD EXPORTS OF MANGANESE ORE (IN TONS)—*Continued.*

From	1908.	1909.	1910.	1911.	1912.
France	940	1,149	722	900	2,270
Germany	2,332	4,487	4,276	9,615	7,117
Sweden	—	—	229	929	3,980
Austria	—	787	285	588	534
Italy	—	—	—	155	2,400
Spain & Portugal	25,447	14,737	6,321	33,266	38,534
Greece & Turkey	7,600	7,700	12,200	3,207	5,600
India	507,633	467,274	587,327	553,628	621,826
Japan	4,348	6,660	5,496	5,000	8,682
Chile	—	—	—	—	—
Brazil	182,508	240,774	254,177	173,941	154,870
Cuba	—	—	—	—	—
Columbia	—	—	—	—	—
Other countries	10,000	—	1,000	15,000	25,000
	740,808	743,568	872,033	796,229	870,763
Georgia	388,463	539,184	609,348	581,149	883,655
Ukraine	50,192	62,413	69,472	48,190	76,520
	1,179,463	1,345,165	1,550,853	1,425,568	1,830,938

8. Association of Georgian Manganese Producers.

Eighty per cent. of the mines in the Tchiaturi district are owned by a large number of Georgians who, in the beginning of the industry, began to exploit them without having sufficient knowledge of rational mining and without regard to any loss of the apparently inexhaustible ore. As each owner worked for himself difficulties soon arose, specially with regard to the transport of the ore in the narrow and steep valleys, and some kind of organization became necessary.

The Association of Manganese Producers and Dealers was therefore formed, under the guidance of the Government, and comprising all the producers extracting at least 1,600 tons of ore, and all dealers exporting a minimum of 5,000 tons per year. It elected a Council which convoked meetings of the members from time to time, as required, at Kutais. The task of the Council is to organize and supervise the following matter:

1. The transport facilities by road or mechanical means.
2. The hospital and ambulance provided for the workmen.
3. The Insurance of the workmen against accidents.
4. The installation of electric light in the mines and neighbouring villages.
5. The installation of the telephone between Tchiaturi and Kutais, Poti and Batum.

Several schools and the water supply in some villages were later added to this list.

To defray the expenses of these services the Council had been authorized by the Government to levy a tax of 1s. per ton on all ore sent from Tchiaturi by rail. This tax was in 1913 increased to a maximum allowed of 2s. 8d. per ton, but the Association decided to collect only 1s. 8d. per ton from January 1, 1914.

The voting conditions at the Annual Meetings, at which the Managing Council had to be elected, were formerly such as to give the small producers and dealers an overwhelming majority, and they used it to elect Councils in sympathy with their views and willing to spend the proceeds of the tax for the purpose of assisting them to compete with the large producers. As some of the latter had installed mechanical means for transporting their ore from the mines to the railway, the smaller men wanted to have similar facilities provided for themselves at the expense of the whole Association. A demand was thus voted in 1910 that the Council should spend one million roubles for this purpose, and also for housing workmen, etc. The necessary authorization was obtained from the Government to construct, in the first instance, an aerial railway to Metchkevi, one of the more remote mines, but its execution met with such difficulties concerning rights of way, etc., and became finally so expensive, that the transport of ore by its means cost more than by the old bullock carts. As this experiment had given such unsatisfactory results, it was then thought advisable that the Government should, in future, give these additional facilities.

In 1913 the Association was also granted the right to contract loans, and new rules were established concerning the voting power of the different categories of members. Although the small producers were doomed to disappear in the course of time, as larger capital is wanted for deep mining and the preparation of the inferior ores, they are still numerous, and to counterbalance their number additional votes were given according to the output and export of the members, for the possession of a washing plant, etc., so that a large producer can now have a maximum of seven votes, and smaller ones proportionately less. In this manner the principal firms expect to be in a better position to get their own proposals voted at the meetings, and to avoid useless expenditure.

The Association did not hold its Annual Meeting in 1914, but it levied the tax of 1s. 8d. per ton agreed upon the previous year. Of this amount 4d. per ton was returned to those exporters who had concluded forward Contracts for 1914 before the increased tax came into force, but this was only done during the first four months of the year.

The number of the Members of the Association is 450, of whom 420 are Georgians and 30 foreigners. The President of the Council is Mr. G. Jouruli, the Vice-President S. Tseretheli, the Secretary J. Bakradze. The Association has also as representative in London Mr. W. Tcherkesichvili.

The activities of the Council extend in many directions. It has constructed 23 macadamized roads of a total length of 35 miles, and also 5 bridges ; it installed water-works supplying 11 million gallons of water, and a large public bath for the workmen, an electric station with 36,500 kilowatt-hours, a hospital attending to 6,137 out-patients during the year. It also keeps three schools for an average of 500 pupils, and spends Rbl. 22,000 per year for scholarships. A theatre for workmen entertains some 10,000 visitors p.a.

The outbreak of the war and consequent absence of income stopped the further activities of the Council, and expenditure was cut down to the unavoidable public services. But, as the above enumeration shows, the Association has done very useful work for the manganese industry.

9. Participation of Foreign Capital.

The Georgian manganese industry was principally financed by the foreign importers of ore, in the beginning specially British, German and French. The mine owners, being mostly small peasants, did not possess the necessary capital for paying the labour, railway and shipping expenses, and advances had, therefore, to be made to them. This was done by transferring money to Caucasian Banks, or to agents at Batum, Poti or Tiflis, who had to pay for the ore as it was produced and also the charges. Some 80 or 90 per cent. of the estimated value of the shipments was thus paid before their real weight and tenour could be ascertained.

This system gave rise to many disappointments and losses, chiefly because in many cases Greek intermediaries stood between the producer and the foreign exporter, and did not fulfil their contracts when prices went against them. In order to exert a closer control many importers, therefore, opened their own branch offices in the Caucasus. From this position there was only one step to the actual purchase of mines and manganese-bearing lands, and in fact extensive areas of unworked manganese lands were bought, specially in 1910 and 1911, by various foreign firms, mostly Germans. An American syndicate also took options on many such properties, but after examination by its engineers gave them up again because they found them insufficient for the large scheme they had in view, and because the best lands were not for sale.

The chief companies operating in Tchiaturi before the war were the Schalker Gruben & Huettenverein of Gelsenkirchen, which consumes its own ore, Forwood Brothers (English), Panassie (French), and the Société Industrielle et Commerciale of Antwerp. The last-named firm has a plant producing 100,000 tons of high-grade washed ore per year.

The small and independent producers sell their ore, as before, to brokers who stock it at the railway platforms and sell it to the smaller consumers.

When the war broke out the Russian Government sequestrated the properties belong to the two German companies and tried to sell them by auction. Many banking interests were anxious to secure them, and were supported by the notorious Rasputin; but the attempt was frustrated by the interference of the Georgian nobility and the Association of Producers, who demanded that the properties should be sold to them as being on their national territory. The matter dragged on until the Revolution, when the properties were finally secured by wealthy Georgian petroleum magnates.

The following Table gives some details on the number of export firms and their relative importance.

TABLE XXV.

NUMBER OF EXPORT FIRMS.

Column A.—Established in Tchiatur.
Column B.—Established in Poti and Batum.
Column C.—Number of large firms of Poti and Batum exporting more than 16,000 tons per year.
Column D.—Percentage of the shipments of the large firms compared with the total exports.

	A.	B.	C.	D.
				Per cent.
1900 ..	25	21	11	88
1901 ..	21	17	8	88
1902 ..	21	25	9	79
1903 ..	20	25	9	79
1904 ..	21	27	9	79
1905 ..	20	23	7	77
1906	28	28	13	90
1907 ..	29	25	9	81
1908 ..	28	18	4	83
1909 ..	39	21	7	85
1910 ..	35	20	9	90
1911 ..	33	17	11	83
1912 ..	22	17	11	97

CUSTOM-HOUSE IN BATUM (GEORGIA).

10. Outlook for the Production of Ferro-Manganese in Georgia.

More than 90 per cent. of all the manganese ores produced in the world are used in the metallurgy of iron and steel, where manganese is looked upon as the trusted remedy for improving the products of inferior iron ores.

About half of the manganese ore consumed in this industry is fed directly into the furnace, while the other half is used in the metallic state as an alloy, principally with iron and some other elements.

Such iron alloys containing up to 25 per cent. of manganese are called Spiegeleisen, and those with more than 25 per cent. are called Ferro-manganese. The latter is now generally marketed with a tenour of about 80 per cent. of manganese and is made by various processes, mostly in the blast furnace. It is added to the steel at the conclusion of the process just before casting. Its effects are :

1. The reduction of the small quantity of iron oxide remaining in the molten metal.
2. The addition of the manganese needed in the finished steel, usually about 0·5 per cent.
3. It minimizes the formation of blow-holes, neutralizes the sulphur contents and produces a fluid slag.

Somewhat similar effects are produced by the addition of silico-manganese which contains from 25-30 per cent. of manganese and 75-70 per cent. of silicium, and also acts as a disoxydizer. Silico-spiegel contains iron in addition.

The usual quantity of ferro-manganese added to ordinary steel is from 17 to 20 lb. per ton of steel produced, or a correspondingly higher percentage of spiegeleisen, according to its tenour in manganese.

For manganese-steel castings 312 lb. of ferro-manganese of 80 per cent. tenour are wanted to each ton of steel. The product then contains $12\frac{1}{2}$ per cent. of manganese and has extraordinary properties of hardness and tensile strength.

These alloys are being manufactured specially in the United Kingdom and in Germany in the blast furnace, while France makes them in the electric furnace, using the water-power of the Alps. In America the U.S. Steel Corporation was the only regular producer until 1915, when in consequence of the diminution of the imports 5 or 6 other companies started the manufacture, two of them by electric furnaces, the others in the older manner.

Before the war the United States imported more than half of their consumption. Their imports for the last few years and the highest and lowest prices of ferro-manganese delivered at the Eastern ports were as follows :

	Ferro-Manganese.	Spiegeleisen.	Prices per ton.
	Tons.	Tons.	Doll.
1912	125,373	119,506	41–65
1913	119,495	126,081	65–45
1914	106,083	100,365	36–100
1915	146,542	93,282	68–110
1916	208,389	197,518	—

In February 1917 the price of ferro-manganese in the U.S.A. was from Doll. 164 to 175, and that of Spiegel from Doll. 60 to 65. In April and May 1917 the ferro-manganese rose to Doll. 325 and even Doll. 450, while in February 1918 it stood again at Doll. 250.

In the United Kingdom the official price was fixed at £25 per ton in 1916–17 for home consumption, and at £35 to £45 for export.

The high prices and increasing demand for ferro-manganese have for many years attracted the attention of the Georgian manganese producers and others interested in the business and inpressed upon them the desirability of manufacturing these products near the mines. The advantages of such a course were evident, as it would save half the freight and give higher profits than the mining business.

A French group of financiers studied the matter first, but as they intended to work by the blast furnace, they found themselves arrested by the difficulty of finding the necessary furnace coke in the neighbourhood of the mines. The coal of the Kvibuli collieries, situated at a distance of about 40 miles, gives a very friable coke which easily falls into powder and is therefore quite unsuitable for blast furnace practice. For this reason the matter was dropped.

In 1902 another project was brought forward by Mr. Gustave Gin, engineer, of Paris. He proposed to use the electric furnace instead of the blast furnace, and by this means eliminated the principal obstacle for which the former project had failed. The fact is that in the electric furnace most of the heat is supplied by the current, so that the coke is only necessary for the reduction of the ores. This reduces the requirements in coke to less than a quarter of the quantity necessary in the blast furnace, which latter amounts to about three tons of coke per ton of ferro-manganese. Also, in the absence of any blast in the electric furnace the pulverulent nature of the Kvibuli coke is without consequence.

The advantages of this plan were, therefore, according to Mr. Gin, to place his factory in the immediate neighbourhood of the mines and to use the force of the Kvirila River for the generation of the necessary current. Exact calculations of the available power were not made at the time, but the necessary 15,000 h.p. can at all seasons be obtained from the river and its tributaries as they drain a large mountainous area, having a high rainfall and considerable snow in winter.

Mr. Gin proposed to use his own patented method for the reduction of the ore, which consists in smelting it with sea salt and iron pyrites, and the necessary coke and coal. The salt and the sulphur of the pyrites form together sodium sulphide, which dissolves the manganese ore at a comparatively low temperature, and the metal in the solution is then reduced in the presence of the carbon.

The gaseous products of the reaction are sulphurous acid, which is oxidized to sulphuric acid in the usual manner and as such used again for converting the caustic soda produced into sodium sulphide ready for the next operation. As there is, however, a small loss of sulphur, some iron pyrites are added to replace it. Hydrochloric acid is also produced by the decomposition of the sea salt.

Therefore, the production of 1 ton of ferro-manganese of 80–83 per cent. tenour in manganese requires :

2,000	kilos	manganese ore 50 per cent.
450	„	sea salt.
60	„	iron pyrites.
700	„	coke, maximum.
500	„	coal for heating.

The products will then be :

1,000 kilos ferro-manganese.
100 ,, silicospiegel.
225 ,, caustic soda.
500 ,, hydrochloric acid 22° B.

The electric current required for obtaining these products would be 5,440 kilowatt-hours.

Mr. Gin's project, of which the above is a bare outline, then went fully into all the details of an installation producing 10,000 tons of ferro-manganese per year, including the hydraulic power-plant, electric installation, buildings, land, etc., which is estimated at a total cost of £155,000. The ton of ferro-manganese was calculated to cost £5 8s., while the usual cost of production in the blast furnace is between £7 and £8. Including the value of the by-products the yearly profit on a production of 10,000 tons was thus calculated at £80,000, while the enterprise would require a total capital of £280,000.

Although this project was not executed, it is clear that sooner or later the manufacture of the metal will be undertaken in the vicinity of the ore deposits, as the necessary power exists on the spot, and the question of fuel can, no doubt, also be satisfactorily organized. In fact, the Government itself is reported to have also considered the question in 1910, but it is to be hoped that private initiative will take the matter in hand.

Whether the process of Mr. Gin be adopted, as outlined above, or the electric furnaces of Heroult, Girod or others, as used in the Alps, the profits are always considerable and the works prosperous. The establishments using the blast furnace are also in a favourable position. For producing 1 ton of ferro-manganese they use about 1·9 ton of ore, 2·5 tons of coke, and 1 ton of limestone, and the smelting charges do not usually exceed £2.

It is also to be considered that much of the inferior ore which it does not pay to export can be used by a smelter in the vicinity, thus avoiding great loss and the difficulties caused by the washing plants established on the Kvirila.

Finally, ferro-manganese made in Russia is at present protected by an import duty of £5 10s. per ton.

11. Prospects of the Manganese Industry.

In the foregoing pages we have tried to present as concise a picture as possible of the Georgian Manganese Industry, vastly supported with statistical material for reference purpose. We have demonstrated not only the utter inability of the old Russian Government to foster this vital industry, but also the methodical suppression on her part of every effort made by the Georgians to improve the condition of the trade.

But in spite of all these difficulties the Georgian owners have succeeded in many ways. Sixty per cent. of all the exploited mines were in their hands at the outbreak of the war, while powerful German and other foreign concerns owned 40 per cent. The Georgian National Bank of Tiflis had opened a Branch in Tchiaturi for facilitating transactions on the spot ; also, at the end of 1917, the Georgian miners had accumulated at Tchiaturi and at the ports of Poti and Batum stocks of ore amounting to more than the average quantity exported in normal years, viz., about 1,100,000 tons at the mines and 80,000 tons at the ports.

Concerning the future of this important industry we can to-day only give vague indications. There are many factors upon which its future depends. First and foremost among them is the future political position of Georgia, which at present is an Independent State as her neighbours Armenia and Aderbeijan, and whose independence will shortly be recognized by the Peace Conference.

The manganese industry will be a very important source of revenue to the State of Georgia, and it is quite obvious that without the powerful assistance of foreign capital these vast deposits cannot be brought to the state of efficiency which will secure for them a predominant place compared with their Indian and Brazilian competitors. It may be that the State of Georgia will endeavour to obtain substantial loans for the future development of this business. In connection with the important untouched deposits of iron ore in the Caucasus a large ferro-manganese trade could be built up, and it is therefore necessary that the Allies should maintain a keen interest in this key industry, which would provide ample material for the ship-building and steel industries all along the shores of the Black Sea.

In the beginning of 1915 the German papers mentioned the discovery of a substitute for manganese which would enable them to forgo the importation of that ore. No details were given, and it is impossible at present to ascertain the exact value of such a substitute for the industry, and its relative cost; but even if it should prove of real utility, it would only interfere with the export of the Georgian manganese ore and could not prevent the development of the steel industry on the spot.

All the mineral deposits on the Georgian territory are the property of the State, and a special Mining Board with seat at Tiflis is directing the affairs connected with the mines. The State ownership is much more convenient for working the mines, by giving concessions to private companies and individuals, than would be the case if the mineral-bearing land were freehold, as in that case questions of titles would lead to numerous litigations in the Courts and many other difficulties.

The development of the huge mining resources of Georgia, as of the mining everywhere, would require the participation of foreign capital, which will have a very profitable field for its employment.

Since 1801 when Russia forcibly annexed the kingdom of Georgia, in violation of the Treaty of 1783, right up to 1917, when Georgia regained again her independence, Russia has done nothing at all to develop the mineral wealth of the country; what is more, she prevented the foreign capital from entering this field, and the Caucasian Mining Board, which under the old Russian Government was supposed to look after the mining developments in this vast area, had an annual budget of not more than £2000. In addition to hundreds of other reasons as to why Russia has forfeited all her "claims" to Georgia, this gross neglect of the development of the mineral resources of Georgia stands against her as most damning evidence.

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