

MINERAL RESOURCES OF CHINA.

PART II.

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III. TSIN-LING REGION.

The Tsin-ling region is so named from the mountain range which, stretching eastward from the Kuen-lung of central Asia, divides North China from South China between the parallels of 33 and 34 degrees, as far east as longitude 113. On the north the range is sharply bounded by great normal faults. On the south the basins and canyons through which the Han-kiang takes its course set a certain topographic limit, but they do not define the area of special geologic conditions which extends somewhat further south.¹

The dominant geologic characteristic of the Province is metamorphism of all the rocks older than the Jurassic. There are very ancient schists which were metamorphosed before the beginning of the Paleozoic, but the Paleozoic limestones and shales themselves exhibit more or less general slatiness, schistosity, and rearrangement produced during a post-Paleozoic disturbance, and also local metamorphism in the vicinity of large granite masses intruded about the same time. These comparatively young granites are not readily distinguished from those which were intruded into pre-Paleozoic schists, and as both occur in very large masses we are unable as yet to describe the structure of the range satisfactorily.

Von Richthofen,² Loczy,³ Obrutchoff,⁴ and Willis and Blackwelder⁵ have described sections across the Tsin-ling range. Von

¹ See Geology of Central Shen-si, Chap. XIV., pp. 299-317, in Vol. I., "Research in China," by B. Willis and E. Blackwelder, Carnegie Inst. of Washington, Publ. 54, and maps by R. H. Sargent accompanying.

² "China," Vol. II., pp. 557 to 658.

³ "Reise des Grafen Szechenyi in Ostasien," p. 407 to 471, 1893.

⁴ "Central Asia, Northern China, and the Nan-shan," by W. Obrutchoff, Vol. II., pp. 245 et seq. (in Russian).

⁵ *Op. cit.*

Richthofen notes an occurrence of graphitic anthracite. The writer saw very irregular badly squeezed pyritiferous beds of the same material which were being worked on the Han, and a third occurrence is mentioned by Leprince Ringuet.¹ But in no instance are the deposits of anything more than local value.

Metalliferous deposits in the Tsin-ling region have not been described, but are supposed to exist. The geologic conditions are favorable to the supposition, as calcareous and carbonaceous rocks have been extensively intruded by granites, conditions which in other parts of the world have given rise to valuable ore bodies, and the field may be regarded as one which may repay prospecting.

Placer deposits in the Tsin-ling-shan and adjacent mountainous regions on the south are very limited, so far as recent gravels are concerned. The present surface is characterized by the corrosion of deep canyons, and gravels accumulate only locally and temporarily. There are older gravels, which correspond with higher channels formerly occupied by the streams and which rest on cut terraces at various elevations above the bottom of a canyon. Such a terrace, 40 feet high, occurs at Ping-li-hiën, in southeastern Shen-si, where there is an abandoned channel of a large stream;² others³ were noted in the northern Tsin-ling-shan up to more than 2,000 feet above the Hei-shui-ho. It is not known that any of these gravels are auriferous, but they probably may be.

IV. RED BASIN OF SSI-CH'UAN.

The Red Basin of Ssi-ch'uan, so named by von Richthofen on account of the red color of the prevailing rocks, is a remarkable depression, roughly estimated at something over 100 miles in diameter, surrounded by high mountains. It lies in western China, west of the 8,000- to 12,000-foot heights of eastern Ssi-ch'uan and east of the 20,000- to 25,000-foot peaks of nearby Tibet, but the elevation of the basin lies between 1,500 and 3,000 feet only above sea. The surface is deeply cut by many streams

¹ *Annales des Mines*, memoirs, 9th ser., Vol. 19, p. 400.

² "Research in China," by B. Willis and E. Blackwelder, Vol. I., p. 330.

³ *Ibid.*, Atlas, geologic map sheet a².

which are generally navigable, though in some cases only for shallow boats capable of running rapids.

The rocks of the surrounding highlands are pre-Paleozoic and Paleozoic chiefly, with minor areas of younger strata (early Mesozoic) and great bodies of intrusives, but the deposits in the basin are very late Paleozoic and early Mesozoic (Permian, Triassic, and Jurassic) strata, which are but slightly disturbed and only locally intruded by igneous masses. In general these sediments constitute red shales and red sandstones.

Coal, petroleum, natural gas, and salt are the chief mineral products of the Red Basin.

Coal.—Von Richthofen gives the following description of the occurrence of the coal deposits in the early Mesozoic strata:¹

“The coal measures as a rule dip from the enclosing mountains toward the middle of the basin where they are covered with very thick sandy and clayey strata. The coal beds are restricted to the lower part of this formation and outcrop along the margins of the basin where they are worked at many places. Furthermore, the basin is traversed in its southeastern portion by folds which trend from southwest to northeast, in which the lower members of the coal-bearing strata occur. Along most of these folds coal mines are opened on both sides, especially where rivers cross the deposits, and, exposing the inner structure, make the coal readily accessible. In the west and north of the basin the coal is bituminous and of a better quality. Toward the south and east on the contrary it is inferior. . . . Coal which is so widely distributed is a great blessing for the people of the province of Ssi-ch’uan, especially as nearly all the rivers are navigable from their junction with the Yang-tzī to the boundary of the coal-bearing basin, and it is therefore possible to supply with cheap fuel all portions of the Yang-tzī region, which is at the same time the most densely populated district of Ssi-ch’uan. Nevertheless this advantage will remain restricted to the province itself, since there can never be an exportation of coal to the region of the lower Yang-tzī, as the product will not be able to compete successfully with the better coals of the province of Hu-nan. The low price

¹ “Die Kohlenfelder Chinas,” *op. cit.*, p. 177.

of fuel will, however, be greatly to the advantage of steamers, which doubtless sooner or later will run on the upper Yang-tzī and its great tributary the Min-kiang and which can be supplied with fuel directly from the mines on the banks of the rivers."

Accounts of local occurrences may be found in the books cited below, but there are no reports on which to form an estimate of the amount of coal or conditions of mining.¹

Gas and Salt Wells.—There is no more interesting illustration of Chinese ingenuity and patience than the drilling of deep wells with rope and a heavy tool by man power. A detailed account of the tools, methods, conditions, accidents, localities, and products, with many illustrations, is given by M. Louis Coldre, a Jesuit father, from observations during a prolonged residence in Ssi-ch'uan, and the following notes are condensed from his article.²

After locating a mountain range which bounds the Red Basin on the southeast and which runs from Wu-shan-hiēn on the Yang-tzī nearly parallel with the higher course of the river, Monsieur Coldre describes the distribution of salt wells as follows:

"Nearly all of the salt wells occur in the central portion of the province bounded on the south by the above described mountain chain, on the west by the river of Kia-ting (Min), and on the north by the first steep slopes of the mountains. The vast extent of this salt-producing region might lead one to think that there was an immense sheet of brine beneath the whole province, but in reality it is in the neighborhood of the final ramifications of the mountain chain that the principal salt-bearing regions occur. Of those which occur in the west, however, that of the district of 'Lo-chan' and 'Kien-ouy,' which is rich in salt wells but has no gas wells, offers no special peculiarity to

¹ "Description of Coal Field at Shui-kia-ho near Kuang-yuan-hiēn, northern Ssi-ch'uan," by L. von Loczy, in *Reise des Grafen Szechenyi in Ostasien*, Vol. I., p. 439. "Five Months in the Upper Yang-tse," Blakiston. "Through the Yang-Tsi Gorges," A. J. Little, 1888. "Three Years in Western China," A. Hosie, 1890, and in general in works on western China, see "Bibliotheca Sinica," by Henri Cordier, 2d edition, 1904.

² "Les salines et les puits de feu de la province du Se-tchoan," *Annales des Mines*, 8^e série Mémoires, Vol. 19, 1891, pp. 441-528.

distinguish it from the three other great groups of salt wells, 'Chee-hong,' 'Lan-pou,' 'Ta-lin' or from the general central region; whereas the district of the fire-wells, 'Fou-choen,' situated on the east of the chain, differs even in the aspect of its surface greatly from the country round about. The exploitations confirm this appearance, for the well-drillers encountered quite a different arrangement of strata from that which we have described for the central region."

Having given many details regarding the distribution of the groups of salt wells, with the names of districts and cities, the writer goes on to say:

"The total number of salt wells of which we have traced the distribution will approximate 10,000. Their output is extremely irregular and unequal. One of the wells of 'Tse-liou-tsin' (in the southwestern part of the basin) yields daily 350 large charges of highly saturated brine. Others, for example in the district of 'Pong-ky,' do not yield more than a single small charge daily of less saturated water. Between these two extremes there are all possible variations of production, and one would therefore form a very inaccurate idea of the richness of a salt-producing district by counting the number of wells."

As a type of wells in general, M. Coldre selects the group which he calls that of Les Grandes Salines, which is situated in the southwestern part of the basin, thirty miles north of the city of Sui-fu, between the Min-ho and the To-kiang. The market town adjacent to the salt field he names "Ta-chan-pou."

"After having traversed the long narrow streets of Ta-chan-pou, which are crooked and dirty as all Chinese streets are, one is greatly surprised on passing the last house to find ones self in a country of an entirely different aspect. The nature of the soil is changed. It is a mixture of yellow, friable sand, pebbly clay, and lime. There is scarcely any cultivation to be seen and one advances 7 or 8 li (2 or 3 miles) across a country where the vegetation is dwarfed, the rice seems to grow sorrowfully, and trees and bamboos are scarce. At last all cultivation disappears in the vicinity of the first wells. All of a sudden on rounding a hill one enters a little vale rich in salt springs, with a

forest of peculiar character, immense trees, trunks without branches and without leaves, many moving cords; these are the derricks and their accessories, the hoisting ropes which are joined to capstans, and the stays which are stretched in all directions. All this rises above the roofs of roughly built houses and from beneath the slopes of sheds built in all directions. To the grinding of pulleys and capstans in operation there is joined a human chant which resounds with the rhythm marking action. It is the song of the well-drillers springing upon their benches or that of the men attached to a capstan in place of buffaloes. Furthermore, one hears a deep, continuous and solemn reverberation. It is the voice of the earth, the sound of the gas of the fire-springs. . . . The general aspect of this country of the fire-wells is typical. It characterizes great activity in a primitive industry which draws from the earth its subterranean riches, at the cost of any risk, by manual force and patience. Not a bit of nicety, not a bit of taste, nor any progress. In the matter of construction, tools, machines, and methods, the sons of Tubal-Cain, the first ironworker, should have known at least as much, perhaps more. The marvel is that the Chinese succeed, thanks to their inexhaustible patience which counts on a result to-morrow if not to-day, or next year if it can not be reached this year."

It is not probable that any great reliance can be placed upon the geological deductions drawn from the descriptions of the strata passed through by the wells. It is said that in this particular southwestern district the stratification is very irregular and the strata disturbed so that there is great difference in the depth of wells at short distances from one another, and unsuccessful wells occur in the vicinity of very productive ones. In general the more saturated springs occur immediately above the supposed Carboniferous horizons and not in the upper part of the Trias as elsewhere. On the other hand "bituminous" accumulations occur frequently in connection with clay layers and some bodies of natural gas escape well above the Carboniferous, above even the least trace of coal, whereas others, and these the strongest ones, come from the deeper beds, in the transition horizons. Some wells yield only salt water or petroleum or gas; others

yield salt water and petroleum or salt water and gas at the same time. The Chinese distinguish and name the rocks only according to their color. Besides the yellow or gray Tertiary sandstone of the surface, of which the thickness varies from 38 to 100 meters, one finds successively red sandstone, gray limestone, and ferruginous oölite. Below the latter, at a depth of about 200 meters, bituminous accumulations are frequently encountered, it is said; beneath the oölite follow white and yellow sandstones of the Lias; then at a depth of 270 meters frequently occur abundant jets of gas. Still deeper occur bluish-gray marls and a white limestone (Permian). In these beds at a depth of 330 to 600 meters there occur yellowish brines of a moderate saturation. Then follow coal, limestone or sandstone of the coal measures, a brilliant brown rock assigned to the Silurian, and black and green shales. Beneath these last beds, at a depth of 930 to 1,100 meters, occur the bodies of black brine, the most saturated, and the most abundant and also the most important jets of gas. Most of the wells of the group of "Tse-liou-tsin" reach these depths and curiously enough they scarcely ever traverse the horizon of the yellow brine which supplies all the wells of "Kong-tsin." Dikes of gray granite, black basalt, and red porphyry frequently traverse the higher horizons and greatly retard the work of drilling.

The wells are drilled with a tool and rope which are attached to the short end of an unequally balanced see-saw. On either side of the longer end of the board is placed a bench. When at rest the weight of the tool raises the long end of the board which is depressed by men who jump from the benches upon the board, thus raising the tool, and leap off again simultaneously, thus allowing the tool to drop. The stroke is about two feet. With shallow wells it suffices to have two men working at once, but as the well is deepened and the weight of the tool and rope increases, as many as ten men are required. The rhythmic action necessary to maintain this operation is obtained by means of a chant which the workmen sing in unison. It is stated that by having two sets of men who jump alternately as many as twelve to fifteen strokes a minutes are secured. According to the nature of the rock the

drilling may advance as much as several feet in a day or in hard rock scarcely an inch.

In regard to the character of the product we are perhaps most interested in that of petroleum. There are oils of four colors. The purest is white, like thin milk, and is sufficiently pure to give a clear light. Another of greenish-white is less valuable; then there is a yellow and a black oil; the latter is viscous, gives very little light and much smoke. The Chinese do not know how to refine these oils, and use them in the crude state in special lamps which are very tightly closed except for the passage of the wick, for the volatile hydrocarbons not having been distilled are very inflammable. The number of petroleum wells exploited is probably about 30 or 40 in the Grandes Salines, and perhaps 50 in the whole province.

The brines from salt wells are concentrated by evaporation and for this purpose, wood, coal, and natural gas are burned. The product of salt from the group of wells at the Grandes Salines was estimated by M. Coldre at approximately 250,000 metric tons per year, which, according to the same authority, was about half as much as the total production of France and two-fifths of that of all the provinces of Ssi-ch'uan.

V. SOUTH CHINA.

The region here designated South China comprises that hilly and mountainous country which extends in an arc from Shanghai on the northeast, parallel to the coast of Ton-kin and the extreme southwestern portion of the empire. It takes in the provinces of Fu-kién, Kuang-tung, Kuang-si, and Yü-nan, together with the southern parts of Kiang-si, Hu-nan and Kui-chóu. It is a country of marked relief but not of great altitude except in the western portion. In the east the valleys are relatively wide, and the hills or mountain ridges separated. In the west the rivers flow in deep and often precipitous canyons and the character is that of a deeply but not widely dissected plateau.

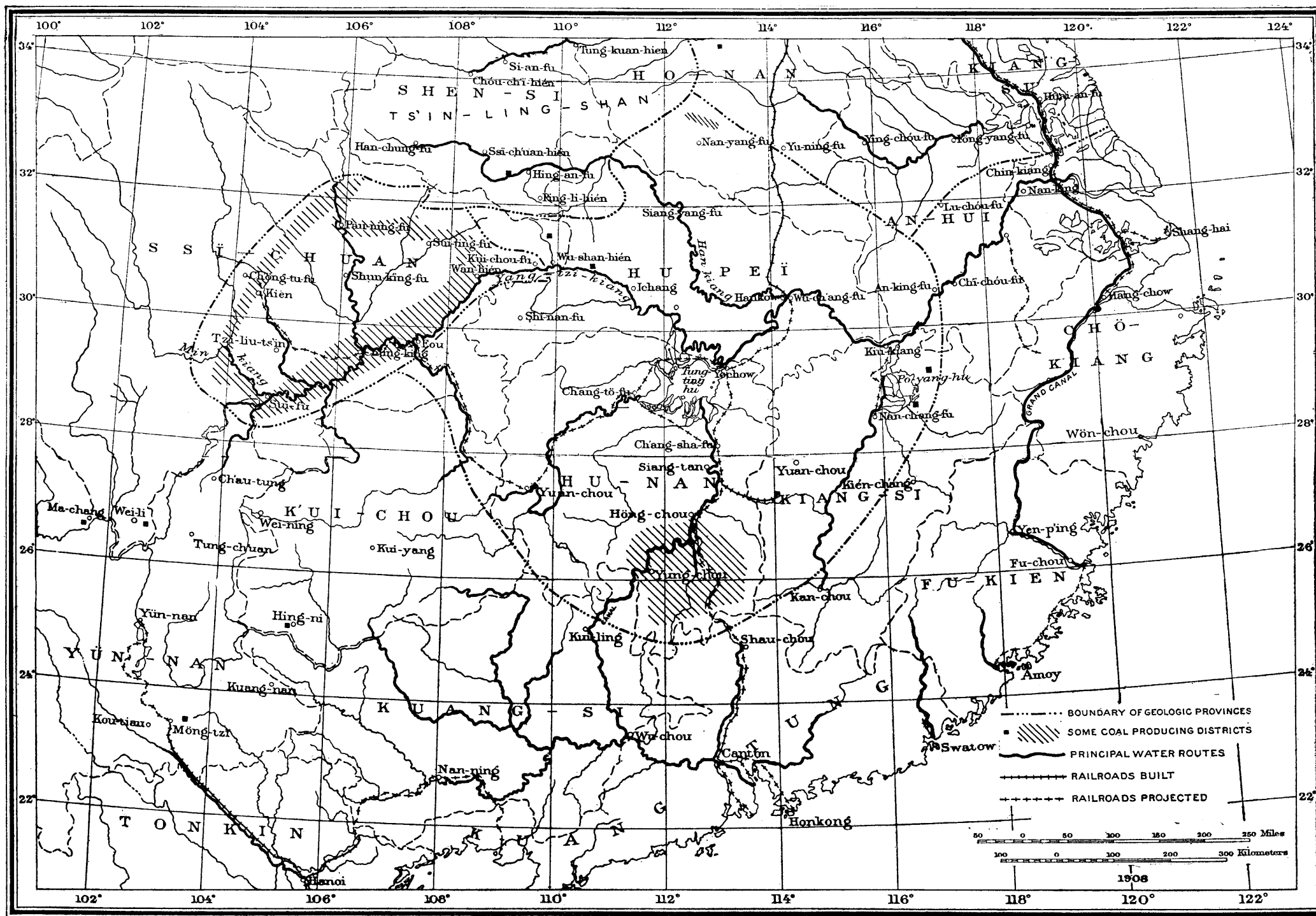
Throughout this entire region the dominant geologic characteristic is due to the presence of large bodies of intrusive rock (granite, quartz-porphyry, etc.), together with some volcanic

rocks which were erupted during the Carboniferous and which accordingly intruded and metamorphosed the earlier Carboniferous and older Paleozoic strata. Throughout the region there occur the ores of tin, copper, and other metals, which are probably intimately associated in genesis with the eruptive rocks, and there are also some ores of iron and numerous more or less extensive coal fields.

The region has been explored chiefly by French engineers who have penetrated from Ton-kin. The journey of Monsieur A. Leclère, who spent nineteen months in the southwest in 1897-1899, has yielded the most detailed information and reliable data available. M. Leclère's observations are published in numerous papers to various French societies, but the essential facts are comprised in the *Annales des Mines*,¹ from which the following notes are taken.

M. Leclère recognizes a number of distinct rock systems. Among these the oldest (terrains cristallophylliens) consists of various gneisses and associated intrusives. It is recognized as the basement of the sedimentary rocks in the higher regions of Ton-kin, but apparently there may be included with it in the descriptions, strata belonging to the Paleozoic which have been metamorphosed in the neighborhood of batholithic masses. There are certain limestones and quartzites apparently of great antiquity which were assigned by Loczy, and by Leclère after him, to the early Paleozoic (Sinian), but which may with equal probability be considered pre-Cambrian. Succeeding these metamorphic and in part old rocks come those which are relatively younger and are identified by fossils. The Devonian is apparently at the base and is succeeded conformably by strata of Carboniferous, Permian, Triassic, and early Jurassic ages. The Devonian and Carboniferous are generally calcareous, the passage from the strata of one period to those of another being characterized by an argillaceous or sandy limestone, above which come in sandy and argillaceous beds which include deposits of coal, that are often very regular but frequently high in ash. In this connection M. Leclère says:

¹"Étude Géologique et Minière des provinces Chinoises voisines du Ton-kin," *Annales des Mines*, 9 serie, Memoires, Vol. 20, 1901.



MAP OF CENTRAL AND SOUTH CHINA

"The early portion of the Carboniferous period was characterized by eruptive phenomena of remarkable importance and extent. An immense sheet of ancient lava which forms everywhere a portion of the southern border of the crystalline massif of Ssi-ch'uan extends to the vicinity of Yün-nan-sen and over the northern portion of Kui-chóu." The rock is described by Messieurs Michel Levy and Lacroix as labradorite melaphyre.

The upper Carboniferous consists of a very uniform limestone which succeeds the coal-bearing strata, constitutes the most constant geological horizon of all the region, and carries numerous characteristic fossils. The formation of limestone continued during the Permian, as is shown by the presence of fossils of that age in the higher calcareous strata. In Yün-nan and Kui-chóu the Permian limestone is followed by upper Permian beds which are salt-bearing and gypsiferous, but these strata are not found further to the southeast and in Ton-kin the lower Trias and Rhetic rest directly upon the Carboniferous limestone. Where present the uppermost Permian is composed of thick and regular beds of compact green and black shale traversed by little veins of gypsum. Where altered the rock takes on a peculiar characteristic wine color. Succeeding this shale occur thin-bedded limestones which vary in color through yellow, red, and green and which also are salt-bearing and gypsiferous. The highest Permian formation consists of a characteristic red sandstone, often in thick beds. The Triassic is represented by an important limestone. A lower less conspicuous part consists of bluish shale, but the limestone frequently forms the crests of the peaks in the regions of marked relief. The upper Triassic or Rhetic consists of iridescent marls which vary in color from rose through blue to black, and they are succeeded by lower Jurassic beds of yellow dolomitic limestone. The latter overlies a coal-bearing horizon of the Lias. Marine sedimentation closed with the Triassic but the Tertiary is represented by beds of sandy shale which include coal deposits.

M. Leclère gives many interesting details of his observations on the occurrence of minerals in the descriptions of his several itineraries, but for the purposes of this article it must suffice to

abstract the summary which he gives regarding the mineral resources.

Coal.—Coal beds of Paleozoic age occur at various horizons from the Carboniferous to the middle Permian. The beds, as might be anticipated from the general structure of the region, are not very thick. Upon a general estimate that the area within which they are known to occur has an extent of 110,000 square kilometers and that the average thickness of the coal is 0.1 meter, it is believed that there is a total of ten billion metric tons.

It is not clear upon what basis this estimate is made. From the geologic descriptions it is evident that the coal strata do not extend horizontally over the area and one is left to infer from the very small thickness assumed, that the writer has in mind beds which have an average actual thickness of perhaps one meter, but which are present over only one-tenth of the area. In any case the estimate has little value as a measure of the resources in Paleozoic coals. These coals as a rule are high in ash.

The Mesozoic coals, especially those of the Rhetic, are described as of great extent but moderate thickness. Several different fields (those of "Mong-tze," "Hing-gni," "Ma-chang," and "Houei-li" (Wei-li), and that of "Kouei-gny") are specially noted, and it is estimated that they contain approximately 20 billion metric tons. These coals of the Rhetic are quite different from those of the Paleozoic. They are generally purer, are flaming coals, and yield a light coke. The Tertiary coals of "Yen-bay" are richer in volatile matters than those of the Rhetic, but also higher in ash. They are of very moderate extent and not regular.

Iron.—Outcrops of hematite, which are worked in those districts where charcoal is still available, are not infrequent, as is natural in a region so traversed by veins as is Yün-nan. In the northeast of Kui-chóu ferruginous nodules occur characteristically at the base of the lower Lias, and kidneys of iron carbonate are found at certain of the coal-bearing horizons of the Carboniferous limestones. Their value as a resource in the future development of the country is not highly estimated.

Tin.—The mines and smelting works of tin of the region of "Ko-Tiou" are at the present time the most important industrial developments of Yün-nan. They lie between 2,200 and 2,700 meters above sea, in the mountains between "Mong-tze," "Lingnan" and the Red River. Their production appears to have attained its maximum of about 3,000 tons of crude tin, which is produced by a population of 30,000 individuals. The deposits are in no sense alluvial. They are obviously vein deposits. The cassiterite is always enclosed in a red clay, contained sometimes in fissures in limestone, sometimes in the neighboring accumulations of soil. There is no doubt that these occurrences are the result of decay in the upper portions of ancient veins. As the exploration goes deeper, foreign metals appear and finally predominate, at first in the form of oxides and then in that of sulphides. The richness of the region in tin may perhaps be due to the existence of tourmaline-bearing pegmatite which is injected across the sedimentary formations up to the lower Trias. It is, however, worth noting that even in the deposits of copper which occur in the midst of masses of porphyrite, analysis shows the presence of a considerable quantity of tin. The two metals are therefore not distinctly separated. The resources of "Ko-Tiou" in tin can not easily be estimated. It is known that deposits of this sort are liable to run out suddenly and it is much more difficult to define their probable depth than in the case of alluvial deposits. The production is limited not so much by the rather high price of charcoal employed in reducing the tin, as by the small quantities of available water. The operation of washing the ores is effected by the most rudimentary methods, but such is the nature of the mineral and the expertness of the Chinese that the extraction is pushed to its utmost limit. For some years past the crude metal has become richer in copper, lead, and arsenic. It is all sent across Ton-Kin to Hongkong.

Copper.—Copper has been exploited in southwestern China at least for a thousand years and probably for a much longer time, and records of the production are said to have been preserved in the library at Yün-nan city. The product is used for the

coinage of copper cash, the only coins in general use throughout the empire, and as the value of the coin depends upon the price of copper, the product has been in some measure regulated by government control. In the seventeenth century at least 6,000 tons were produced annually; at present about 1,000 to 1,500 tons. The diminution is not a result of the exhaustion of the deposits, but rather of the disappearance of the forests. On account of the lack of charcoal only minerals of the most exceptional richness or those which are most accessible are worked. Among the copper minerals and copper-bearing rocks Leclère mentions chalcocite, cantonite, and copper pyrite as occurring in veins in the carbonaceous shales; layers of cuprite and of native copper intercalated in porphyrite; and sandstones of the Trias impregnated with carbonate. The principal deposits which are worked occur in Triassic limestone, the mass of which is impregnated by diffusion from veins with the formation of a carbonate enclosing only traces of pyrite. The veinlets take the form of concretions arranged in zones which follow the natural fissures of the limestones. The principal centers of extraction are those of "Toung-tchouan," "Oui-si" near "Li-king," and the vicinity of "Ouei-ning" (Wei-ning) in Kui-chóu, which produces much zinc and lead. The works at present do not accept any minerals which will not form a matte containing 20 to 30 per cent., a richness which can only be obtained by hand-sorting, at which the Chinese are very expert. Minerals which do not contain more than 15 per cent. remain upon the mine dump and form considerable masses. The facts stated show that the province of Yün-nan still contains very considerable resources of copper-bearing minerals, chiefly in those deposits which were beyond the reach of the ancient methods of exploitation. Only general conclusions, however, can be drawn, and a special study of each deposit would be necessary to fix its value.

Lead, Zinc and Mercury.—Veins containing lead minerals are less numerous than those of copper. They are only worked to a notable extent in the vicinity of "Ko-tiou" and "Ouei-ning." Only those superficial ores which have been transformed into carbonates are used.

Deposits of calamine are still superficially exploited near "Kui-tsing" and "Ouei-ning."

Deposits of mercury, which is widely distributed through the southern province of Kui-chóu, are not considered by Leclère to have great promise for the future. He deems it probable that the Chinese, who have made great use of cinnabar and of the metal, have worked the available deposits until they are to a very great extent exhausted. The fact that the exploitation, which was interrupted by the Mohammedan rebellion, has not been extensively resumed leads him to think that the remaining deposits are not rich, but he says without doubt the question is worthy of further investigation.

Gold.—Gold mines are said to be very numerous in the western region where the Miocene folds of a north-and-south trend are superimposed upon older structures. The quartz veins have never been deeply worked by native methods. At present the only place where gold is extracted is at the mine of "Ta-lan" near "Se-mao." While this point was not examined by M. Leclère he states that the reports leave no doubt of the auriferous wealth of the eastern portions of Tibet and Burmah.

Salt, cobalt, manganese, realgar, and antimony are also mentioned as occurring in the provinces visited by M. Leclère.

The preceding notes are restricted to the southwest portion of the Chinese empire, that being the region to which the French engineers have necessarily confined their explorations. It is a country which has been extremely inhospitable to strangers, and the observations which have been made have been limited by the fact that the traveler was really liable to be mobbed by the rough mining population. The tone of M. Leclère's statements is, however, conservative and there is little doubt that this portion of China possesses very considerable wealth at least in tin and copper and the mineral fuels necessary to their reduction.

The eastern portion of the region under discussion lying in the provinces of Fu-kién and Chō-kiang, is even less well known and so far is without any special reputation as a mineral-producing district. Quartz porphyries similar to those of the southwest

were collected by von Richthofen and have been described by Kollbeck.¹ So far as the descriptions go the rocks appear to be of types similar to those which are common in the western United States.

According to a report attributed to an American mining engineer² there is a large body of magnetic iron ore estimated to contain 10,850 short tons near Amoy in Fu-kién. Such a deposit might be of great value. Kaolin, galena, and zinc are mentioned as occurring in the same region.

This necessarily partial account of the mineral resources of China may be closed by a reference to the relations of the Chinese to foreigners and foreign capital, as the writer understands them.

The attitude of the Chinese toward a foreigner at first is one of intense curiosity in regions where they are not accustomed to strangers, followed by friendly or unfriendly treatment, according to what they find him to be. There are many who will mischievously annoy and some who are keen to take advantage; but there are more who respect rank as shown in character and learning, and a square, steady, considerate man will usually have no serious trouble among them. Unfortunately they too often find the foreigner "ignorant of restraint," and he is least liked where he is most often met.

Through costly experience the Chinese officials have learned that the presence of a foreigner entails grave responsibility for his safety. It is the testimony of every traveller who has deserved well at their hands, and of many who have not, that they as a rule exert themselves to protect the stranger and to forward his reasonable purposes. On the other hand, the more or less crystallized sentiment is now "China for the Chinese." The Imperial Government has bought back railway and mining concessions so far as practicable. Exploitation by foreigners is not wanted. Foreign capital is wanted, is indeed absolutely necessary

¹"Ueber Porphyrgesteine des südöstlichen China," *Deutsche Geol. Gesell. Zeit.*, Band 35, 1883, p. 461.

²U. S. Daily Consular and Trade Reports, Bureau of Manufactures, Dept. of Commerce and Labor, Washington, D. C., May 3, 1907, p. 10.

to adequate development of railways and mines, but the policy is to accept it only on condition of Chinese control. It remains to be seen how soon China can establish that confidence in her business methods and credit which alone will invite investments on reasonable terms. Reforms of her finances and taxation are fundamentally necessary to that end.