but it went as low as 10,000 flasks in 1880, and rose to 53,000 flasks five years later; from this it declined to 15,000 flasks in 1875, though in the following year it grew to 75,000 flasks. Last year we produced 59,000 flasks.

"Gold is the only metal in which our production has been declining. In 1852 it amounted to $60,000,000; but, with some fluctuations, it has now declined to less than $32,000,000 annually.

"The production of silver, on the contrary, has largely increased. Commencing in 1859 with $100,000, it has now attained $45,000,000. In 1877 only were these figures exceeded, and then only by about $1,000,000.

"The production of petroleum, that great American industry, has grown with wonderful rapidity. In 1859 it commenced with only 3000 barrels, and, after an almost uniform increase, it attained last year the enormous figures of 27,000,000 barrels. Scientific investigation has recently raised a note of warning in this industry, asserting the limited area of oil-producing territory and its approaching exhaustion."

Some valuable statistics concerning the production of the precious metals in the United States are contained in a report issued by the Census Bureau.[1] The output for the year ended 31st May 1880 is summed up as follows :—

	Gold.		Silver.		Total.
	Ounces.	Value.	Ounces.	Value.	Value.
Deep mines....	1,033,974	$21,374,152	31,717,297	$41,007,296	$62,381,448
Placers.....	580,767	12,005,511	80,177	103,661	12,109,172
All mines.....	1,614,741	33,379,663	31,797,474	41,110,957	74,490,620

The State producing the greatest value is Colorado, viz., $19,249,172, or gold 130,607 oz. and silver 12,800,119 oz.; California comes next, having produced $18,301,828 of bullion, and then Nevada, with $17,318,909 of bullion.

The greatest gold producer among the States and Territories is California, with 829,676 oz. of gold, half from deep mines and half from placers. Next follows Nevada, with 236,468 oz. of gold, of which only about 1 per cent. came from placer mines; then Dakota, 159,920 oz. of gold, nearly entirely produced by deep mines; and in the fourth rank Colorado, 130,607 oz., with a placer production of less than 5000 oz.

The greatest silver producer is Colorado, with 12,800,119 oz.; then Nevada, 9,614,561 oz.; then Utah, 3,668,365 oz.; Montana, 2,246,938 oz.; and fifthly Arizona, 1,798,920 oz.

It is useless within the limits of this article to attempt to convey an adequate idea of the enormous mineral resources of the United States. We can merely very briefly allude to some of the principal deposits, which are of commercial value on account of their magnitude, of scientific interest owing to their mode of occurrence, and of technical importance as having led to the introduction of considerable improvements in the arts of mining, milling, and dressing.

Among these may be mentioned the coal and anthracite mines and oil wells of Pennsylvania, the gold and quicksilver mines of California, the silver mines of Nevada, the lead and silver mines of Colorado, and the copper mines of Lake Superior. The articles Coal (vol. vi. p. 60) and Gold (vol. x. p. 743) may be referred to for information concerning the occurrence of these minerals and the method of extracting gold by hydraulic mining and improved stamping machinery.

Quicksilver in the form of native mercury and cinnabar occurs in considerable abundance in California, and much of it is found in connexion with serpentine, either in the serpentine itself or in sandstone near its junction with serpentine. The most important mines are those of New Almaden in the southern part of the State near San Jose. The deposit at Sulphur Bank in Lake County is of much geological interest. It consists of native sulphur, gypsum, and cinnabar in a decomposed andesitic lava close to an extinct geyser from which boiling water still issues. The top of the bank was worked open-cast for sulphur, and then for sulphur and cinnabar, and now underground mining is carried on in stratified sandstone and shale impregnated with cinnabar and underlying the lava.

Some of the most marvellous silver mines in the world are those upon the Comstock lode in Nevada. A horizontal section of part of this great vein is shown on Plate IV., copied from the excellent and well-known report of Mr J. D. Hague.[2] The strike is nearly north and south, and the dip about 45° to the east. "The vein matter of the Comstock consists of crushed and decomposed country rock, clay, and quartz." "Up to January 1, 1880, the Comstock had yielded in twenty years about $325,000,000 worth of bullion. The total length of shafts and galleries is about 250 miles. The number of men employed in the mines in January 1880 was 2800, earning average wages of $4 a day. At the same date 340 men were at work in the amalgamating mills."[3] The heat of the Comstock lode is remarkable. On the 2700 feet level of the Yellow Jacket mine Mr Becker found the temperature of the water to be 153°, that of the air 128°; whilst the water in the Yellow Jacket shaft at a depth of 3065 feet has a temperature of 170° Fahr.[4]

During the last few years the Comstock lode has been falling off in productiveness. In 1876 the total yield of the Comstock lode was $38,572,984 (gold, $18,002,906; silver, $20,570,078). During the census year ending May 31, 1880, the product of the whole Comstock district, including outlying veins, was $6,922,330 (gold, $3,109,156; silver, $3,813,174), showing a decline of $31,650,654, or 82·06 per cent., since 1876.[5]

Though the extraction of silver from its ores may be regarded as the business of the metallurgist rather than of the miner, we must not forget to mention that it is to the necessities of the treatment of the Nevada ores that we owe the system of pan amalgamation first developed in that State and practised since in Colorado.

Another district in Nevada which cannot be passed over in silence is that which contains the Eureka and Richmond mines, which are celebrated, not only for the silver they have produced, but also for the important trial in which the issue hinged upon the definition of the term vein or lode (p. 441). The bullion produced in the Eureka district from ore raised and treated during the census year ended May 31, 1880, was—gold, 62,893 oz.; and silver, 2,037,666 oz.; worth altogether $3,934,621.[6]

The history of Leadville in Colorado seems like a romance when we read of the rapid development of the mines, the creation of a large and important town, the erection of smelting works and the building of railways, under very adverse conditions, in the heart of the Rocky Mountains, all within the space of four or five years. It affords additional proof that the miner is the true pioneer of civilization. The main facts concerning the Leadville deposits are admirably summed up by Mr S. F. Emmons, from whose report[7] we borrow, not only the following facts, but also the geological section across the district (Plate IV.).

The principal deposits of the region are found at or near the junction of the porphyry with the Blue limestone, which is the lowest member of the Carboniferous formation. This bed is about 150 or 200 feet thick, and consists of dark blue dolomitic limestone. At the top there are concretions of black chert. The porphyry occurs in intrusive sheets which generally follow the bedding, and almost invariably a white porphyry is found overlying the Blue limestone. This porphyry is of Secondary age; it is a white homogeneous-looking rock, composed of quartz and felspar of even granular texture, in which the porphyritic ingredients, which are accidental rather than essential, are small rectangular crystals of white felspar, occasional double pyramids of quartz, and fresh hexagonal plates of biotite or black mica. Along the plane of contact with the porphyry the limestone has been transformed, by a process of gradual replacement, into a vein consisting of argentiferous galena, cerussite, and cerargyrite mixed with the hydrous oxides of iron and manganese, chert, granular cavernous quartz, clay, heavy spar, and "Chinese talc," a silicate and sulphate of alumina. The vein seems to have been formed by aqueous solutions, which took up their contents from the neighbouring eruptive rocks and brought about the alteration of the limestone as they percolated downwards through it. In Carbonate Hill, a gradual passage may be observed from dolomite into earthy oxides of iron and manganese. The masses of workable ore are extremely irregular in shape, size, and distribution. They are often 30 to 40 feet thick vertically, and occasionally 80 feet, but only over a small area. The rich ore bodies are commonest in the upper part of the ore-bearing stratum. At Fryer Hill the Blue limestone is almost entirely replaced by vein material.

In the census year ended May 31, 1880, Lake County, Colorado, which includes the Leadville district, produced 28,226 gross tons of lead, with 3830 oz. of gold and 8,853,946 oz. of silver, of a total value of $13,032,464.[8]

The most important copper mines of the United States are those on Lake Superior, where the native metal occurs "in veins, in large masses, or scattered more or less uniformly in certain beds which are either amygdaloid or conglomerates."[9] The principal copper-producing districts are in Michigan, where the Portage Lake district, in Houghton county, contains the famous Calumet and Hecla mine, which alone produced 15,837 tons of copper in 1880, or about half the entire output of the United States. The deposit from whence this vast amount of copper was obtained is a bed of conglomerate, generally called a vein, dipping about 38° north-west. It has been worked for a depth of 2250 feet on the incline. In 1875 the stuff stamped yielded 4½ per cent. of copper.

In conclusion, we will point out that the value of the mining industry in the United States exceeds that of any other country in the world, Mr Porter estimating it for 1879–1880 at 360 million dollars, and that of Great Britain at 325 millions.[10] Germany holds

[1] Clarence King, special agent of the Census, *Statistics of the Production of the Precious Metals in the United States*, Washington, 1881, p. 69.
[2] *United States Geological Exploration of the Fortieth Parallel*, vol. iii., Mining Industry, Atlas, plate 11.
[3] Clarence King, *First Annual Report of the U.S. Geological Survey*, p. 39.
[4] *Op. cit.*, pp. 44, 45.
[5] Clarence King, *Statistics of the Production of the Precious Metals in the United States*, Washington, 1881, p. 19.
[6] *Op. cit.*, p. 21.
[7] *Abstract of a Report upon the Geology and Mining Industry of Leadville, Colorado*, Washington, 1882.
[8] Clarence King, *op. cit.*, p. 47.
[9] Charles E. Wright, commissioner, *Annual Report of the Commissioner of Mineral Statistics for the State of Michigan for* 1880, Lansing, Michigan, 1881.
[10] Robert P. Porter, *The West from the Census of* 1880, Chicago and London, 1882, p. 19.

the third rank, followed by France and Russia. The United States produce 33 per cent.[1] of the gold yield of the whole world, 50 per cent. of the silver, 22 per cent. of the pig iron,[2] 29 per cent. of the steel, and about 25 per cent. of the lead.

Mexico has been renowned for its gold and silver mines ever since the Spaniards first took possession of it, and its production is still very considerable. Indeed, after the United States, it still produces far more silver than any other country in the world. The average annual output of silver during the twenty-five years 1851 to 1875 is estimated by Dr Adolf Soetbeer at 501,520 kilogrammes, or 16,124,235 oz.;[3] whilst the average annual output of gold during the same period was 1785 kilogrammes, or 57,389 oz. Tin ore occurs in considerable quantities in Mexico, and is likely to be worked on a large scale as soon as the tin district is opened up by a railway.

Central America possesses numerous gold mines.

South America.—Venezuela produces gold, copper, and a little lead. The copper is found at Aroa near the north coast, and the gold in the province of Guiana, which is now producing upwards of 100,000 oz. annually. It is highly probable that the existence of this gold was known to the Indians, who reported it to Sir Walter Raleigh, and so led him to undertake his unfortunate expedition in search of "El Dorado." French Guiana contains workable deposits of gold, and yielded 72,168 oz. in 1880.

The chain of the Andes forms a long belt of mineral-producing country. Beginning with the United States of Colombia we have a country rich in gold,—the State of Antioquia being especially favoured in this respect. The annual yield of all the states is about 200,000 oz. Colombia has mines of rock salt, yielding 10,000 tons a year, and the emerald mine at Muzo has long been famous. Peru is renowned for its silver mines; the best-known are those of Cerro de Pasco, situated at an elevation of 14,000 feet above the sea-level. Passing into Bolivia, we must notice the silver mines of Potosi, the wealth of which is proverbial. Chili is best known as the principal copper-producing country of South America; but its silver mines are not unimportant, and beds of nitrate of soda are largely wrought.

The most remarkable gold mines of Brazil lie in the province of Minas Geraes, whilst diamonds are obtained in that of Matto Grosso. In the Argentine Republic gold, silver, and copper mines are worked, especially in the provinces on the eastern flanks of the Andes.

The total annual output of the precious metal in South America is estimated to be upwards of 300 000 oz. of gold, and 2,000,000 oz. of silver. In 1877 Chili exported 35,128 metric tons of metallic copper, in addition to ore and regulus.

Australia.—Australia is remarkably rich in minerals, especially gold (see Gold, vol. x. p. 744), tin, and copper, and its coal deposits are likely to be largely utilized in the future.

Queensland, though a young colony, has already made itself famous for gold and tin, and it also possesses vast resources of coal and copper, in addition to the ores of other metals. The quantity of gold sent by escort from the different gold fields was 204,388 oz. in 1880, in addition to what was carried by private hands. Tin ore was first worked in 1872 near the border of the colony with New South Wales, and large quantities of stream tin have been obtained from very shallow alluvial diggings near Stanthorpe. Like gold, the tin ore is not confined to one district; it occurs and is worked at the North Palmer diggings, a little to the south is Great Western, rich in tin ore, and so is Herberton to the north-east on the other side of the Dividing range.

In 1881 New South Wales[4] produced minerals and metals worth £2,373,191, viz., 149,627 oz. of gold, 1,775,224 tons of coal, 8200 tons of tin, 5493 tons of copper, 6560 tons of iron, besides silver, oil-shale, and antimony. In addition to the facts concerning the occurrence of gold already mentioned (*loc. cit.*), it is interesting to note that auriferous conglomerates containing the precious metal in payable quantities have been discovered and worked in this colony in rocks of the age of the Coal Measures.[5] The most important tin district is that of Vegetable Creek in New England, which from 1872 to 1880 produced 20,988 tons of tin ore. The accompanying map (fig. 105[6]) shows the recent alluvium which has hitherto been

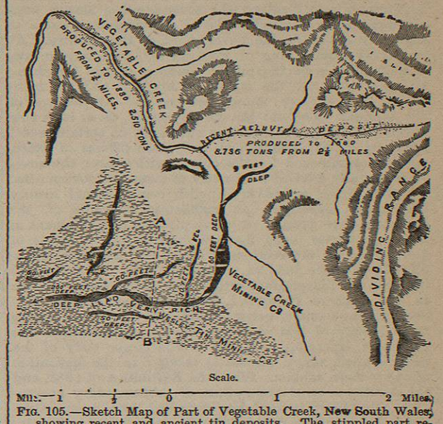

Fig. 105.—Sketch Map of Part of Vegetable Creek, New South Wales, showing recent and ancient tin deposits. The stippled part represents tin-bearing alluvium. The shaded part AB denotes basalt which has covered the lower portions of the ancient tin-bearing alluvia (deep leads), as explained in fig. 106. The rest is granite.

the main source of the supply, and the deep leads which, as far as explored at present, promise still greater riches. The section (fig. 106[6]) shows that these deep leads, like those of the gold fields

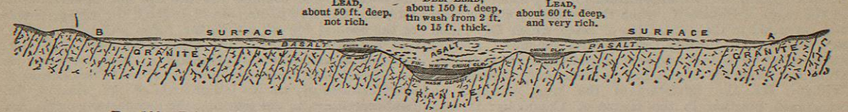

Fig. 106.—Enlarged Section (on AB of fig. 105) across Deep Leads in Vegetable Creek, New South Wales.

(Gold, vol. x. p. 743), are old alluvia preserved under a capping of basaltic lava. There are also numerous tin lodes which are beginning to be worked.

Victoria heads the list of gold-producing British colonies, having yielded in 1882[7] as much as 864,610 oz., of which 352,078 oz. were derived from alluvial deposits, and 512,532 oz. from quartz mines. 1077 tons of tin ore were raised and 375 tons of antimony ore.

South Australia is the great copper-producing province, though the yield is not so great as it was ten years ago. The principal mines now at work are on Yorke's Peninsula. In 1881[8] South Australia produced 3824 tons of copper, worth £263,370, and 21,638 tons of copper ore, worth £154,926.

In 1881 Western Australia exported 1400 tons of lead ore, valued at £11,204.

Tasmania, like some parts of Australia, is rich in tin ore, which is now obtained principally from an alluvial deposit at Mount Bischoff. The ore is now almost entirely smelted in the colony, and in 1880 the exports were 3951 tons of metal and 3 tons of ore, worth altogether £341,736.

New Zealand furnishes a considerable amount of gold from quartz reefs and alluvial diggings. The annual exports during the ten years 1862 to 1872 were often 600,000 and even 700,000 oz. Of late years the yield has gradually diminished, and in 1880 only 303,215 oz., valued at £1,220,263, were exported. Silver is exported to the

[1] Clarence King, *op. cit.*, p. 93.
[2] James M. Swank, *Statistics of the Iron and Steel Productions of the United States*, Washington, 1881, p. 179.
[3] Dr Adolf Soetbeer, *Edelmetall-Produktion*, Gotha, 1879, p. 60.
[4] *Annual Report of the Department of Mines, New South Wales, for the year* 1881, Melbourne, 1882, p. 8.
[5] *Annual Report of the Department of Mines, New South Wales, for the year* 1876, Sydney, 1877, p. 173.
[6] Furnished by Mr W. H. Wesley.
[7] *Mineral Statistics of Victoria for the year* 1882, Melbourne, 1883, p. 7.
[8] *Statistical Register of the Province of South Australia, for the year* 1881, Adelaide, 1882.

extent of 20,000 to 30,000 oz. annually; it is mainly derived from the gold obtained in the Thames district, which contains about 30 per cent. of the less valuable metal. Coal is worked in several places, but the total output is at present comparatively small.

New Caledonia.—The discovery of nickel ore in this island by M. Garnier in 1867 was one of great mineralogical interest, and it has since borne fruits of considerable commercial importance. The New Caledonia ores are hydrous silicates of nickel and magnesium, which occur in veins in serpentine, and contain from 7 to 18 per cent. of metal. The mineral is found on the Mont d'Or not far from Noumea. Most of the ore is sent to France to be treated

To the list of works on mining mentioned in the article Coal (vol. vi. p. 81) the following may be added:—Callon, *Cours d'exploitation des Mines*, Paris, 1874, and English translation by C. Le Neve Foster and W. Galloway; Serlo, *Leitfaden zur Bergbaukunde*, Berlin, 1878; Zoppetti, *Arte mineraria*, Milan, 1882; A. von Groddeck, *Die Lehre von den Lagerstätten der Erze*, Leipsic, 1879; P. von Rittinger, *Lehrbuch der Aufbereitungskunde*, Berlin, 1867; *Jahrbuch für das Berg- und Hüttenwesen im Königreiche Sachsen*, Freiberg, annually; *Annual Reports of H.M. Inspectors of Mines*; *Preliminary Report of Her Majesty's Commissioners Appointed to Inquire into Accidents in Mines*, London, 1881; *Annales des Mines*, Paris, 6 parts published yearly; *The Engineering and Mining Journal*, New York, published weekly; *Transactions of the American Institute of Mining Engineers*, Philadelphia; *Die berg- und hüttenmännische Zeitung*, Leipsic, weekly; *Oesterreichische Zeitschrift für Berg- und Hüttenwesen*, Vienna, weekly. (C. L. N. F.)

MINISTRY. Ever since the introduction of monarchical institutions into England the sovereign has always been surrounded by a select body of confidential advisers to assist the crown in the government of the country. At no period could a king of England act, according to law, without advice in the public concerns of the kingdom; the institution of the crown of England and the institution of the privy council are coeval. At the era of the Norman Conquest the king's council, or as it is now called the privy council, was composed of certain select members of the aristocracy and great officers of state, specially summoned by the crown, with whom the sovereign usually advised in matters of state and government. In the earlier stages of English constitutional history the king's councillors, as confidential servants of the monarch, were present at every meeting of parliament in order to advise upon matters judicial in the House of Lords; but in the reign of Richard II. the privy council dissolved its judicial connexion with the peers and assumed an independent jurisdiction of its own. It was in the reign of Henry VI. that the king's council first assumed the name of privy council, and it was also during the minority of this sovereign that a select council was gradually emerging from out of the larger body of the privy council, which ultimately resulted in the institution of the modern cabinet. Since the Revolution of 1688, and the development of the system of parliamentary government, the privy council has dwindled into comparative insignificance when contrasted with its original authoritative position. The power once swayed by the privy council is now exercised by that unrecognized select committee of the council which we call the cabinet. The practice of consulting a few confidential advisers instead of the whole privy council had been resorted to by English monarchs from a very early period; but the first mention of the term cabinet council in contradistinction to privy council occurs in the reign of Charles I., when the burden of state affairs was intrusted to the committee of state which Clarendon says was enviously called the "cabinet council." At first government by cabinet was as unpopular as it was irregular. Until the formation of the first parliamentary ministry by William III. the ministers of the king occupied no recognized position in the House of Commons; it was indeed a moot point whether they were entitled to sit at all in the lower chamber, and they were seldom of one mind in the administration of matters of importance. Before the Revolution of 1688 there were ministers, but no ministry in the modern sense of the word; colleague schemed against colleague in the council chamber, and it was no uncommon thing to see ministers opposing one another in parliament upon measures that ought to have been supported by a united cabinet. As the exchange from government by prerogative to government by parliament, consequent upon the Revolution of 1688, developed, and the House of Commons became more and more the centre and force of the state, the advantage of having ministers in the legislature to explain and defend the measures and policy of the executive Government began gradually to be appreciated. The public authority of the crown being only exercised in acts of administration, or, in other words, through the medium of ministers, it became absolutely necessary that the advisers of the sovereign, who were responsible for every public act of the crown as well as for the general policy they had been called upon to administer, should have seats in both Houses of Parliament. The presence of ministers in the legislature was the natural consequence of the substitution of government by parliament for the order of things that had existed before 1688. Still nearly a century had to elapse before political unanimity in the cabinet was recognized as a political maxim. From the first parliamentary ministry of William III. until the rise of the second Pitt divisions in the cabinet were constantly occurring, and a prime minister had more to fear from the intrigues of his own colleagues than from the tactics of the opposition. In 1812 an attempt was made to form a ministry consisting of men of opposite political principles, who were invited to accept office, not avowedly as a coalition Government, but with an offer to the Whig leaders that their friends should be allowed a majority of one in the cabinet. This offer was declined on the plea that to construct a cabinet on "a system of counteraction was inconsistent with the prosecution of any uniform and beneficial course of policy." From that date it has been an established principle that all cabinets are to be formed on some basis of political union agreed upon by the members composing the same when they accept office together. It is now also distinctly understood that the members of a cabinet are jointly and severally responsible for each other's acts, and that any attempt to separate between a particular minister and his colleagues in such matters is unfair and unconstitutional.

The leading members of an administration constitute the Cabinet (*q.v.*). The members of an administration who are sworn of the council, but who are not cabinet ministers, are the lord-lieutenant of Ireland, the vice-president of the council for education, the judge advocate general, and the chief officers of the royal household. The subordinate members of an administration who are never in the cabinet, and who are seldom raised to the distinction of privy councillors, are the junior lords of the treasury, the joint-secretaries to the treasury, the paymaster-general, the junior lords of the admiralty, the parliamentary under-secretaries of state, and the law officers of the crown.

During the present century the power of ministers has been greatly extended, and their duties more distinctly marked out. Owing to the development of the system of parliamentary government, much of the authority which formerly belonged to English sovereigns has been delegated to the hands of responsible ministers. As now interpreted, the leading principles of the British constitution are the personal irresponsibility of the sovereign, the responsibility of ministers, and the inquisitorial power of parliament. At the head of affairs is the prime minister, and the difference between theory and practice is curiously exemplified by the post he fills. The office is full of anomalies. Like the cabinet council the prime minister is unknown to the law