

ESTIMATED PRODUCTION OF GOLD SINCE THE OPENING OF THE N.S.W. GOLD-FIELDS IN 1851

Information taken from Annual Reports of the N.S.W. Department of Mines

Year	Quantity fine oz.	Value	Year	Quantity fine oz-	Value
1851	110,2564	68,336	1908	224,792	954,854
1852	626,440	2,660,946	1909	204,709	869,546
1853	419,324	1,781,172	1910	188,857	802,211
1854	182,029	773,209	1911	181,121	769,353
1855	154,105	654,594	1912	165,295	702,129
1856	162,245	689,174	1913	149,657	635,703
1857	158,785	674,477	1914	124,507	528,873
1858	259,945	1,104,175	1915	132,498	562,819
1859	296,424	1,259,127	1916	108,145	459,370
1860	314,978	1,465,373	1917	82,171	349,038
1861	425,200	1,806,172	1918	87,045	369,743
1862	580,965	2,467,780	1919	65,839	279,666
1863	422,854	1,796,170	1920	48,907	207,746
1864	307,206	1,304,926	1921	51,173	217,370
1865	289,859	1,231,243	1922	25,222	107,139
1866	262,824	1,116,404	1923	18,833	79,998
1867	248,033	1,053,578	1924	18,685	79,370
1868	234,164	994,665	1925	19,422	82,498
1869	229,334	974,149	1926	19,435	82,551
1870	219,180	931,016	1927	18,032	76,595
1871	294,389	1,250,485	1928	12,831	54,503
1872	387,072	1,644,177	1929	7,496	31,842
1873	328,735	1,396,375	1930	12,493	53,066
1874	245,217	1,041,614	1931	19,673	100,000
1875	206,627	877,694	1932	27,941	203,315
1876	144,357	613,190	1933	29,252	225,683
1877	110,988	471,448	1934	36,123	307,594
1878	101,278	430,200	1935	50,102	439,945
1879	95,867	407,219	1936	60,739	527,386
1880	104,586	444,252	1937	68,607	600,705
1881	138,033	553,582	1938	88,708	785,966
1882	123,954	526,522	1939	87,189	850,622
1883	107,947	458,530	1940	100,255	1,068,753
1884	93,240	396,059	1941	88,091	940,698
1885	89,145	378,665	1942	77,249	807,541
1886	86,233	366,294	1943	63,779	666,490
1887	92,892	394,579	1944	62,610	673,840
1888	74,685	317,241	1945	43,129	464,175
1889	102,357	434,784	1946	32,009	344,501
1890	108,360	460,285	1947	50,082	539,010
1891	131,654	559,231	1948	52,164	561,415
1892	135,437	575,299	1949	51,793	638,994
1893	153,326	651,286	1950	51,350	795,514
1894	272,314	1,156,717	1951	48,810	756,165
1895	309,796	1,315,929	1952	39,030	604,653
1896	252,690	1,073,360	1953	26,461	409,934
1897	259,978	1,104,315	1954	31,434	486,976
1898	282,914	1,201,743	1955	30,067	469,797
1899	382,162	1,623,320	1956	28,821	450,328
1900	252,116	1,070,920	1957	31,043	485,047
1901	173,543	737,164	1958	18,709	292,328
1902	161,256	684,970	1959	13,275	207,422
1903	254,260	1,080,029	1960	13,628	212,891
1904	269,817	1,146,109	1961	12,034	188,031
1905	274,267	1,165,013	1962	11,234	175,531
1906	253,987	1,078,866	1963	11,395	178,047
1907	247,363	1,050,730	1964	10,547	164,734
TOTALS				16,468,000	80,344,878

manganese and oxides of molybdenum and bismuth. The gold contents of the gossan were sufficiently high to pay working expenses. but, at shallow depths, sulphides of molybdenum and bismuth were found, and the manganese gossan gave place to a transparent form of granular garnet throughout an altered form of siliceous granite.

Irregular Deposits, such as Masses of Ironstone containing Gold

Small deposits of gold-bearing iron ore were worked at Mount Allen, about 12 miles from Mount Hope. The presence of gold was not detected until a considerable quantity of Iron ore had been removed for use as a flux for siliceous copper ores smelted by the New Mount Hope Copper Mining Company.

The Mount Allen Gold Mining Company worked a mass of ironstone which outcropped over an area 60 feet long and 30 feet wide. The country rocks were formed of contorted slates of Silurian age. the ironstone being disposed on the crest of an anticlinal fold. In places the slates were gold-bearing, particularly on the cleavage planes, where fine scales of gold were found. The iron ore consisted chiefly of hematite, with some magnetite. Small quantities of bismuth were present in addition to gold.

Production

The total production of gold in New South Wales from 1851 to the end of 1927 amounts to 14,968,346 oz. fine, valued at £63,581,454, exclusive of the premium obtained on gold sold per medium of the Gold Producers' Association, now defunct. This amount represents slightly more than 10 per cent. of the value of the total Australian production, or 15 per cent. of the total value of all minerals produced in New South Wales. Of the Australian States, New South Wales ranks fourth as a gold producer, being surpassed by Victoria, Western Australia, and Queensland. Victoria has raised almost five times, and Western Australian nearly two and a half times as much gold as the Mother State. In 1852 the value of gold won in New South Wales reached a maximum of £2,660,946, while in 1927 the output was the lowest on record being valued at £76,595.

The gold-bearing zone is confined to a belt of hard rocks of Devonian age south of the village of Yalwal. In this zone are included quartzites, conglomerates, altered in places to quartzites, schists, and slates. (It has recently been shown (1964) that rhyolites occupy a large proportion of the mine area.) These beds have been altered peculiarly in many places to masses of soft silicates and dense siliceous rocks containing iron and arsenical pyrites.

Free gold occurred in the oxidised zone, while the pyrites of the sulphide zone contained 2 to 24 dwt. of gold per ton; but the ore was generally low-grade, with an average of less than 2 dwt. per ton. The surface gold occurred in a variety of gossan, at times coarse in nature. Throughout the gold-bearing rock the gold occurs irregularly distributed, and as films coating divisional rock planes. In very many places tip trace of the gold is to be seen in the solid rock between these gold-covered joints.

Mining at the Pioneer and Homeward Bound mines was by means of open cuts, from which the ore was conveyed to the batteries by tunnel beneath the quarry floor, and inclined trainway or chutes. The cost of mining and treatment under favourable conditions was remarkably low.

Other mines were known as the Pinnacle, or No. 1, the Caledonian, and the Star.

Impregnations in Igneous Rocks

Free gold in a very fine state of division, and, in association with iron pyrites also, is known to occur in igneous rocks of various types throughout the State, but the production from these sources is relatively insignificant, although it is believed that some of the gold won from alluvial deposits, notably at Rocky River, Young, Major's Creek, and Araluen, has been derived from the disintegration of neighbouring igneous masses.

In certain localities payable gold has been obtained from mines within masses of igneous rock. Mention may be made of Bushy Hill, near Cooma, where the gold occurred in serpentine; of Wolumla, and Pambula, where the precious metal was associated with a rock known as felsite; and of Poverty Point, near Timbarra, where granite is the host of the gold.

The Cargo Goldfield

Cargo is 23 miles from Orange, on the Main Western Railway, 205 miles from Sydney.

The ore deposits of Cargo consist of irregularly - shaped and narrow zones of rocks altered along the courses of dykes of peculiar type. Quartz is conspicuous by its absence, and the so called "reefs" are of the nature of irregular impregnations of very variable width. Copper, iron pyrites, and gold occurs within them.

The principal mine of this field was known as the Ironclad, the main shaft of which was sunk to a depth of 320 feet. Other mines were known as the Dolcoath, Golden Clad, Cargo Consols, Commonwealth, and Essex.

Very little mining appears to have been done on this field since 1904.

"Pipes" or "Pipe-veins" occurring in Siliceous Granite

This type of deposit is not important as a source of gold in New South Wales, the amount won from "pipes" being only a few ounces.

The "pipes" are suggestive of twisted cylinders of quartz and other siliceous material arranged near the contact of siliceous granite and other rocks such as basic granite or sediments.

Gold has been recorded in "pipes" at Mouni Metallic, near Whipsaick, and at Timbarra, near Drake.

At Whipstick a siliceous granite has intruded sedimentary rocks of Devonian age. A number of "pipes" or "pipe-veins" have been worked along the margin of the granite for bismuth and molybdenite. In some places gold has been found in intimate association with rich ores of bismuth and molybdenite. In the Mount Metallic area one pipe, known as the "GoldPipe", was mined for gold. The outcrop of this pipe contained a considerable quantity of

Impregnations in Sedimentary Rocks

In New South Wales this type of deposit is relatively unimportant as a source of gold.

Gold occurs, in many places, disseminated finely throughout rocks of sedimentary origin. in such proportion that the whole thickness of the bed may be worked profitably. A certain amount of alteration, chiefly to silica or siliceous material, is present in places.

In addition to free gold, a considerable quantity of gold is associated intimately with iron pyrites. Enrichment in restricted masses is common. The ore-bodies of Lyndhurst and Yalwal may be classified here.

The Lyndhurst Goldfield

This field contains some very peculiar and interesting gold-bearing deposits. It is situated on the Belubula River, in the parishes of Lyndhurst and Belubula, county of Bathurst, about 8 miles west by south from the town of Carcoar.

The geological formations here comprise indurated bluish-grey claystones and intercalated beds of highly-altered rock, which form the ore-bodies. Arsenical pyrites, pyrrhotite. and Iron pyrites are disseminated through the altered rocks. Gold is associated with these sulphides. The sediments have been intruded by a mass of granite, dykes and sills of diorite, and dykes of augite - ande site.

The claystones and ore-bodies at Lyndhurst vary in thickness from that of a sheet'of paper to a maximum of 20 feet. In places the alteration of extremely thin beds differing in composition and colour has resulted in the formation of a banded rock of remarkable regularity.

Mining was commenced here at least forty-five years ago, at three principal localities known as "The Junction Reefs", "The Frenchman's", and "TheCornishman's" mines respectively. The oxidised ores were mined by means of shallow open cuts, and for some time no attention was paid to the sulphide ores proper. Subsequently the open cuts were deepened to extract the low grade pyritic ores, which were treated by roasting and cyanidation. Until recent years the mines were controlled by the Lyndhurst Railway and Mines Limited. Water-jacket furnaces were erected in 1903. The gold ore has since been concentrated and smelted in conjunction with copper ores for other mines owned by the same company.

In 1923 the Mount Boppy Cold Mining Company, Limited, obtained a working option over one of the mines. The average extraction from the sulphide ore-bodies has been very low, probably less than 10 dwt. of gold per ton of ore treated.

The Yalwal Goldfield

Yalwal is situated about 18 miles west of Nowra on Danjera Creek, a tributary of the Shoalhaven River.

Although the presence of gold in this district had been mentioned by various writers very many years ago, the first real efforts at prospecting at Yalwal did not take place until 1870. Alluvial gold was worked first at the junction of Danjera and Yarramunmun Creeks.

In 1871, reef gold was found at the spot known as "The Pinnacle" or No.1 Claim. In 1872 the ore-bodies worked at the Pioneer Mine were discovered; while those mined at the Homeward Bound were located in 1874. For many years the ores were treated by battery and amalgamation processes. but in 1898 a cyanide plant was erected at the Pioneer Mine for the recovery of gold from accumulated battery sands and slimes and low-grade ore. A large cyanide plant was installed at the Homeward Bound Mine in 1900.

The Homeward Bound and Pioneer mines are the two most important in this field. In 1904 they were acquired by the Yalwal Consolidated Gold Mines Limited. Very little work appears to have been done since 1916, at which date, approximately, the large batteries belonging to the Pioneer and Homeward Bound were sold. Small quantities of gold were won during 1924 and subsequent years.

A series of quartz veins, varying in width from a few inches to 6 feet, or, in places, to 10 or 15 feet, were exposed within the "andesite" of the footwall. These veins trend approximately east and west, and do not extend easterly into the "serpentine," but appear to be truncated along the line of contact. At and near the junction of the veins and the main fissure the rich ore-bodies were found. A remarkable feature of these deposits was the invariable association of rich gold values with calcite, especially adjacent to -serpentine-. In the lower levels both free gold and gold-bearing mispickel were contained within a gangue composed almost wholly of calcite.

In the upper levels free gold occurred in association with quartz, ironstained sandy clay, and accretions of yellowish brown siliceous material known as "clinkers". In the unoxidised zone the gold was contained principally in arsenical pyrites. Metallic antimony, stibnite, iron pyrites and pyrrhotite were present also in the gangue. The mispickel occurred in masses of beautiful stellate or radiating crystals known to the miners as "Prince of Wales' Feathers". The gold contents of the mispickel ranged from 50 to 500 ounces per ton. The main fissure was developed for a total distance along its strike, approximating to 4,000 feet.

No ore-bodies were found below a depth of 780 feet, although prospecting was continued to 1,000 feet. At the 800-foot level the junctions of some of the veins with the "joint" were exposed, but no productive ore-bodies were found. In the lowest level, no serpentine was noted along what was considered to be the main "joint"

The total output of gold from Orange Mining Division, of which the greatest proportion by far was furnished by the Lucknow Mines, is approximately 504,790 ounces, valued at £1,718,181.

The Cullinga Goldfield

Cullinga is situated 9 miles southerly from Wallendbeen, a station on the Main Southern railway line, 251 miles from Sydney.

Gold was discovered here in 1892 on an area subsequently held by the Democrat Goldmining Company. The more northerly deposits worked by the Christmas Gift companies were opened in 1899. Since that year mining has been carried on more or less constantly. The total production of gold to the end of 1927 from the Cullinga field is approximately 29,269 oz., valued at £79,298.

The geological formations comprise altered sedimentary rocks, amphibolite, serpentine, and porphyry. The altered sediments are made up of silicified and indurated claystones and limestone altered in great measure to marble with which amphibolite and serpentine are associated. The alteration has been due to contact metamorphism induced by the intrusion of the mass of porphyry lying to the east of the belt of sediments.

Within a distance of 200 yards from the contact, the effect of metamorphic action may be seen to diminish appreciably. The sediments of the altered zone appear to have been crushed and shattered in narrow belts arranged approximately parallel to the main trend of the porphyry. Portions of the crushed and shattered areas appear to have been replaced by siliceous solutions accompanying the intrusion, and from these solutions sulphides of iron, copper, lead, and zinc, containing gold, were deposited.

The ore-bodies are irregular in shape, and the grade of ore is variable. As in all contact deposits the ore-bodies are discontinuous, being arranged as isolated masses, separated by blank zones. The western limit of the payable ore appears to be defined by a prominent wall dipping towards the porphyry at a high angle.

The production to date has been won principally from the Christmas Gift group of mines, and also from the Democrat Mine, about 2 miles south of the former. The deepest level yet developed is 200 feet from the surface in the Christmas Gift Mine. The main shaft of this mine is the deepest on the field being sunk to a depth exceeding 300 feet.

The gold occurs in the free state, even where associated with sulphides, and is amenable to treatment by battery crushing, amalgamation, and cyanidation. A considerable tonnage of ore is exposed in the large ore-body of the 200-foot level, Christmas Gift Mine. Winzes sunk below this level to depths of 50 feet or more, are understood to have exposed payable ore.

CONTACT DEPOSITS

Contact deposits are formed at or near the contact of an igneous rock and one which it has intruded. The older rock or one which has been intruded is usually sedimentary, but may be igneous in some instances.

The ore deposits have been produced by the action of mineral-bearing solutions and vapours accompanying the intrusive mass, a considerable amount of alteration being developed within a zone around the margin of the intrusion. In many places new minerals are formed, of which the composition represents a compromise between the constituents of the invading magma and those of the invaded rock. Structural alteration is produced also, and is reflected in areas of fracture and minor faulting, with zones of shear or crush in places, as at Cullinga.

In general, contact ore-bodies are very irregular in form and size, and are separated by zones of altered rock. In gold-bearing ores of this class the principal gangue is usually quartz or siliceous material, with relatively small quantities of calcite and pyrites, arsenical in part. The ore deposits of Lucknow and Cullinga are examples of bodies formed at or near the contact of an igneous mass.

The Lucknow Goldfield

Lucknow is situated 6 miles from Orange, near the main road to Bathurst. The rich deposits of gold-bearing material formerly worked in this locality, especially in the mines controlled by the Wentworth Goldfields Proprietary Company Limited, are unique both in mode of occurrence and nature of the ore. In general appearance the ore is constituted so peculiarly that it can be distinguished readily from any other ores of gold worked in Australia to date.

Some doubt appears to exist as to the exact date of discovery of the field, the earliest date advanced being 1851. Mining operations, however, were conducted extensively during the years 1862 to 1867. From this time until 1880 returns were furnished intermittently, principally from the Homeward Bound and New Reform mines. In 1881 the Wentworth Goldfields Proprietary Company Limited, was formed in London with a capital of £500,000. This company with its subsidiary - the Aladdin's Lamp Goldmining Company - worked the more important veins until 1900, producing approximately £800,000 worth of gold. A little gold was won subsequently by tribute parties, but no mining work of importance was done at Lucknow for many years after 1900.

In 1920 several syndicates were formed to test an area southerly from the old workings. Efforts have been made to discover the southerly extension of the main "Joint" or "contact" if such exist - but results to date have not been very encouraging.

The general geology of the Lucknow area is complicated and masked to a great extent by the presence of an extensive sheet of Tertiary basalt, which forms a capping to rocks of early Palaeozoic age. The older rocks comprise slates and two principal varieties of igneous rock of doubtful origin, known locally as "andesite" and "serpentine". Other varieties, mainly of basic and ultra-basic rocks, are present also but no detailed research having been carried out upon the petrology of the area, no satisfactory classification can be given. The structure, nature and origin of these rock types is complicated further by reason of the intense alteration to which they have been subjected in many places.

At the present time it is not possible to give any more than a short description of the mining geology as gleaned from examinations of the small area of gold-bearing rocks exposed at the surface and of the workings of the old Lucknow mines, now inaccessible.

A double "serpentine" and "andesite" contact is stated to exist over a distance approximating 3,000 feet, the maximum width of the serpentine exposed being 1,200 feet. The western contact of the two rock types is known as the main "fissure" or "joint". The general trend of the "joint" is north-west and south-east, but many sharp changes in direction and breaks in continuity were noted in the old workings. The dip varies from horizontal to vertical, with an average of 60 degrees towards the north-east. In general the north-eastern or hanging-wall is formed of "serpentine", while the footwall is "andesite". In some places, however, the -joint- is in "andesite", while in other places the walls are formed of altered rocks dissimilar to the types already mentioned. No "serpentine" was found at a depth of 1,000 feet in the Wentworth Proprietary Mine.

from this field during the first twenty-five years of work, no yield of high-grade ore has been forthcoming from bodies proven or prospected in more recent years. No attempt appears to have been made to prove the presence or otherwise of saddle reefs underlying those already worked.

4. Replacement Deposits

In many places large ore-bodies have been formed by the removal of the original constituents of rocks by mineral-bearing solutions and the precipitation of new minerals by a process of substitution or replacement. The action has taken place generally under conditions of considerable heat at great depths below the earth's surface. Replacement deposits occur in New South Wales in many localities, particularly in the Central-western and Western Districts, as at Cobar and Broken Hill. They are developed either along zones of great strain, with faulting in places, or in rocks adjacent to such zones which have been crumpled and drag-folded by earth movement. These replacement deposits occur mainly within ancient rocks which have suffered much alteration. The ore-bodies are arranged in the form of large lenses within the zones of strain or as masses of irregular shape in crumpled beds..

Gold may occur in the free state in a gangue composed mainly of quartz or siliceous material, or may be present in ore-bodies mined specifically for such metals as copper, as at Cobar, or silver, lead and zinc, as at Broken Hill. In the latter examples the gold is associated intimately with sulphides of copper, iron, lead and zinc.

The Cobar District

The Cobar district is famous for its production of copper, but, in addition, a considerable quantity of gold has been won both from gold ores proper and gold-bearing sulphide ores worked principally for their copper contents.

The principal mines from which gold has been produced are the Great Cobar, the Cobar Chesney, the Cobar Gold, the Peak, the Occidental, and the Mount Drysdale. With the exception of the Occidental, these mines were worked mainly by the Great Cobar Limited. The total quantity of gold won from these mines from 1887 to 1927 is approximately 629,086 ounces fine. Returns prior to 1887 are not available.

The Great Cobar Mine - In addition to the copper recovered, a total of 288,680 oz. fine of gold was produced from the Great Cobar mine, and the mines held in the same interests during the years 1898-1919. It should be noted also that a large quantity of gold, of which there is no specific record, was contained in refined copper, the product of Great Cobar Limited, shipped overseas in the earlier years of mining.

The Cobar Gold-mine - The total production of gold from this mine for the years 1890 to 1910, inclusive, is approximately 123,586 ounces, valued at £386,400. Returns subsequent to 1910 are included in the figures for Great Cobar, Limited.

The Chesney Mine - From 1887 to 1903 inclusive, 4,657 ounces of gold were won. Returns subsequent to 1903 are included in the figures for Great Cobar, Limited.

The Peak Mine (see also under -Silver, Lead, Zinc, Cadmium, page 154). - Gold is the principal mineral mined at The Peak, although rich silver ore has been won in some places. The gold produced to date has been extracted from rich shoots of ore occurring within a mass of silicified and altered country, which in itself may be considered a low-grade ore-body. The workings are shallow, the deepest shaft being the Conqueror shaft, sunk to a depth of 289 feet.

The production of gold is difficult to estimate, as, in some years, the output was treated in conjunction with other ores at Great Cobar, Limited. In addition to the amount of gold refined from Great Cobar matte, approximately 20,000 ounces of gold, valued at £80,000, were extracted from ores mined at The Peak.

The Occidental Mine. - The Occidental Mine appears to have been taken up originally for copper in 1872. The earlier prospecting was disappointing. In 1889 the mine was acquired by the Occidental Gold-mining Company, and, until 1921, proved a consistent producer, the total output of gold probably exceeding £750,000 in value.

available bodies of rich gold-bearing ore were exhausted in two years' work, and since 1872 no ore-bodies comparable in size or richness with these earlier discoveries have been mined. The most remarkable mass of gold in quartz ever found was unearthed in Beyers and Holterman's claim during this earlier mining campaign. The first stamper battery used in Australia was erected on "The Old Company's" ground about 2 miles north of Tambaroora.

The ore deposits occur in three main types - (1) Veins parallel to bedding planes In old rocks, mainly comprised of schist, phyllites, slates, and altered sandstones; (2) irregular masses of quartz along the unconformable junction of younger and older rocks; (3) "saddlereefs" in the younger rocks.

Of these the first group is the most important by far, comprising the whole of the reefs worked at Hawkins' Hill in the early days, and from which the largest quantity of gold has been won. The reefs appear to be composed of a network of veins and veinlets of quartz in beds of slate. The slate between the veinlets is partially replaced and silicified in many places. In general the veins are more or less parallel to the bedding planes of the enclosing rocks, and together with the slate form collectively a reef in which the average gold values may be sufficiently high to permit of profitable mining of the full width of the slate bed. In some places there is evidence of movement on a large scale, particularly along the course of the reefs. Several cross-courses have been recognised, some of which are of the nature of faults, which have displaced the reefs, but the extent of movement is apparently small.

The quartz composing the veins has resulted partly from direct crystallisation and partly from replacement of slate. Fragments of unreplaced slate enclosed within quartz are a common feature in the ore-bodies. The gold occurs in defined chutes, having a limited extension in all directions. The principal gangue mineral is quartz, but in one remarkable instance, namely, that of the Mica Vein, exceedingly rich gold-bearing material has been mined from chutes of ore in which the gangue is composed almost entirely of muscovite or white mica. Calcite is a common constituent of the ore, and small quantities of iron pyrites, arsenical pyrites, zinc-blende, and galena are present.

The saddle reefs in the younger rocks appear to represent the forcing apart of bedding planes on the apices of anticlines by the entry of ore material. They are thickest on the crest of the fold and generally thin rapidly along each limb. The quantity of gold won from these deposits is very small, and they are relatively unimportant as ore-bodies, the gold contents being poor and sporadic in distribution.

Mining has been carried on intermittently for many years, and attempts have been made to develop the ore-bodies at depths lower than the old workings. Several companies were formed to prospect new ground, but very little organised mining work appears to have been done. Operations have been confined mainly to the upper levels more or less alongside the positions of the rich chutes formerly worked. The amount of gold won in these later campaigns has not been sufficient to pay more than the costs of mining.

The total production of gold from the Hill End Mining Division approximates 689,958 oz., valued at £2,610.755.

The Hargraves Goldfield

The Hargraves goldfield, situated 24 miles southerly by road from Mudgee, was one of the first to be discovered, the celebrated Kerr's Hundredweight being unearthed close to the present village of Hargraves in July, 1851.

Two main types of gold-bearing reefs were mined - (1) Saddle Reefs and (2) Flat Reefs - the former being the more important. Six distinct lines of saddle reefs were proven to occur, and, at Big Nugget Hill, three saddles were intersected in vertical sequence.

The "Flat Reefs" were more or less horizontally disposed and generally very narrow. Rich gold occurred along the intersection of the reef with an indicator composed of a band of dark greenish slate enclosing a very thin band of quartz.

Reef-mining has been carried out at Hargraves in a desultory and intermittent manner for a period exceeding seventy years. With the exception of the high yields of gold obtained

The most remarkable gold-bearing ore-body yet worked in New South Wales, namely, the Mount Boppy lode, is disposed in the form of an "inverted saddle reef" in part. Several "saddle reefs" are known to occur at Hill End, Tambaroora, and Hargraves.

The Canbelego Goldfield (Mount Boppy Gold Mine)

In the neighbourhood of Canbelego perhaps the most important gold-bearing lode yet developed within the State was mined extensively from 1898 to 1923. The one outstanding gold mine in this district - the Mount Boppy mine - was such a consistent producer that it is considered to be the most celebrated yet worked in New South Wales. The value of the output of gold from the lode in question exceeds £1,840,000, and is probably greater than that from any other lode in the history of gold-mining in this colony. An additional feature of interest lies in the fact that the Mount Boppy lode was not discovered until 1896, so that the mine was the youngest among those of any importance.

Canbelego is situated about 39 miles by road from Florida railway station. on the branch line from Nyngan to Cobar, at a distance of 445 miles from Sydney.

The first discovery of gold near Canbelego was made about the year 1889, but it was not until September, 1896, that the Mount Boppy lode was found.

The Mount Boppy Gold-mining Company was formed in England in 1900 to acquire the property formerly under the control of another company. The mine was developed to the fullest possible extent. Modern treatment works were erected at various times during the mine's history. At present only a relatively small quantity of low-grade ore is known to exist in the mine.

In reality the lode is a peculiar form of inverted saddle reef. due in great measure to the action of replacement along bedding planes. The eastern leg has been developed for a length of 1,840 feet. and worked to a depth of 800 feet from nine levels, of which the uppermost or 100-foot level is the longest. The greatest length of workings on the western limb does not exceed 600 feet. The lode consisted mainly of impure quartz and silicified slate, and its content of copper, iron, lead, zinc, and sulphur was small. Gold was present in intimate association with the sulphides below water level, but free gold occurs also in places below this level. "Paint gold" has been recorded in tiny veinlets traversing the slate in the centre country.

The oxidised ore was of free-milling nature. The sulphide ore was treated originally by a system comprising amalgamation, concentration, cyanidation of sands by percolation, and cyanidation of slimes by filter pressing. Modifications were made in this system of treatment, and a new plant erected in 1913. Extraction results were very satisfactory. the recovery of gold contents exceeding 86 per cent. Residues contained approximately 1.3 dwt. of gold per ton. The average recovery from the total tonnage of ore treated, was approximately 8 dwt. of gold per ton. The sulphide ores, as mined, assayed 10 to 12 dwt. of gold per ton.

The production from the mine under the control of the Mount Boppy Gold-mining Company, Limited, was as follows: - Ore crushed, 1,081,812 tons; tailings treated, 480,646 tons; slimes treated, 578,697 tons; residues treated, 59,232 tons; gold won, 432,816.86 oz. fine; value, £1,841,281.11s.9d. In addition, approximately 300 oz. of gold, valued at £1,200, were obtained from ore mined prior to the formation of the Mount Boppy Gold-mining Company.

The Hill End-Tambaroora Goldfield

Hill End is situated about 30 miles north by west of Bathurst, but, owing to the rough nature of the intervening country, the journey by road covers a distance of 56 miles. Tambaroora lies about 3 miles northerly from Hill End. Alluvial gold was discovered near Hill End in 1851. Soon afterwards, it is believed, the first claim for reef-mining in New South Wales was granted over an area embracing Sargent's Hill. In 1858 and 1859 several reefs were worked along the slopes of Golden Gully, and in 1860 the first reef was discovered on Hawkins' Hill, although gold had been won by surfacing in this locality for five years previously. The most successful mining appears to have been done at Hawkins' Hill between the years 1870 and 1872. Enormously rich chutes of gold-bearing material were found and worked over a length approximating 2,000 feet, and for depths ranging from 400 to 900 feet. The

Gold was discovered near Grenfell in 1866. Since that year, approximately 334,121 oz. fine have been obtained both by alluvial and reef mining. Of that quantity fully 180,000 oz. were obtained from ores mined near Grenfell prior to 1871.

The rocks in the neighbourhood comprise slates and quartzite of Silurian age, which have been intruded by igneous rocks known as granite and porphyrite. Within the latter the more important reefs are developed, but smaller lodes have been worked within the granite. Wherever the reefs were observed to pass from the porphyrite into the neighbouring slates, the gold values were found to decrease appreciably. The porphyrite has a width of 5 to 25 chains, and a length approximating 1½ miles.

The principal mine, known as the Grenfell Consols, developed and mined O'Brien's Reef to a depth of 750 feet on the underlay, the latter being 56 to 65 degrees in a direction 40 degrees west of north - A considerable quantity of ore containing an average of 1 oz. per ton over widths of 1 to 10 feet, was mined above the 530-foot level. Below this level, however, prospecting failed to reveal an ore-body of grade sufficiently high to permit profitable extraction. From November, 1866, to the time of purchase by the Grenfell Consols Gold-mining Company, this mine produced 33,494 oz. of gold.

Other reefs worked were known as The Victory, Homeward Bound, Frenchman's, Enterprise, Welcome Home, Band of Hope, Lawson's Golden Point, White Rose, Perservance, Prussian, Young O'Brien's, and Oriental.

A considerable quantity of gold was obtained also from alluvial deposits in shallow and deep leads derived from the disintegration of porphyrite and granite. The depth of sinking was from 40 to 200 feet, and the yield of gold was as much as 2 oz. per load of wash-dirt. The principal leads were known as The Grenfell Deep Lead, the Seven Mile, Chance Gully, Peep-of-Day, Eureka Flat, Stuart's Gully, Quondong, Milkman's Slaughter Yard, and Two-mile.

Bribaree

The Bribaree mines are situated about 4 miles south-east of Bribaree railway station, on the connecting railway from Forbes to Stockinthal. Gold was discovered in this locality in May, 1922, and a syndicate formed to work the deposits. In 1923 the Bribaree Combined Gold Mines, N.L., was registered, and a 10-head battery erected.

The geological formations in the immediate neighbourhood of the lodes comprise sandy slates and shaley sandstones, in part altered by the introduction of silica. About 4 miles south-westerly from the mines granite outcrops. The lode channel ranges in width from a few inches to 4 feet, with bulges to 8 or 9 feet in places, but the maximum width of the lode material is 2 feet only. The lode material is mainly quartz with stainings of iron and manganese oxides. There is evidence of considerable faulting, both prior to and subsequent to the formation of the lode. The total production from the Bribaree mines to the end of 1927 is as follows:- Quartz crushed, 3,069 tons; gold yield, 5,236 oz.; value, £19,088. In addition, 2,200 tons of sands yielded gold valued at £1,835.

3. Saddle Reefs and Deposits arranged parallel to Bedding Planes

Many gold deposits in the State are arranged between, or parallel to, the planes of bedding of sedimentary rocks. The ore bodies may be composed of quartz with subordinate amounts of calcite and pyrites in places or may be formed of a number of veinlets of quartz separated by bands of altered shale and sandstone. In some occurrences, the gold values are not confined to the quartz alone, but are present also in the altered rocks in a manner such that the **whole** width of a bed may be mined profitably. Certain members of the ~kins' Hill Reefs at Hill End are of this type, although the ore-bodies appear to represent replacement of slates in part.

"Saddle reefs" are peculiar types developed in folded rocks on the crests of anticlines or arches and at the bottoms of synclines or troughs. The forms occupying synclines are known as "inverted saddle reefs". The ore-bodies of these types are due partly to the separation of bedding planes by pressure and partly to replacement. In some places, as at Bendigo, several "saddle reefs" and "inverted saddle reefs" in vertical succession have been exposed in mine workings.

The most important mine in this neighbourhood was that known as the Prince of Wales, on portion 194, parish of North Gundagai, county of Clarendon, at Kimo, about 5 miles north-west of Gundagai. Here the reef occupies a fissure developed between crushed conglomerate, which forms its foot-wall. and slate on the hanging-wall. The lode was worked over a width of 4 to 30 feet, and a maximum length approximating 1.400 feet on the 200-foot level. The lowest level developed is at a depth, approximately, of 500 feet.

The ore in the upper levels had an average grade of 10 dwt. per ton, but the grade of ore exposed in the lowest level was not more than 5 dwt. per ton. A remarkable feature of the ore-body was the presence of tellurides of gold, in the form of calaverite and coloradoite, associated with free gold, and telluride of bismuth (tetradymite). The quantity of tellurides present, however, was very small.

The mine was worked from 1897 until 1901 by the Howell Consolidated Gold-mining Company, 72,464 tons of ore being treated for a return of 23,342 oz. of gold, valued at £86,786. 10s. 8d. An additional amount of 3,000 oz. approximately, was won by tribute parties until 1910, since which time very little mining appears to have been done.

A considerable amount of attention has been given to deposits of gold bearing material developed in the Long Tunnel Mine, about 8 miles west of Gundagai, on portions 138 and 139, parish of Kimo, county of Clarendon. The ore-bodies occur at the contact of altered slates and diorite, with which serpentine is associated at the southern end. The lode material consists of quartz, calcite, and talcose rock, which, in places, contains copper and iron pyrites, zinc-blende, and galena, the latter being abundant on the 400-foot level.

The average values are low; many lean zones are present, and the gold produced has been obtained from irregular masses of enriched material in widely separated portions of the ore body. As far as can be ascertained from the official records, the total amount of gold produced from the mines in the Gundagai Division since the year 1875 is approximately 132,187 oz., valued at £ 506,511.

The Peak Hill-Tomingley Goldfield

Tomingley is situated about 3 5 miles south-west of Dubbo and 12 miles northerly from Peak Hill. Gold-mining appears to have begun at Tomingley about the year 1883. The Peak Hill lodes were discovered in 1889.

The rocks in the neighbourhood of Tomingley and Peak Hill comprise slates and sandstones of Ordovician age,* much altered in places. A number of diorite dykes intersect the quartz veins, and have been productive of enrichment in some places.

In general, the ore-bodies are low-grade, but a considerable amount of gold was won by direct cyanidation, particularly at Peak Hill and The Myalls.

The principal mine, known as the Peak Hill Proprietary, mined an ore-body to a depth of 650 feet. the main shaft being 700 feet deep approximately. The output was maintained well until 1917, when there was a considerable decrease on account of the difficulty experienced in the profitable treatment of the low-grade pyritic ores of the lower levels. As far as can be ascertained from official returns the total amount of gold won from ores mined in the Tomingley- Peak Hill Goldfield is approximately 231,599 oz., valued at £848,102.

The Grenfell Goldfield

Grenfell is situated about 275 miles from Sydney, and may be reached by train from Blayney on the Main Western line, or Flarden on the Main Southern line.

* Graptolites were found in the slates by Mr. F. Danvers-Power, and determined as of Ordovician age by Mr. W. S. Dun of the Geological Survey.

The principal reefs of this type are:- The Magpie, McGuiggans, Victoria, London, Newhaven, Band of Hope, Mount Morgan, and Strickland. The deepest mines are the Lachlan, at Forbes, 610 feet., and the Koh-i-noor, at Parkes, 988 *feet*.

(c) Saddles. - These appear to be represented in places.

The total output of gold from the Forbes-Parkes Goldfield from 1861 to the present is approximately 610,855 oz. fine.

Drake

Drake is situated about 33 miles easterly from Tenterfield. Gold has been extracted from ores mined from several lodes, which occur in rocks of Permian age. In some places the ore-bodies contain copper and gold, while in others these two metals are associated intimately with lead and zinc, together with small quantities of silver. The vein material is composed mainly of mixed sulphides, principally iron pyrites and quartz. The ores of copper are chalcopryite, black sulphide, and oxides, the copper content of the vein material approximating 4 or 5 per cent.

The country rocks consist of rhyolite tuffs, breccias, and agglomerates, together with lava flows. In certain cases dykes of igneous rocks form walls of the lodes, while in other cases the lodes appear to be related to the occurrence of such dykes in their vicinity.

The mines were worked originally for gold. but copper is now the more valuable product.

The principal mines are the Pioneer, the Adeline, the Lady Mary, the Kyloe, the Mount Carrington, the Red Rock, the Poor Man's Friend, and the Rainbow.

The Mount Bombandy Deposits

Gold was discovered here in 1923, and a considerable amount of prospecting has been done, but the results have been disappointing.

Mount Bombandy is situated 22 miles west- south-west of Rylstone. The rocks in the vicinity comprise slate, sandstone, and quartzite overlain by conglomerate. Several well-defined reefs were located. Free gold and arsenical pyrites were detected in the quartz.

Gundagai Goldfield

Gundagai is situated on a breach line from Cootamundra to Tumut, at a distance of 301 miles from Sydney.

Mining for gold has been carried on intermittently for many years at several localities in the neighbourhood of Gundagai. Reef mining has been confined principally to deposits developed at Kimo, Bark-Hut, Tarrabandra, Spring Flat, Bongongolong, and Reno. while gold has been won from alluvial deposits along the Murrumbidgee River at Jackalass, and also at Stony Creek.

The rocks in the neighbourhood comprise slates and conglomerates of Silurian age, associated with quartz porphyry, diorite, and serpentine. In many places the rocks exhibit features of strong crushing and shearing.

The gold-bearing ore-bodies are of three main types:-

(a) Normal quartz veins occupying fissures in crushed sediments; (b) Lenses of slate replaced by chalcedonic quartz; and (c) Deposits formed at or near the contact of serpentine and sedimentary rocks.

Calcite, iron pyrites, and galena are prominent constituents of the gangue in some places.

The most important mine which has been worked on this field is known as the Gibraltar Consolidated. The deepest level is 1,200 feet below the surface in the O'Brien workings. No ore was discovered at this depth, and the ore-body at the 1,100-foot level being very low-grade, the mine was closed in 1916 after a continuous production for thirty years. The total output of gold was approximately 125,000 oz., valued at £500,000. One dividend only of Is. was paid by the old company. In 1921 the New Gibraltar Consolidated Gold-mining Company was formed to acquire and work the mine. The production in recent years has been very small. The total output of gold from reefing claims in the Adelong field has been estimated at 350,000 oz., valued approximately at £1,300,000.

The Forbes-Parkes Goldfield

Parkes is 272 miles and Forbes 292 miles by rail from Sydney, via Orange and Molong, Forbes being 20 miles south of the sister town. In the neighbourhood of these two towns and throughout the belt of country extending between them a considerable quantity of gold has been won, principally from the rich gold-bearing alluvium of the deep leads and subordinately from a number of reefs mined. Reference has been made elsewhere to the deep leads of Forbes, and the lodes only will be described briefly here.

Gold was discovered in 1861 in alluvium, and soon a population of 28,000 persons was reached at Forbes. Within two years from that date about 300,000 oz. of gold were won. The first discovery of reef gold was made at Billabong, near Parkes, in 1862. The earlier ventures were disappointing and mining ceased practically in 1867. The Bushman Lode at Parkes was discovered in 1876-1877 and reef mining was carried on intermittently for some years. The famous Lachlan Mine at Forbes was pegged in 1896, and soon became an important producer. Since 1907 mining at both Forbes and Parkes has been at a very low ebb, and the production since that year has been practically nil.

The geological formations in the neighbourhood of Parkes and Forbes consist of sedimentary rocks of Ordovician, Silurian, Devonian, and Pleistocene age, intruded in places by granite and andesites. Contemporaneous lava flows of glassy andesite occur interbedded with the oldest sediments. The gold reefs occur within a belt of pre-Silurian or Ordovician rocks having a general northerly trend between Forbes and Parkes. The geological formations within this belt comprise highly altered breccias, tuffs, sandy shales, slates, and limestones, intruded by sills of andesite. Interbedded flows of glassy andesite are present also in places.

The ore deposits are of three types, of which (a) and (b) are the most important:-

(a) Quartz veins associated with intrusive andesite. (b) Gold-bearing quartz-bodies arranged along zones of crushing. (c) -Saddles- have also been recorded.

(a) Quartz Veins Associated with Intrusive Andesite. - A number of veins containing gold were worked in close proximity to a compact augite andesite having a north and south strike conformable with the general trend of the altered sediments. In places the veins follow the junction of the andesite and sediments, while in others they intersect obliquely the igneous rock. These ore-bodies are not contact phenomena, but represent replacement action in the main, for example in the Britannia Lode. The principal reefs of this type are:- The Britannia, Lachlan, Nil Desperandum, North Lachlan, Federal, Nibbler's, Koh-i-noor, Buchanan, Phoenix, Bonnie Dundee, Bushman, Pioneer, Dayspring. and several minor veins. The principal lode material was quartz, with which iron and arsenical pyrites, fahlore, calcite, and small quantities of copper pyrites and galena were found. Carbonaceous slates were present in many places, and may have been responsible for some precipitation of gold.

(b) Gold-bearing Quartz Bodies arranged along Zones of Crushing. - Zones of crushing, or shear zones, occur within the pre-Silurian sediments, having a strike generally parallel to the bedding planes of the enclosing rocks. In places the weaker rocks have been crushed and altered to schists, while the more stable and resistant beds, such as indurated claystones and cherts have not been cleaved, but simply crumpled. The ore-bodies are large lenses arranged along the crush zones, having a very variable width. Each large lens is composed of a number of small "eyes" or lenses of quartz, arranged parallel to the main contour of the larger body, and cemented by siliceous material. which was proved to be gold-bearing in many places.

1 C. Gold in Permian Conglomerates.

In the neighbourhood of Tallawang, to the north of Gulgong, gold in payable quantities was obtained in 1875 from conglomerates which form the base of the Upper Coal Measures. Yields of 1 to 1.5 dwt. and nuggets of 5 oz. weight were won. While it is likely that similar gold-bearing conglomerates may be found to occur elsewhere the existence of payable gold in these rocks, over considerable areas, is hardly probable.

2. Lodes or Veins.

This type of ore-deposit includes lodes or reefs occupying fault-planes, fissures, and joints. True fissure veins are those in which the lode material occupies the space between the walls of faults and fissures. They are usually tabular in shape, and relatively narrow in cross-section. The angle of dip is variable, and the ore is arranged in many places in chutes within non-productive lode material.

In places a great number of planes of separation or of weakness in sedimentary or igneous rocks occur filled with quartz or other gangue minerals containing gold. These form what are known as "stockworks," and are so arranged that the whole mass, in certain cases, may be mined profitably.

The principal constituent of the gangue of gold-bearing lodes is quartz; calcite is a common associate, while barytes and fluorspar are present in some veins. In the Hawkip Hill veins (Hill End), the gold, where richest, was associated with potash mica instead of quartz. In the oxidised portions of lodes limonite, malachite, azurite, and cuprite are found in many places. In the sulphide zone, below water-level, gold is associated commonly with either iron pyrites or mispickel, and to a less extent with galena, copper pyrites, zinc-blende, pyrrhotite, and stibnite.

In some places the gold occurs in fragments and films through the solid quartz, but is found more usually in the upper portions of lodes, in the cavities left by the decomposition of pyrites. Below water-level the gold is found both in the free state and in the sulphide minerals.

The occurrence of large masses of gold in lodes. - At least two notable discoveries of large masses of gold from lodes have been recorded within the State. The largest of those masses, known as Beyers and Holterman's Nugget, was found at Hill End in 1872. The dimensions were - height, 4 feet 9 inches., width, 2 feet 2 inches. It weighed 630 lb., and contained, approximately, £12,000 worth of gold. This specimen is the largest yet recorded in the world.

In 1851 a mass known as Kerr's Hundredweight, was discovered at Hargraves, by an educated aboriginal, who had been in the employ of Dr. W. J. Kerr, of Wallawa. The specimen was broken into three pieces, the largest of which was about a foot in diameter, and weighed 75 lb. gross. This piece contained over 700 oz. of gold. The total weight of the gold from the three specimens was 106 lb.

The Wyalong Goldfield

Gold was discovered at Wyalong in August, 1893. Wyalong is situated on the railway line from Cootamundra to Lake Cargelligo, 345 miles from Sydney. The country where gold was discovered consists of plains with a few isolated low ridges. The surface of the plains is composed, to a depth of 2 or 3 feet, of red and black clayey soils of Pleistocene age, with ironstone pebbles, and sub-angular fragments of quartz. The low hills in the vicinity of Wyalong are formed of hard rocks, such as diorite and hornblende-granite, with narrow belts of slate. The latter are probably of Upper Silurian age, and have been intruded by the granites and diorites.

The gold-bearing reefs occur usually in the hornblende-granite. In the vicinity of the reefs the granite is crushed, and gneissose structure is present. The reefs are lenticular, and vary in width from a fraction of an inch to 5 or 6 feet. The width varies considerably in short distances, both in horizontal and vertical directions. In many places along the strike of the reefs, unproductive lengths of lode material were met, and development costs were increased considerably.

The "leads" here considered represent the valleys of old rivers which formed drainage systems in middle and late Tertiary times.

Associated with the gravels occupying the beds of these old streams are nuts and leaves, fragments of fossil wood, trunks of trees, and occasional specimens of freshwater shells. The gravels themselves are very water-worn and well rounded, presenting a marked contrast to those of Pleistocene and recent drifts, which are sub-angular. owing to their having undergone less abrasion by the action of running water.

Many of the "leads" are covered by a thick layer of basalt, and the depth of the drifts below the present surface in consequence is considerable, ranging to several hundred feet. Hence, the common term "deep leads". Moreover, the gold-bearing gravels in many places contain large bodies of water, and, therefore, the difficulties in the way of recovery of the gold are very great, and, in very many instances, quite beyond the means of small working parties of miners.

The first "deepleads" worked in New South Wales were discovered at Forbes In 1862, the gold-bearing drift being followed from shallow ground. It is recorded that 235,043 oz. of gold were won in less than twelve months from a number of small claims. The depth of the gold-bearing alluvium was in many places considerable on the north lead, particularly where a shaft exposed very water-worn drift at a depth of 400 feet. The relatively low relief and a thick mantle of Pleistocene and recent alluvium in the neighbourhood of Forbes rendered difficult the tracing of the old stream valleys.

It would not be practicable in a small treatise, such as this, to describe all the Tertiary leads of the State. Many other leads have been worked in other goldfields such as Adelong, Albury, Braidwood, Grenfell, Gulgong, Gundagai, Kiandra. Rockley. Rocky River, Temora. Tumbarumba, and Corowa. With the exception of Gulgong no attention is being paid to any of these deposits at present. In recent years prospecting has been done at Gulgong by means of boring. The results were considered satisfactory, but subsequent developments have not been promising.

It is interesting to note that the total output of gold from the Gulgong field to the end of 1927 is 546,279 oz., valued at £2,174,916, inclusive of small quantities of reef gold won at such places as Red Hill, Salvation Hill, Louisiana and the Three Mile. Of the above total, approximately 490,000 oz. were produced prior to 1885, the field being discovered In 1870.

1A. (c) Cretaceous Alluvial Leads.

In the far north-western portion of the State "leads," in part buried beneath rocks of Upper Cretaceous age, known as the Desert Sandstone, occur at Mount Browne, Tibooburra, and The Peak. the lastnamed locality being situated between Kayrunnera and Tarella Stations. on the road from Milparinka to Wilcannia.

From evidence obtained at Mount Browne and Tibooburra, where the leads probably rest upon Lower Cretaceous rocks, the age of the deposits is regarded provisionally as Middle Cretaceous. Some very rich yields of gold were obtained in shallow and deep workings at Billygoat Hill, near Mount Browne.

1 B. Beach Sands.

Gold in a very fine state of division occurs in accumulations of "black sand" concentrated by wave action on beaches along the coast of New South Wales. the more abundantly between Byron Bay and Clarence Heads, and in less quantity between Port Macquarie and Cape Hawke, near Seal Rocks. and at Shell Harbour and Termeil. Tinstone. platinum, zircon, garnet, ilmenite and monazite are associated also in the sands.

The presence of gold was discovered first in 1870 and the sands have been worked intermittently to the present day. The proportion of gold content is very small. but, In the past, concentrates were produced and shipped abroad.

The principal mining, and, as yet the only payable work, has been done at McAuley's lead, south of Evans Head, between the Richmond and Clarence Rivers.

SOURCES OF SUPPLY

Gold-bearing deposits have been worked at a great number of localities in New South Wales, but in a summary statement of the position of the industry such as this It is possible to describe only those centres which are of the foremost importance.

The largest proportion of gold produced in New South Wales has been won from alluvial deposits and quartz reefs, but a large quantity has been obtained from the treatment of pyritic copper ores, mined particularly in the neighbourhood of Cobar. In addition, gold has been recovered in the treatment of ores mined essentially for their silver, lead, and zinc contents, principally from large, replacement ore-bodies at Broken Hill.

For the purpose of consideration of the sources of supply of gold it has been found convenient to arrange these notes under headings according to the mode of occurrence of the gold-bearing deposits.

1. Detrital Deposits or "Placers."

A. Alluvial deposits -

(a) Recent and Pleistocene alluvials. (b) Tertiary alluvial leads. (c) Cretaceous alluvial leads.

B. Beach sands along the coast.

C. Permian conglomerates.

A. - Alluvial Deposit

IA. (a) Recent and Pleistocene Alluvial Deposits.

The rocks exposed at the surface of the earth are undergoing continual decomposition, and are being broken down under the influence of weathering and stream action. Detrital material is accumulated in the more low-lying areas, and particularly along stream channels. In this manner gold contained in gold-bearing rocks and quartz reefs is removed and concentrated by reason of its weight in the lower layers of alluvium, and, more commonly, in coarse gravels and pebbly drift.

The newest alluvial deposits thus formed are termed -recent alluvials. " In some instances the shallow drainage channels were filled completely, and the gold covered by accumulations of sediment, while, in other instances, the deposits occupy the beds of large existing rivers such as the Macquarie or the Shoalhaven.

An older group of deposits known as "Pleistocene alluvials- occupy somewhat deeper channels than those mentioned above. These channels were filled with gravel, sand, and clay, and the recovery of the gold necessitated comparatively deeper sinking.

Recent and Pleistocene alluvial deposits being the most accessible were the first to be discovered. Rich returns were obtained from them in the early days of gold mining, but, although they occur in connection with most goldfields where gold-bearing reefs exist, production from these sources is now unimportant, with the exception of relatively small quantities furnished by dredges at localities such as Adelong and Araluen.

Formerly it was impracticable in many instances to extract by ordinary methods the gold contained in gravels occupying the beds of present-day streams, mainly owing to the presence of large bodies of water. This difficulty, however, was overcome by the introduction of dredges. Dredging for gold commenced in 1899 on the Macquarie River near Stuart Town. The total output of gold by dredges to the end of 1927 is 580,784 oz. fine, valued at £2,451,974.

1 A. (b) Tertiary Alluvial Leads or Deep Leads.

The same processes which now cause erosion of the rocks exposed at the earth's surface were active in past geological ages. In the Tertiary period rainfall probably was greater than at the present time, and the cutting power of streams much stronger. Likewise the quantity of material deposited along stream channels and in depressions was considerably in excess of the more recent accumulations.

3. Saddle reefs and veins formed between bedding planes.
4. Deposits resulting from the replacement of sedimentary rocks, especially parallel to bedding planes, by sulphide minerals with which gold is associated In many places.
5. Deposits formed along the contact of Igneous intrusive rocks.
6. Impregnations of gold in stratified deposits such as slate, quartzite, and volcanic tuff -
7. Impregnations in igneous rocks such as granite, serpentine, and felsite.
8. "Pipes" or "pipe-veins" occurring in siliceous granite.
9. Irregular deposits, such as masses of ironstone containing gold.

In some instances ore deposits containing gold possess features of structure and mineral composition which indicate that they have been formed under conditions which do not permit of classification under any one particular group. They are combinations of two or more of the types, enumerated above. For example, the ore body worked in the Occidental Mine, near Cobar, is in part, a replacement of crushed material along a fault or crush zone, in part a replacement of slates in the vicinity of the crush zone, and in part a series of "pressure lenses- within the crush zone.

Treatment

In the early days of gold-mining in New South Wales attention was given exclusively to alluvial deposits, the gold being recovered in pans, cradles, or sluice boxes. These methods are still used on small claims. In later years large and important deposits of sand and gravel, containing free gold, have been, and are being, worked by dredges, the alluvial material being sluiced or dredged and fed into sluice boxes, where the gold is caught on various forms of riffles or other devices.

With the advent of reef mining the ore was crushed by hand or in batteries, and the product washed for the recovery of free gold. Usually the residues from the first concentration were treated by amalgamation, a process by which mercury is added to the crushed ore.

"Refractory" ores, or those which contain substances injurious to mercury, and preventing amalgamation; compounds of gold such as tellurides; and ores in which the gold is present in very fine particles, were treated by cyanidation, chlorination, or smelting according to their nature, and various other considerations.

Complex ores, such as those mined at the Mount Boppy and Occidental Mines, were subjected to a process involving fine crushing and cyanidation.

Certain sulphide ores and complex mixtures of sulphides, mined principally for such metals as copper, lead, silver, zinc, and antimony, and composed of galena, copper, and iron pyrites, zinc blende, and stibnite contain gold in intimate association with the base metals. Such ores are treated usually by smelting or electrolysis or by a combination of both methods. Gold is recovered in refining the bullion or the precipitant remaining after the electrolytic process. A considerable quantity of gold has been obtained in this manner as a by-product from the treatment of copper ores from Cobar, C.S.A., Tottenham, and Nymagee, and of silverlead ores from Sunny Corner and Broken Hill.

Uses

The principal use of gold is for coinage and jewellery. Silver or copper is usually added to increase resistance to abrasion or wear. The purity or "fineness" of gold is expressed in parts per 1,000, the standard for coin in the British Empire being 916.6 parts of gold to 83.4 parts of copper. In England the legal standard for jewellery is the carat of 22, 18, 15, 12 or 9 parts per 24. For example, pure gold is 24 carats or 1,000 fine, British gold coin is 22 carats fine or 916.6 thousandths fine.

Gold is used also in photographic processes, as leaf in art and decorative work, in various chemical reagents, and in certain scientific instruments.

About the middle of March, 1851, Hargraves explained to Lister, James Tom and William Tom (a younger brother) how to make and use a cradle similar to that used in California. The cradle was finished before Hargraves left the district, and in Lewis Ponds Creek he demonstrated to the others how to use it. This cradle is now in the possession of the Royal Australian Historical Society at Sydney, and a model of it is on view at the Mining Museum, George street North.

Hargraves returned to Sydney about 20th March, 1851, while, during the remainder of the month, the Toms, by the use of the cradle, obtained 16 grains of gold in Lewis Ponds Creek. On a considerable extent of country and offered to indicate the localities for a reward of £500. This proposal was not entertained. About this time James Tom left Springfield for the Bogan River district to take delivery of some cattle. Lister and William Tom proceeded to the junction of Lewis Ponds and Summer Hill Creeks, near Orange, and there between the 7th and 12th April, 1851, they obtained about 4 ounces of gold, which was the first payable gold discovered in Australia.

Within a month there were a thousand persons engaged in mining along the Summer Hill Creek, and the news of the discovery of payable gold spread with amazing rapidity. Great excitement prevailed in Sydney and Melbourne, thousands deserting their employment to rush to the diggings. The authorities of the day were apprehensive of the grave consequence which would result from any disorganisation of the normal life of the community.

Prospecting operations were commenced throughout the country with the result that a number of the principal goldfields, not only in New South Wales but also in Victoria, were discovered in the same year. When the occupation of the pioneer prospectors ceased, they turned their attention to agricultural and pastoral pursuits and assisted materially to build up these great industries which now contribute such a great and increasing proportion of our national wealth.

Hargraves was granted a reward of £10,000 by the Government of New South Wales for his discovery, and was appointed a Crown Lands Commissioner. He was given also a sum of £2,300 by the Victorian Government.

The work of six days in April, 1851, was a fitting climax to months of patient search, in that the result has been the means of attracting population to our shores, of placing before the pioneers the great potentialities of the land of their adoption, of encouraging a flourishing mining industry. and of speeding-up the development of the great pastoral and agricultural areas throughout the continent.

Ores

The largest proportion by far of the gold won in New South Wales has been in the---freestate, either as -alluvial gold- resulting from the decomposition of gold-bearing rocks, or in lodes, veins, impregnations, and replacements of various types. In many ore deposits containing such metallic minerals as iron and copper pyrites, galena, and stibnite, native or ---free-gold, in very fine particles, occurs in intimate association with the sulphides.

Other important ores of gold are the tellurides - calaverite, sylvanite, and nagyagite. These minerals contain a higher proportion of gold than any other minerals excepting native gold itself. Silver, and, in at least one important instance, lead are constituents of telluride ores. Such ores have been mined extensively in Western Australia, but are rare in New South Wales and unimportant as a source of gold.

Mode of Occurrence

The principal types of ore deposits containing gold may be classified according to origin, as follows: -

1. Detrital deposits or "placers" composed of gravel and sand, compacted or uncompactd, resulting from the erosion of rocks which enclosed gold-bearing material.
2. Lodes or veins, composed usually of quartz or quartzose rock, occupying fault-planes, fissures. and joints. Stockworks are included here.

GEOLOGICAL SURVEY OF NEW SOUTH WALES

GOLD

E. J. Kenny

Introduction and History

The discovery of gold in payable quantities in 1851 was the means of encouraging a vigorous prospecting campaign, which led to further discoveries of valuable gold ores, and, subsequently, of important ore deposits containing valuable metals such as silver, lead, zinc, tin, and copper.

The romance attending the search for gold, and the expectation of fortunes thus to be quickly made, attracted pioneers and immigrants of the most desirable type to Australia. and thus assisted to stabilise, in the most material manner, the beginnings of its young nationhood.

To the period of marked prosperity into which the mining industry of New South Wales thus entered, the output of gold contributed 'in greatest measure. the value of the production of this mineral reaching a maximum of £2,660,946 in 1852.

The total production of gold in New South Wales to the end of 1927 is 14,968,346 ounces fine, valued at £63,581,454, or less than one-sixth of the value of the total output of all minerals produced in the State.

To the best of our knowledge the first reference to the occurrence of gold on the Australian continent is furnished by the Dauphin Chart(a map of Australia), dated 1530 to 1536, preserved in the British Museum. London. and which is believed to have been reproduced from earlier Portuguese charts. On this map the north-western coast of the continent is named Costa d'Ouro. meaning Gold Coast. However, ' the first authentic record of gold discovery in Australia is given in a field-book of Assistant Surveyor McBrien, and now in the possession of the Lands Department, Sydney.

In 1823 McBrien was engaged in the survey of a road along the Fish River, between Rydal and Bathurst. At one station in his traverse he records the following note:-

---AtE. (E. signifying end of survey line) 1 chain 50 links to river and marked gum tree. At this place I found numerous particles of gold in the hills convenient to river.---

This locality is on the north side of the Fish River, 3 miles east-south-east of Loc~sley railway station on the main line from Sydney to Bourke. A considerable quantity of gold was won in later years from the soil in the neighbourhood by the process known as "surfacing".

Subsequently many references to the occurrence of gold in New South Wales were recorded, but it was not until the year 1851 that the case for a widespread and thorough prospecting campaign was presented properly to the public. In April of that year there was enacted at Ophir a scene which was destined to place Australia upon the stage of national greatness, and the events which preceded the discovery read as a romance.

Edward Hammond Hargraves returned from the goldfields of California in January, 1851, impressed by the resemblance of the geological formations of the goldfields of California with those of the district around Lewis Ponds Creek, near Orange, which he had visited seventeen years previously. In February Hargraves proceeded to Gulgong and called at a hotel on the old Bathurst -Orange road. kept by a widow named Mrs. Lister, whose husband Hargraves had known years before. He then obtained the services of young John Hardman Australia Lister, promising that if he would guide him to Emu Creek, Lewis Ponds, and Summer Hill Creek he would show him where to find gold. They proceeded to a spot 2 miles above the junction of Lewis Ponds and Summer Hill Creek, and on 12th February, 1851, Hargraves washed out six pans of earth, obtaining a grain of gold in each, with the exception of one.

Later Hargraves and Lister were joined by James Tom, of Springfield, and they proceeded to Burrandong, returning up the bed of the Macquarie River. A little gold, known to miners as colours, was obtained in many places.

Hargraves then visited the Wellington- Dubbo district and, in the meantime, John Lister and James Tom visited the Turon River where they found a nice speck of gold.