GOLD IN CANADA

A. H. A. ROBINSON

MINES BRANCH
DEPARTMENT OF MINES
OTTAWA
1932

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CANADA
DEPARTMENT OF MINES
HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES BRANCH
JOHN MCLEISH, DIRECTOR

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BY

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PREFACE

The present report is an attempt to present in brief form for the non-technical, as well as the technical, reader a picture and description of the Gold Mining Industry that will show the character and extent of the mining and production operations now in progress at the principal gold mines in Canada. The statistical records and industrial descriptions are prefaced by short discussions of such topics as the physical and chemical properties of gold; its rarity and mode of occurrence; the history of its use, and the gold standard; the history of the world's production and Canada's present place amongst the world's producers; the types of ores from which it is produced, and the history of its production in Canada.

The Geological Survey Branch of this Department is concurrently publishing a geological report on Gold Occurrences of Canada.

The subject of gold is at the present time receiving such an enormous amount of attention and study in connexion with its position in the world's economic structure that the issue of these two reports would seem to be particularly opportune in presenting Canada's position as a producer of this metal.

JOHN McLEISH,
Director, Mines Branch.

June 18, 1932.

GOLD IN CANADA

CHAPTER I

INTRODUCTORY

The object of man's cupidity from the earliest times, gold has been perhaps more influential than any other metal in shaping the course of human history. The lure of gold has drawn men to the remotest corners of the earth and thus paved the way for settlement and civilization in many new countries. It has been a fruitful source of wars and of many other of the strenuous activities, both good and evil, of the human race. A somewhat remarkable fact regarding the influence that has been exercised on human affairs by gold is that this has not been due to any intrinsic, specially useful qualities of the metal but to the importance that has been attached to its mere possession. In other words the value placed upon gold is purely symbolic; at no time has it been desired merely for the industrial uses to which it could be put and the material services it could render to mankind. Valued at first as an ornamental substance of considerable rarity, it soon became a common intermediary in barter and exchange, a function which it has shared at different times and places with silver, copper, iron, and even salt, corn, oxen, cloth, beaver skins, and shells. The acceptability of substances other than gold for monetary purposes, with the exception of silver, has, however, always been confined within comparatively narrow limits in time and space; so that gold, always and everywhere held in high esteem, finally became an accepted standard of value throughout the greatest part of the civilized world.

Outside its principal and most essential use as a universal medium of exchange, making commerce possible among the peoples of the earth, gold finds its chief application in the manufacture of jewellery, gilding and other forms of ornamentation; in the manufacture of fountain pens; and in dentistry, for the filling of teeth, bridge work, etc.

THE GOLD STANDARD; AND THE ECONOMIC IMPORTANCE OF GOLD

Gold is the only substance that is freely accepted in return for all services and in exchange for all other commodities, in all parts of the globe—the one commodity the market for which is never glutted. The chief interest in gold therefore does not lie, as is the case with most metals, in its industrial applications, but in the quantity that can be produced, and the way in which when produced it is applied to facilitate trade and commerce.

The gold standard simply means that in countries in which it is in force gold is the basic money and standard of value and that all other kinds of currency are redeemable in gold.

Following, and doubtless suggested by its use as an ornament by primitive man, gold soon came to be used also as money; and the nations of the ancient world maintained until sometime in the Middle Ages a monetary system that may be broadly described as a double standard of silver and gold. Beginning with the eighth century, however, a single silver standard of coinage became prevalent and remained so until some time in the thirteenth century when the double standard of gold and silver was again introduced and remained in vogue until well on in the nineteenth century.

The pre-eminence of gold as the monetary metal is quite a new thing; and it is due to an historical accident. An English coinage act of 1816 provided that from a day to be fixed by Royal Proclamation the mint should buy and coin silver at a price of 62 shillings an ounce. The object was that gold and silver coinage should both be used in England. . . . . However, no proclamation was made, and England was safe for the gold standard.

When England, in the second half of the century, had risen to a place of commercial predominence, other nations found it desirable to have the same standard. The English pound was exchangeable into a fixed weight of gold. By making their currencies legally exchangeable into fixed weights of gold the others made them exchangeable also into fixed numbers of English pounds. Thus when two countries are both on the gold standard the exchange rate between their currency is thereby fixed. And the more countries adopted the standard the more desirable it became for other countries to abandon silver or other standards and join the fixed-exchange-rate union of the gold standard.[1]

Portugal followed England onto the gold standard in 1854; Germany, in 1871; the United States, in 1873; the Scandinavian countries, in 1874; Holland, in 1875; France and the Latin Union, in 1876; Austria-Hungary, in 1892; British India, in 1893; Japan, in 1898, and Russia in 1899. Up to the present China is the only country of importance that has failed to adopt the gold standard; and those countries that have once adopted it have adhered to it except when compelled to abandon it temporarily on account of wars and financial crises.

There is a popular notion that a country can stay on the gold standard simply by refusing to pay out gold for export and thereby maintaining the legal gold reserves. But the mere existence of reserves has nothing to do with the gold standard. This is demonstrated by the fact that England has held her legal minimum gold reserve all along, while she has admittedly been off the gold standard since the Bank of England refused to sell gold last September. Obviously, gold that is to be kept immobile in bank vaults might just as well have been left immobile in the gold mines—except for the magic-confidence producing effects which an unseen, unapproachable gold reserve exercises upon a non-comprehending public. It is not the mere existence of gold but the unhampered movement of gold, resulting in stable exchange rates, that is the essence of the gold standard.[2]

To the gold miner—as a miner—the gold standard is chiefly of interest because, thanks to it, he can always get a fixed minimum price, and always has an unlimited market for his product; any general substitution of another standard for gold would seriously affect the prosperity of his

[1]A. F. W. Plumptre: "The Gold Standard. How it Grew and What it Means"; University of Toronto Monthly, November, 1931.
[2]Op. cit.

industry. In view of the widespread interest that recent events have aroused in gold and its use, it may not be out of place to insert here some quotations taken from the writings of bankers and economists, which have a bearing on the place of gold in the world's financial systems and indicate some of the implications involved in the gold standard.

The desirability of measuring for purposes of trade all commodities by one and the same standard of value is obvious; it is also obvious that the material chosen for this standard should, as far as possible, be one not liable to changes in its relationship to the whole body of commodities by reason of undue changes in its plentifulness or otherwise. Gold is the substance that the greater part of the world has decided is best adapted to fulfil this requirement.

Its success in this capacity is not absolute, for the production of gold naturally does not expand or contract in correspondence with cycles of prosperity or of depression in the world's trade, nor can it be relied upon to increase in just relation to that of the world's population, nor can supplies be adjusted automatically to any reduction in its use caused by the adoption of other methods of payment. On the contrary the search for gold continues, whether additional supplies of the metal be needed for the world's currency requirements or not;[1] the reason for this is the existence under the gold standard of "free mints," a free mint being one which receives gold bullion, or foreign coins at a figure based on the fine gold content and gives out in exchange legal tender gold coins of the country concerned; in some cases a small deduction, called seignorage, being made to cover the expense of minting. Thus in all countries enjoying a gold standard the possessor of gold in any form can always obtain an equivalent in gold legal tender currency at a fixed rate in relation to the fine weight of gold in his possession. The word "equivalent" is used because the function of a mint in some gold standard countries has become atrophied from lack of use—gold currency having ceased to be maintained in circulation. . . . .

In currency systems based upon a gold standard, a unit of money containing a certain defined quantity of fine gold is designated, but it does not follow necessarily either that there is occasion to mint the coin, or, if it be minted, that it circulates within the country of origin. Hence, something more than the mere existence of a gold standard coin is necessary to render gold an effective basis of currency.

Provided confidence exists in the issuing authority, it is practically immaterial of what substance money be composed. Articles of the most varied character, feathers, dried fish, rum, etc., have been employed in this way, their usefulness being somewhat marred by their perishable character. In highly civilized communities the tendency is for money to be expressed by a material practically of no intrinsic value at all, namely, paper, but possessing effective value as a lien upon the credit of the issuing authority. It is of supreme importance, however, that a state should enjoy the confidence of its subjects as to one important detail, namely, that when they have occasion to discharge indebtedness, incurred by them outside the state, the money in their hands—be it silver, copper, or paper—shall be exchangeable into currency considered good enough for their connexions abroad without loss to the present holders. Gold currency is almost universally thus accepted.[2]

The advantage of a common basis of currency throughout the world like that which the gold standard now largely forms, is that it facilitates trade between one country and another, by tending to prevent wide variations in currency exchanges between them. As regards fluctuations in exchange, however, a gold standard can never make up for a balance of trade—exports and imports really decide the question of exchange.

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[1]White, Benjamin: "Gold, Its Place in the Economy of Mankind;" Pitman's [Common Commodities and Industries Series; Sir Isaac Pitman & Sons, Ltd., London, Melbourne, and New York, p. 76.
[2]Ibid, pp. 78-82.

Though the gold standard does not imply that legal tender currency should actually consist of gold, it does imply that the purchasing power of such currency should be equivalent to that of the defined quantities of gold in the monetary units it represents; in other words, in gold standard countries the value of money must be kept in a fixed ratio to gold. In order to do this, under the gold standard, governments and banks issuing money notes are required to maintain the fixed ratio of money to gold, i.e., maintain their credit by keeping on hand adequate reserves of gold.

At the present time little gold coin actually circulates from hand to hand, but stocks of gold accumulated by governments and bankers form the essential foundation of our paper currency and of the vast modern system of credit relations; and in the settlement of international trade balances considerable quantities of gold are frequently transferred from one country to another. The real economic function of gold to-day is to serve as a basis of fiduciary note issues and as a medium for the adjustment of trade balances between countries; and for both these purposes stamped standard gold bars are now in more general use than coinage.

Reserves held in gold are *not alive* but in a state of *suspended animation*. Gold reserves may be necessary in the present structure of currency systems, but as the world moves towards an accurate solution of such problems they are likely to be superseded to a much greater degree, if not entirely, by living reserves of a more profitable character.[1]

Gold, if we reflect upon it, is something like stored up vital force; it is labour, it is energy in the potential state—energy which has been somehow condensed in the little metallic discs by the pains spent in wresting them from the earth; after which, passing from hand to hand, they excite at every move an amount of labour equal to that which was necessary for their acquisition simply as a price paid for the exchange and without losing anything themselves; moreover, the quicker they circulate the more labour they produce.[2]

Bankers regard gold as "a mere accumulation of matter, capable of subdivision into the most minute quantities," and possessing "as a commodity a value relative to other commodities so stable that it performs the function of a medium of exchange more perfectly than any other. It also possesses a faculty which, to a banker's mind, is of extreme importance, namely, it retains this stability for an extended period."[3] "The ratio of gold to currency is now so small that the gold standard is hardly a physical fact, but it is to be regarded more as a profession of faith."[4]

PROPERTIES OF GOLD

Gold has a number of interesting properties, some of which adapt it specially to the uses to which it is put, others of which greatly facilitate its recovery from its ores.

Physical Properties

Gold has a specific gravity that varies from 19·2 to 19·4. Its hardness is 2·5 to 3·00. It is yellow in colour, with a metallic lustre.

[1] Ibid, p. 18.
[2] De Launay, L.: "The World's Gold," G. P. Putman's Sons, New York, 1908, p. 239.
[3] White, Benjamin: "Gold: Its place in the Economy of Mankind;" Pitman's Common Commodities Series, Sir Isaac Pitman & Sons, Ltd., London, p. 20.
[4] Leith, C. K.: "Economic Aspects of Geology," Henry Holt and Company, New York, 1921, p. 223.

The specific gravity of gold—which is 19·3 for cast, 19·48 for rolled, and 19·65 for hammered gold—is considerably greater than that of any other substance ordinarily met with, and taken in conjunction with its colour and lustre serves as a ready means for its identification. It is one and one-half times heavier than lead and nearly twice as heavy as silver, bulk for bulk.

Pure gold is somewhat harder than lead, but softer than copper, silver, platinum, zinc, or iron. It is too soft in its pure state for the uses to which it is ordinarily put, and consequently is always alloyed with other metals, usually with copper or silver. Native gold also is practically never found pure. It nearly always contains silver. The purest native gold that has been found is said to be that from the Pike's Peak mine at Cripple Creek, Colorado, which contained 99·9 per cent pure gold; gold from Mount Morgan in Australia was 997 fine, the alloying metals being chiefly copper with a trace of iron.

In the arts the proportion of gold in an alloy is expressed either as degrees of "fineness" or as "carats." Fineness is expressed in parts gold per thousand of alloy; carats in parts gold in twenty-four parts alloy. Thus gold 750 fine, contains 750 parts of gold in 1,000 of alloy, and is the same as 18-carat gold which contains 18 parts of gold in 24 of alloy. British standard gold coin consists of 22 parts gold and two parts copper, hence is 22 carats or 916·0 fine; and Canadian and United States standard gold coins, which contain one part copper to nine of gold, are 21·6 carats, or 900 fine. The lowest recognized standard is 9 carat gold. Fifteen-carat gold is considered the best alloy for long wear; while 13-carat quality is said to be the lowest that has a really effective colouring.

Composition of English Standard (Hall-Marked) Gold Wares in Parts per 1,000

Standard	Fine gold	Fine silver	Base metal, chiefly copper
22 carats	916·6	20	63·3
18 "	750	125	125
15 "	625	100	275
12 "	500	100	400
9 "	375	100	525

Gold is distinguished from all other metals by its beautiful characteristic yellow colour, and its high metallic lustre which remains untarnished indefinitely under all ordinary conditions. The word "gold" is said to be probably derived from a Sanscrit word meaning "to shine." The colour of pure gold, however, is seldom seen since gold, both in the native state and as used in the arts and for coinage, is practically always alloyed with other metals; but it is closely imitated by certain mixtures of gold, silver, and copper used in the manufacture of 18- and 22-carat gold wares, and some specimens of gold leaf consist of nearly pure gold. The colour of

gold becomes paler when small quantities of silver are added to it, while the addition of copper gives it a reddish hue. Gold containing 10 to 20 per cent silver is said by some observers to have a greenish hue; that containing 60 per cent or more is silver-white.

Composition of Some Gold Alloys

Alloy	Parts in twenty-four					
	Fine gold	Silver	Copper	Iron	Ni	Zn
Red Gold	18	.....	6	.....	.....	.....
Green Gold	18	6	.....	.....	.....	.....
" Gold	14	8	2	.....	.....	.....
Blue Gold	18	.....	.....	6	.....	.....
White Gold	12	12	.....	.....	.....	.....
" Gold	14	.....	4½	.....	5	½
" Gold	19	.....	.....	.....	4½	½

Gold is the most malleable and ductile of all metals and retains these properties at all temperatures, hence is readily manipulated by the worker in metals. Pure gold has a tenacity of about seven tons a square inch and elongates about 31 per cent before breaking. A wire one-tenth of an inch in diameter will support nearly 123 pounds. Its alloys with silver and copper are still stronger.

Gold wire less than $\frac{1}{20,000}$ of an inch thick has been made. Five hundred feet of such wire would weigh only one grain. Gold wire used for thread in the making of gold lace is drawn down to sizes measuring from 1,100 to 2,000 yards to the ounce of metal. The minimum thickness to which gold can be beaten is not known with certainty. A book of gold leaf containing 25 leaves, each measuring 3½ inches square—equal to a total area of 264 square inches—generally weighs 4 to 5 grains. A thin particle of gold weighing only $\frac{1}{2,500,000}$ of a grain may be readily visible to the naked eye. Very thin leaves of gold are translucent and appear green by transmitted light; on heating, the green colour changes to ruby red.

On heating, gold, like iron, can be welded below the point of fusion, and finely divided gold agglomerates on heating without being subjected to pressure. The finely divided metal, in the condition in which it is precipitated from solution, can be compressed into solid form between dies.

The melting point of gold is about 1064° C., at which temperature it begins to volatilize, though volatilization is slight at the temperatures ordinarily attained in industrial furnaces. It can be boiled readily in the heat of electric-arc furnaces or of the oxy-hydrogen blowpipe. Its vapour is purple.

Chemical Properties

One of the chief chemical characteristics of gold is the difficulty with which its compounds—which are not numerous and have not been fully studied—are formed and the ease with which they are decomposed. In

nature gold is nearly always found native; less often as a telluride. The alchemists of old, called gold a "noble" metal because, if it were put in the fire and melted it emerged unchanged, whereas under similar treatment the "base" metals were "destroyed," i.e., they became oxidized and lost their metallic characteristics. The other noble metal was silver, but it was considered less noble than gold because it could be dissolved in *aqua fortis,* or nitric acid, by which gold is ordinarily unaffected.

Gold is not appreciably attacked at any temperature by water or by air, and hence its untarnishability. It is not perceptibly attacked by any of the simple acids, except selenic; but it dissolves readily at ordinary temperatures in water containing chlorine, bromine, or a mixture of iodine and potassium iodide. Any mixture producing nascent chlorine, bromine, or iodine will readily dissolve it; as also will a boiling concentrated solution of ferric chloride. Potassium or sodium cyanide, in the presence of oxygen, or an oxidizing agent, dissolves it slowly at ordinary temperatures. The most rapid solvent of gold is *aqua regia,* a mixture of three parts of hydrochloric acid with one part nitric acid. Gold unites readily with mercury to form alloys, called *amalgams,* and dissolves in excess of that metal. The amalgams recovered in gold mills consist of mercury containing particles of gold into which mercury has penetrated. If the mercury is strained these mercury-coated particles are separated, forming the amalgam of the gold miner. This generally contains 25 to 50 per cent gold, the proportion of gold being highest when the average size of the gold particles is greatest.

The solubility of gold in aqueous solutions of potassium cyanide, its affinity for chlorine, and the ease with which it amalgamates with mercury, are of very great interest to the gold miner, especially the first and the last; since the processes by which a very large part of the world's gold is extracted from its ores are based on these properties of the metal.

RARITY OF GOLD

Gold is a widely distributed, but not an abundant metal. It is found nearly everywhere, but usually only in minute quantities, either as a minor constituent of river sands and gravels or of solid rock deposits, seldom in concentration large enough and rich enough to allow it to be extracted profitably. The scarcity of gold may be illustrated by the fact that if the world's entire production of that metal, from the discovery of America in 1492 to the end of 1927, were cast into a cube, an edge of the latter would measure only 38·5 feet in length.[1] The following table, in compiling which prices and production figures for 1930 have been used, shows in a general way the relative natural abundance, annual output, and cheapness of a number of the more important metals:—

[1] Summarized Data of Gold Production; U. S. Dept. of Commerce, Bur. of Mines, Econ. Paper 6, p. VII.

Relative Abundance, Cheapness, and Output of Metals

Metal	Percentage in earth's crust	Natural abundance, Gold=1	Annual output 1930, Gold=1	Cheapness, Gold=1
Gold	0.0000005	1	1	1
Silver	0·00001	20	12	54
Lead	0·0020	4,000	2,600	5,580
Zinc	0·0040	8,000	2,200	6,700
Copper	0·0075	15,000	2,500	2,330
Iron	4·44	8,800,000	68,000	36,750

The table shows that there is little correspondence between the natural scarcity of a metal and either the amount produced or the price. Gold, in comparison with the other metals, is produced in far larger amount and at much lower price than would be expected from its relative natural scarcity.

Gold has been profitably extracted from ores yielding less than $1 to the ton when worked in a large way, as at the Alaska Juneau mine in Alaska; and the Homestake mine in South Dakota has for many years worked at a good profit gold ores yielding less than $4 a ton. On the Rand in South Africa the average yield is between $6 and $7 a ton and on the Hollinger, Canada's largest gold mine, it is also a little over $6 a ton. In the case of gold gravels worked by hydraulicking or dredging as little as 4 or 5 cents to the yard may be profitable where conditions are favourable. The remarkable efficiency that has been attained in the art of recovering gold from its ores may be judged by the fact that 1 dwt. (or approximately $1) to the ton of 2,000 pounds is only 1 part in 583,333 by weight and taking into account the difference in specific gravity of gold and the ordinary gangue minerals less than 1 part in 3,500,000 by volume. Auriferous gravels that do not need to be crushed have been treated at a profit when they contained only two or three grains of gold a ton, or about 1 part of gold in 5,000,000.

Gold in amounts much below the lowest present limits of profitable extraction is very widely disseminated. In minute quantities it appears to occur in all ores of silver, copper, lead, antimony, and bismuth; in rocks of all ages and types—igneous, metamorphic and sedimentary; and in sea water. It has been estimated that the total quantity of gold in the sea amounts to about $50,000,000 for each inhabitant of the globe.[1] The presence of gold in sea water has been made the basis of fraudulent schemes for the fleecing of the public, but there seems little prospect of its successful extraction on a commercial scale at the present time.

MODE OF OCCURRENCE OF GOLD

In nature gold usually occurs in the metallic state alloyed with varying amouts of silver and smaller amounts of copper and other metals either in placer or in lode deposits.

[1] Rose, T. K.: "The Precious Metals"; Archibald Constable & Co., Ltd., London, 1909, pp. 68-69.

Placers

In placer deposits native gold in grains, scales and lumps—"dust" and "nuggets"—forms one constituent of sand and gravel, for the most part alluvium deposited by streams, or on a beach, or as talus. Placers have been classified as shallow, deep, creek, hillside, bench, river-bar, gravel-plain, sea-beach, lake-bed, and dry, according to the situation in which they are found. The grains and nuggets of gold found in them vary in size, from minute scaly particles so small as to defy all ordinary means for their recovery to masses of considerable size. The "Welcome" nugget found in Australia contained 2,019¾ ounces of gold, valued at £8,376 10s. 10d. and is the largest on record; one found in California weighed 280 ounces; and Klondike produced one of 85 ounces. Most of the gold recovered from placers, however, is medium to fine "dust."

Placers, being surface deposits, are as a rule comparatively easily found; and as nature has done all the mining and reduction work, the winning of their gold contents requires only the cheapest and simplest of appliances. Consequently, in a new gold-bearing country placers are usually the first deposits found and the first to be worked out. It has been estimated that between 1848 and 1875, nearly 90 per cent of the world's gold was derived from placers. Present-day production from placers is probably under 10 per cent.

Lode Deposits

At the present time by far the largest part of the world's gold is won from hard-rock, or lode deposits, the recovery of the gold from which involves the provision of more or less costly and elaborate plants for the mining and crushing of the ore and the subsequent separation of the metal from waste material.

In gold-bearing veins or lodes the greater part of the material forming the deposit is often quartz, but various silicates also occur, and sulphides or arsenides of base metals are almost invariably present. Pyrite —sulphide of iron—is an almost universal accompanist of lode gold, and auriferous deposits not uncommonly consist chiefly of base metal sulphides. The gold itself occurs as scales, threads, or grains disseminated through the vein matter; sometimes in masses large enough to be seen with the naked eye, but usually in too fine a state of division to be seen without the aid of a microscope. Though most of the gold found in lode deposits is in the native state, in some localities it is not uncommon to find it chemically combined with silver or lead and tellurium, in tellurides—the best known of which are calaverite, $AuTe_2$, a telluride of gold; sylvanite or graphic tellurium, $(Ag,Au)\ Te_2$, a gold-silver telluride; petzite, $(Ag, Au)_2\ Te$, also a gold-silver telluride; and nagyagite, which contains considerable lead. The tellurides are for the most part dark grey or black in colour, rarely silver-grey. Often they are mixed with metallic gold which may give them a brassy-yellow colour.

The mode of occurrence of the gold in lode deposits largely determines the metallurgical processes adopted for its recovery. In a general way,

gold-quartz ores are treated by amalgamation and cyanidation, methods which are especially adapted to the recovery of gold, while auriferous sulphide ores are usually smelted for the production of base metals from which the gold is afterwards separated and saved.

HISTORY OF GOLD

Gold, from its mode of occurrence and widespread distribution, was probably the first metal with which man became acquainted. The striking colour and lustre of particles of gold lying mixed in the gravel of a stream bed can hardly have failed to catch at an early date the eye of primitive man. Next, its weight, so much greater than that of any other substance with which he was acquainted, would be noticed, and, his curiosity aroused, he would proceed to further test this new material. He would find that, though too soft to be of much use in making weapons or tools, it could be hammered into almost any shape his fancy suggested and that the articles so formed lost none of their original brightness through time and use. Thus gold became an ornament, greatly valued for its indestructible beauty as well as for its rarity. At the same time it would become an object of barter, for which purpose also it had obvious advantages. Gold, on account of its characteristic lustre, colour, and weight could be identified with ease and certainty by those who wished to possess it; and once possessed it was easily transported and easily secreted. It was, therefore, well adapted to serve also as an unchanging store of wealth reserved for future needs. "It may be taken for granted, from the records of antiquity, that gold possessed a distinct value in prehistoric times, measureable by other commodities, and that this appreciation was maintained owing to the travel of the metal far from the place of origin, and to the purpose to which it was almost universally applied, namely, the adornment of the person."[1] It was well known in Egypt at least 5,500 years ago and appears even at that time to have become a standard of value; for in the code of Menes of about 3600 B.C. one part of gold is declared equal in value to two parts and a half of silver.

Among ancient peoples gold would appear to have been linked with the idea of divinity. With them the ornamental use of gold was closely associated with the palace and the temple—with priest and king, the earthly representatives of divine authority. References to gold in these associations, as well as to the value placed upon it, are numerous in the Bible. Thus the psalmist, in describing the prince of God's own choosing: "For Thou preventest him with the blessings of goodness; Thou settest a crown of pure gold on his head" (Ps. XXI, 3); and in the description of the heavenly city "the street of the city was pure gold" (Rev. XXI, 21). When the Jews were leaving Egypt their women folk were exhorted to "borrow" from their neighbours "jewels of silver and jewels of gold," and by so doing to "spoil the Egyptians" (Ex. III, 22). And "they came, both men and women, as many as were willing-hearted, and brought bracelets and earrings, and rings and tablets, all jewels of gold; and every man

[1] White, Benjamin (see previous reference p. 4), p. 9.

that offered, offered an offering unto the Lord" (Ex. XXXV, 22). The purpose for which this gold was required was the adornment of the Ark and of the Tabernacle. The temple of Solomon was profusely adorned with gold; the wall of the Holy of Holies being overlaid with gold, and the accessories such as lamps, hinges, etc., being made of the same precious metal. Among the ancient Egyptians, gold to show its sacred character was represented by a circle with a dot in the centre, the circle being the symbol of divinity and perfection. The flood of gold that poured into Spain in the years following 1492 was largely loot from temples, palaces, and graves in Central and South America—plunder torn from peoples who apparently valued gold solely as an appanage of religion and of royalty.

What is believed to be the first coin was struck in Lydia about 700 B.C. It was a bean-shaped piece of metal containing about 73 per cent gold and 27 per cent silver. Crude gold coins were in use in Britain before the Roman invasion and a few were produced in the Saxon period, but from sometime in the eighth century until the middle of the thirteenth the prevailing English coin was the silver penny. The first English gold coin was the gold penny, struck by Henry III, in 1257. It had a current value equal to that of twenty of the silver pennies of the day. No other description of gold coin was minted in England until the reign of Edward III, 1327-1377, when a florin (6s.), a half-florin, a quarter-florin, a noble (6s. 8d.), a half-noble, and a quarter-noble were issued.

The earliest gold mining centres, of which few traces now remain, were no doubt within the boundaries of the most ancient civilizations, in Armenia, Chaldea, Asia Minor, Egypt, and India. In Europe, gold was mined in Spain by the Phoenicians and later by the Romans. The latter also obtained it in Gaul, Corinthia, and Transylvania. With the barbarian invasions of the Roman Empire, the working of the ancient mines practically ceased, the more readily because most of them had been exhausted, and for centuries Europe was very poor in the precious metals. About the thirteenth century a revival began, which reached its zenith about the time of the discovery of America. During this period active mining was carried on in the Alps, Transylvania, Spain, and various other parts of Europe; a considerable portion of the world's gold output at this time coming from Austria, which even for a century after the discovery of the western hemisphere produced over one-fifth of the world total. Most of the gold of ancient times appears to have come from India and that country continued to supply most of the gold used in Europe until the discovery of America in 1492.[1]

Our earliest records of gold-mining are pictoral rock carvings in Egypt, dating back to 2500 B.C., in which the art of gold washing, by working up auriferous sands by hand in hollowed-out stone basins and subsequently melting the gold in little furnaces with the aid of mouth blowpipes, is depicted. Sloping tables of stone, as well as basins, were also used for washing gold ores. In very early times auriferous sands were also washed over hides or sheepskins spread out on sloping rocks or tables, the heavy gold particles sinking and becoming entangled in the hair or wool. The legend of Jason and the Golden Fleece would appear

[1] T. K. Rose: "The Metallurgy of Gold," 4th Ed., 1902, p. 1.

to have had its origin in a Phoenician free-booting expedition to despoil the natives of gold won by washing auriferous gravels over sheepskins from the streams of Colchis.

Just when the working of hard rock deposits involving the preliminary mining and crushing of the ore to obtain the gold commenced is unknown; but according to the writings of Diodorus, the Sicilian, it was well established in Egypt in 59 B.C.; and the methods he describes were even at that time very ancient. He says the rock was broken with iron wedges, by workmen under the surveillance of hard taskmasters, then crushed in iron mortars, the fragments thus obtained being further ground in mills resembling modern flour mills, turned by women and aged men. When the ore had been reduced to powder, it was spread on slightly inclined tables and a stream of water was directed over it, carrying off the waste material and leaving the gold behind.[1] This operation was repeated several times, after which the remaining impurities were removed by hand. Hollowed-out stone mortars and stone grinding mills have been found in proximity to ancient gold workings in many parts of the world besides Egypt, and the methods described by Diodorus were probably very widespread.

When mercury was first employed for the separation of gold from other materials is not known, but its use for this purpose at the beginning of the Christian era is mentioned by writers of that time. During the Middle Ages there are few references to the use of mercury in the metallurgy of gold, though one writer, in the eighth century, mentions it in this connexion and in the eleventh century the extraction of gold from the sands of the Rhine by means of quicksilver is described. In the Tyrol, a process of great antiquity was in vogue for the treatment of gold ores. This consisted in crushing the ore in stamp batteries and stirring the crushed material in circular bowls with large quantities of mercury. A stream of water passing through the bowl washed away the tailings and left the gold to sink into the mercury bath at the bottom of the bowl. The principle of this process was still in use in modern times in amalgamating machines employed in Hungary. The catching of amalgam on copper plates was probably first used in the seventeenth century, while the modern use of amalgamated copper plates in conjunction with stamp mills is a comparatively recent development.

Among the best known of the earliest combined crushing and amalgamating contrivances used for the treatment of gold ores in America, was the arrastra, introduced about 1557; and this simple apparatus in modern form is still occasionally found useful by the prospector in isolated districts. It consisted of a shallow, circular, flat-bottomed pit paved with hard stones, in the centre of which was an upright revolving shaft carrying two or more horizontal arms. To each arm a heavy stone was attached by thongs of bullock hide or chains, the forward end of the stone being raised a little off the floor of the pit whilst the other end rested on it. Mules hitched to the ends of the arms and walking around the outside of the pit, or a waterwheel connected by suitable gearing with the central vertical shaft, caused the latter to rotate and drag the stones attached to the arms round and round over the circular pavement, crushing beneath

[1] Translation by B. H. Brough, in Jour. Soc. Arts, 1892.

them the ore which, mixed with water and mercury, was thrown into the pit. When the ore was ground sufficiently fine for all the gold to be exposed to the action of the mercury and become amalgamated, water was turned into the pit to wash away the lighter waste material, after which the amalgam left on the floor of the pit was collected and retorted to obtain the gold.

Stamp batteries for the crushing of gold ores appear to have been first employed in Germany, about the beginning of the sixteenth century, and their use gradually spread throughout that country; in France, however, they seem to have been still unknown in 1579. Previous to their introduction, hand-mortars, grinding mills, and sieves appear to have been about the only apparatus used in dressing gold ores. The early stamp batteries were crude affairs, consisting of wooden stems shod with hard stones or iron. They were usually arranged in sets of three stamps to a battery and driven by a waterwheel. One of the first improvements made in stamp-battery practice was the introduction of screens in the side of the battery box, or mortar, so that crushing and screening went on simultaneously. These were in use in 1556 or earlier, but had not become universal one hundred years later.

There is no mention of feeding mercury into stamp batteries and catching the gold on amalgamated copper plates before 1850, when plates inside the mortar-box were introduced in California. Up to this time the usual practice was to pass the pulp from the battery over tables covered with blankets and catch the gold in much the same way that Jason may have seen it caught on sheepskins in Asia Minor in 1200 B.C. The rich gold-bearing sand collected on the blankets was washed off from time to time, and ground in mills with mercury to extract the gold. About 1860, blankets began to be replaced by amalgamated copper plates outside the battery, their use becoming almost universal soon after 1870.

The first wet chemical process for the extraction of gold from its ores, by dissolving the gold as a chemical compound and subsequently precipitating it from solution, was the chlorination process which originated in 1848. This process, which is specially applicable for the treatment of small batches of rich gold-bearing concentrates, was at one time quite extensively used, notably in Australia. It has now, however, been almost entirely superseded by the cyanide process.

Though patents covering the extraction of gold by aqueous solutions of cyanides were taken out in Great Britain as early as 1840, and in the United States in 1867, it was not until 1887 that the practicability of the method was demonstrated. It was introduced into South Africa in 1890, where it was an immediate success in the treatment of the Rand ores in which the gold is in such a fine state of division that only 55 to 65 per cent of it could be recovered by amalgamation, and only small additional amounts by further treatment by concentration and chlorination. After its success on the Rand its use spread to all parts of the world and it is now by far the most important method used for the recovery of gold from its ores. Were it not for the cyanide process many of the world's largest gold mines could not be profitably worked, and its introduction is probably the most important development in the whole history of the metallurgy of gold.

WORLD ERAS OF GOLD PRODUCTION

A study of the production of base metals over long periods of time shows a practically continuous increase corresponding in a general way with increasing population and fuller realization of the uses to which metals could be put, except for some recessions brought about by abnormal

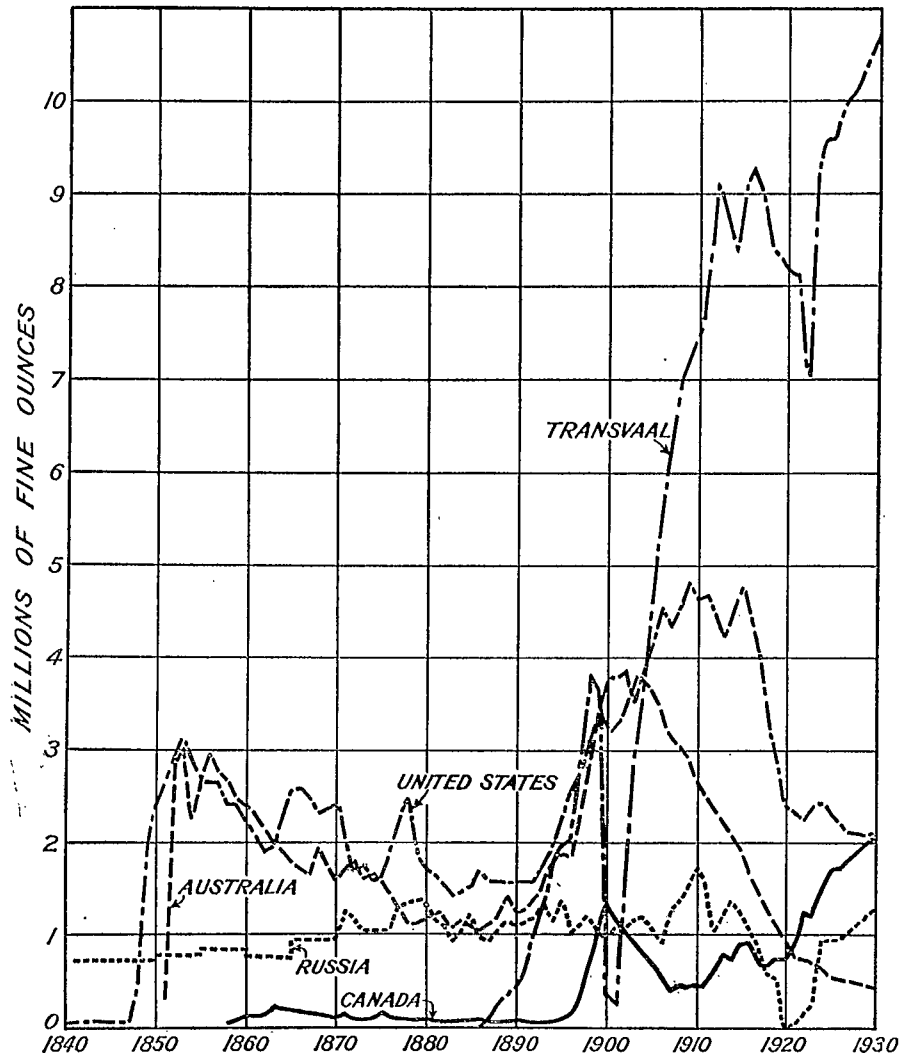


Figure 1. Graph showing production of principal gold-producing countries, 1840 to 1930.

economic and political conditions. In other words, the production of base metals depends more on the demand than on the supply. This is not the case with gold. Gold having a constant and practically unlimited market

there has been no economic barrier to complete and rapid exploitation—production has been limited by supply, not by demand. Hence, though the long-time trend of gold production has on the whole been upward, minor ups and downs have corresponded with the making of new discoveries and their subsequent depletion rather than with changing rates of increase in population and periods of business activity and depression.

In ancient times Asia and northern Africa were the chief sources of gold and continued to supply most of the world's gold prior to the discovery of America. There are no records on which an estimate of this early production can be based, but in all likelihood it was small as compared with that of later times.

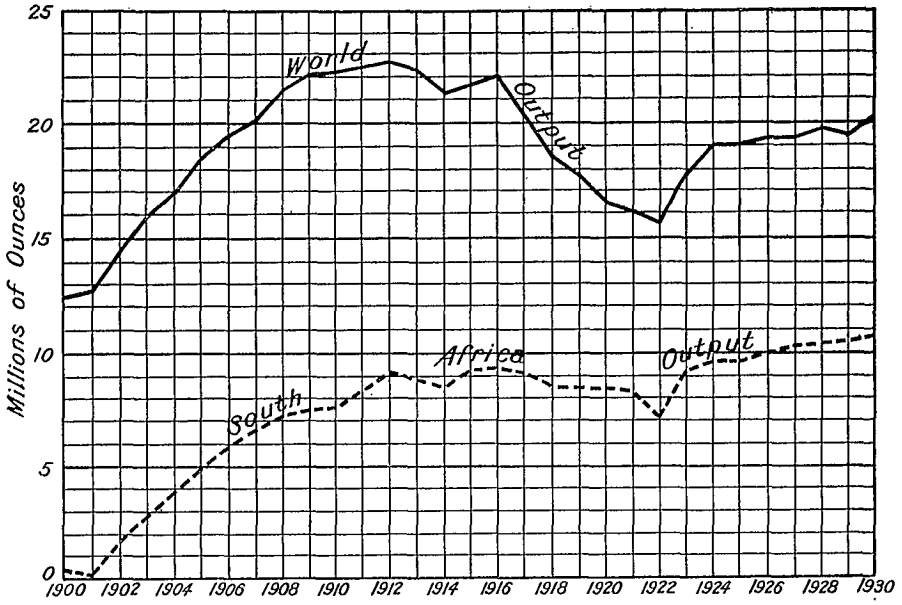


Figure 2. Graph showing gold output of the world and of the Union of South Africa, 1900 to 1930.

The discovery of America, in 1492, was followed almost immediately by what was probably the greatest era of gold production the world had seen up to that time. The exploitation of mines by slave labour and the looting of palaces, temples, and graves in Central and South America—one of the darkest chapters in the history of civilization—resulted in a flood of gold that unbalanced the economic structure and unsettled the political control of Europe. A second period of intense gold production began in 1850, following discoveries in California and Australia. In the twenty-five years following 1850, more gold was produced in the world than in the whole three hundred and fifty-eight that had immediately preceded it.

The third and latest notable period of gold production began in 1890, when the application of the cyanide process to the gold ores of the Rand made available the gold of much the greatest concentration of that metal yet found anywhere. The discovery and development of the Rand was almost immediately followed by other important discoveries; in Yukon, Alaska, Nevada, and Colorado, resulting in the peak of world production being reached in 1915, when the world's output was 22,718,154 ounces. Between 1915 and 1922, annual production fell to 15,467,223 ounces. Since 1922, the trend is again upward; due chiefly to increasing production in South Africa and in Canada; the world's output in 1930 being about 20,160,355 ounces.[1] This upward trend in production will probably continue for some years to come. The predominating influence of South Africa's gold production in determining the trend of that of the world is illustrated graphically in Figure 2.

[1] Preliminary figures from Report of the Director of the U. S. Mint, 1931.

CHAPTER II

GOLD MINING IN CANADA

HISTORICAL

Placer gold is said to have been found in the valley of the Chaudiere river in the province of Quebec, as early as 1823 or 1824, but no systematic attempt was made to work it until nearly 25 years later. Following the world-wide excitement caused by the famous discoveries in California in 1848 and in Australia in 1851, important gold discoveries of placer gold were made in British Columbia, in 1858, and of lode deposits in Nova Scotia, in 1862. Up to 1895, the greater part of the gold produced in Canada was from British Columbia placers, though there was also a substantial production from Nova Scotia lode mines during this period, and the Chaudiere placers, in Quebec, are estimated to have yielded about $2,000,000 in gold between 1860 and 1876.

In 1896, the discovery of rich gravels on the Klondike river in Yukon was the beginning of a second period of intensive gold production in Canada; when between 1898 and 1905, gold to the value of more than $100,000,000 (4,838,000 fine ounces) is said to have been obtained from placers on Bonanza, Eldorado, Hunker, Dominion, and Sulphur creeks. During this period also the rich copper-gold deposits of Rossland and adjoining districts in southern British Columbia were opened up and exploited, marking the beginning of lode-gold mining in that province; there was also a revival of activity in gold mining in Nova Scotia; and considerable excitement was caused in Ontario by discoveries in the Lake of the Woods district, though in this last case comparatively little actual production resulted. The peak of prosperity during this period was reached in 1900, when Canada's gold output reached 1,350,057 fine ounces, the largest annual output recorded up to that time. Between 1900 and 1907, production gradually but steadily decreased to 405,517 ounces in 1907.

With the discovery of the Porcupine gold camp in 1909, followed by that at Kirkland Lake in 1912, Canada entered on its third, and most important period of gold-mining activity, which has not yet reached its culmination, the effect of the Porcupine discoveries on production figures first becoming markedly evident in 1912. The remarkable success that attended the development of the Porcupine and Kirkland Lake camps led to intensive search for gold not only in other parts of Ontario but also in the adjoining provinces of Quebec and Manitoba. In 1924, discoveries were made at Rouyn that have now made Quebec the second largest producer of gold in the Dominion. Others made in Manitoba since 1911 have transformed what was formerly an almost purely agricultural province into one that now approaches British Columbia in the magnitude of its gold output. In British Columbia, the Premier mine was discovered in

TABLE I

Production of Gold in Canada, 1858-1931*

Year	Canada		British Columbia		Nova Scotia		Quebec		Yukon		Ontario		Alberta		Manitoba		Yr.
	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	Fine ounces**	Value	
		$		$		$		$		$		$		$		$	
1858...	34,104	705,000	34,104	705,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1858
1859...	78,129	1,615,072	78,129	1,615,072	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1859
1860...	107,806	2,228,543	107,806	2,228,543	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1860
1861...	128,973	2,666,118	128,973	2,666,118	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1861
1862...	135,391	2,798,774	128,528	2,656,903	6,863	141,871	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1862
1863...	202,498	4,186,011	189,318	3,913,563	13,180	272,448	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1863
1864...	199,605	4,126,199	180,722	3,735,850	18,883	390,349	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1864
1865...	192,898	3,987,562	168,887	3,491,205	24,011	496,357	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1865
1866...	152,555	3,153,597	128,779	2,662,106	23,776	491,491	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1866
1867...	145,775	3,013,431	120,012	2,480,868	25,763	532,563	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1867
1868...	134,169	2,773,527	114,792	2,372,972	19,377	400,555	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1868
1869...	102,720	2,123,405	85,865	1,774,978	16,855	348,427	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1869
1870...	83,415	1,724,348	64,675	1,336,956	18,740	387,392	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1870
1871...	105,187	2,174,412	87,048	1,799,440	18,139	374,972	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1871
1872...	90,283	1,866,321	77,931	1,610,972	12,352	255,349	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1872
1873...	74,346	1,536,871	63,166	1,305,749	11,180	231,122	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1873
1874...	97,856	2,022,862	89,233	1,844,618	8,623	178,244	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1874
1875...	130,300	2,693,533	119,724	2,474,904	10,576	218,629	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1875
1876...	97,729	2,020,233	86,429	1,786,648	11,300	233,585	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1876
1877...	94,304	1,949,444	77,796	1,608,182	15,925	329,205	583	12,057	.....	.....	.....	.....	.....	.....	.....	.....	1877
1878...	74,420	1,538,394	61,688	1,275,204	11,864	245,253	868	17,937	.....	.....	.....	.....	.....	.....	.....	.....	1878
1879...	76,547	1,582,358	62,407	1,290,058	12,980	268,328	1,160	23,972	.....	.....	.....	.....	.....	.....	.....	.....	1879
1880...	63,121	1,304,824	49,044	1,013,827	12,472	257,823	1,605	33,174	.....	.....	.....	.....	.....	.....	.....	.....	1880
1881...	63,524	1,313,153	50,636	1,046,737	10,147	209,755	2,741	56,661	.....	.....	.....	.....	.....	.....	.....	.....	1881
1882...	60,288	1,246,268	46,154	954,085	13,307	275,090	827	17,093	.....	.....	.....	.....	.....	.....	.....	.....	1882
1883...	53,853	1,113,246	38,422	794,252	14,571	301,207	860	17,787	.....	.....	.....	.....	.....	.....	.....	.....	1883
1884...	51,202	1,058,439	35,612	736,165	15,168	313,554	422	8,720	.....	.....	.....	.....	.....	.....	.....	.....	1884
1885...	55,575	1,148,829	34,527	713,738	20,945	432,971	103	2,120	.....	.....	.....	.....	.....	.....	.....	.....	1885
1886...	70,782	1,463,196	43,714	903,651	22,038	455,564	193	3,981	†4,837	100,000	.....	.....	.....	.....	.....	.....	1886
1887...	57,460	1,187,804	33,558	693,709	20,009	413,631	78	1,604	3,386	70,000	327	6,760	102	2,100	.....	.....	1887
1888...	53,145	1,098,610	29,834	616,731	21,137	436,939	181	3,740	1,935	40,000	.....	.....	58	1,200	.....	.....	1888
1889...	62,653	1,295,159	28,489	588,923	24,673	510,029	58	1,207	8,466	175,000	.....	.....	967	20,000	.....	.....	1889
1890...	55,620	1,149,776	23,918	494,436	22,978	474,990	65	1,350	8,466	175,000	.....	.....	193	4,000	.....	.....	1890

1891...	45,018	930,614	20,792	429,811	21,841	451,503	87	1,800	1,953	40,000	97	2,000	266	5,500	.....	.....	1891
1892...	43,905	907,601	19,327	399,525	18,865	389,965	628	12,987	4,233	87,500	344	7,118	508	10,506	.....	.....	1892
1893...	47,243	976,603	18,360	379,535	18,436	381,095	759	15,696	8,514	176,000	708	14,637	466	9,640	.....	.....	1893
1894...	54,600	1,128,688	25,664	530,530	18,834	389,338	1,412	29,196	6,047	125,000	1,917	39,624	726	15,000	.....	.....	1894
1895...	100,798	2,083,674	61,289	1,266,954	21,919	453,119	62	1,281	12,094	250,000	3,015	62,320	2,419	50,000	.....	.....	1895
1896...	133,262	2,754,774	86,504	1,788,206	23,876	493,568	145	3,000	14,513	300,000	5,563	115,000	2,661	55,000	.....	.....	1896
1897...	291,557	6,027,016	131,805	2,724,657	27,195	562,165	44	900	120,937	2,500,000	9,157	189,294	2,419	50,000	.....	.....	1897
1898...	666,386	13,775,420	142,215	2,939,852	26,054	538,590	295	6,089	483,750	10,000,000	12,863	265,889	1,209	25,000	.....	.....	1898
1899...	1,028,529	21,261,584	203,295	4,202,473	29,876	617,604	238	4,916	774,000	16,000,000	20,394	421,591	726	15,000	.....	.....	1899
1900...	1,350,057	27,908,153	228,916	4,732,105	28,955	598,553	.....	.....	1,077,553	22,275,000	14,391	297,495	242	5,000	.....	.....	1900
1901...	1,167,216	24,128,503	257,292	5,318,703	26,459	546,963	145	3,000	870,750	18,000,000	11,844	244,837	726	15,000	.....	.....	1901
1902...	1,032,161	21,336,667	288,383	5,961,409	30,348	627,357	391	8,073	701,437	14,500,000	11,118	229,828	484	10,000	.....	.....	1902
1903...	911,559	18,843,590	284,108	5,873,036	25,533	527,806	180	3,712	592,594	12,250,000	9,096	188,036	48	1,000	.....	.....	1903
1904...	796,374	16,462,517	275,975	5,704,908	10,362	214,209	140	2,900	507,938	10,500,000	1,935	40,000	24	500	.....	.....	1904
1905...	684,951	14,159,195	285,529	5,902,402	13,707	283,353	191	3,940	381,001	7,876,000	4,402	91,000	121	2,500	.....	.....	1905
1906...	556,415	11,502,120	269,886	5,579,039	12,223	252,676	165	3,412	270,900	5,600,000	3,202	66,193	39	800	.....	.....	1906
1907...	405,517	8,382,780	236,216	4,883,020	13,675	282,686	.....	.....	152,381	3,150,000	3,212	66,398	33	675	.....	.....	1907
1908 ..	476,112	9,842,105	286,858	5,929,880	11,842	244,799	.....	.....	174,150	3,600,000	3,212	66,398	50	1,037	.....	.....	1908
1909...	453,865	9,382,230	250,320	5,174,579	10,193	210,711	193	3,990	191,565	3,960,000	1,569	32,425	25	525	.....	.....	1909
1910...	493,707	10,205,835	261,385	5,403,318	7,928	163,891	124	2,565	221,091	4,570,362	3,089	63,849	89	1,850	.....	.....	1910
1911...	473,159	9,781,077	238,496	4,930,145	7,781	160,854	613	12,672	224,197	4,634,574	2,062	42,625	10	207	.....	.....	1911
1912...	611,885	12,648,794	251,815	5,205,485	4,385	90,638	642	13,270	268,447	5,549,296	86,523	1,788,596	73	1,509	.....	.....	1912
1913...	802,973	16,598,923	297,459	6,149,027	2,174	44,935	701	14,491	282,838	5,846,780	219,801	4,543,690	.....	.....	.....	.....	1913
1914...	773,178	15,983,007	252,730	5,224,393	2,904	60,031	1,292	26,708	247,940	5,125,374	268,264	5,545,509	48	992	.....	.....	1914
1915...	918,056	18,977,901	273,376	5,651,184	6,636	137,180	1,099	22,720	230,173	4,758,098	406,577	8,404,693	195	4,026	.....	.....	1915
															1917	-1931	
1916...	930,492	19,234,976	219,633	4,540,216	4,562	94,305	1,034	21,375	212,700	4,396,900	492,481	10,180,485	82	1,695	.....	.....	1916
1917...	738,831	15,272,992	133,742	2,764,693	2,210	45,685	1,511	31,235	177,667	3,672,703	423,261	8,749,581	.....	.....	440	9,095	1917
1918...	699,681	14,463,689	180,163	3,724,300	1,176	24,310	1,939	40,083	102,474	2,118,325	411,976	8,516,299	27	558	1,926	39,814	1918
1919...	766,764	15,850,423	167,252	3,457,406	850	17,571	1,470	30,388	90,705	1,875,039	505,739	10,454,553	24	500	724	14,966	1919
1920...	765,007	15,814,098	124,808	2,580,010	690	14,263	955	19,742	72,778	1,504,455	564,995	11,679,483	.....	.....	781	16,145	1920
1921...	926,329	19,148,920	150,792	3,117,147	439	9,075	635	13,127	65,994	1,364,217	708,213	14,640,062	49	1,013	207	4,279	1921
1922...	1,263,364	26,116,050	207,370	4,286,718	1,042	21,540	.....	.....	54,456	1,125,705	1,000,340	20,678,862	.....	.....	156	3,225	1922
1913...	1,233,341	25,495,421	200,140	4,137,261	655	13,540	667	13,788	60,144	1,243,287	971,704	20,086,904	.....	.....	31	641	1923
1924...	1,525,382	31,532,443	245,719	5,079,462	1,047	21,643	883	18,253	34,825	719,897	1,241,728	25,668,795	.....	.....	1,180	24,393	1924
1925...	1,735,735	35,880,826	219,227	4,531,824	1,626	33,612	1,602	33,116	47,817	988,465	1,461,039	30,202,357	.....	.....	4,424	91,452	1925
1926...	1,754,228	36,263,110	225,866	4,669,065	1,678	34,687	3,680	76,072	25,601	529,220	1,497,215	30,950,180	.....	.....	188	3,886	1926
1927...	1,852,785	38,300,464	183,094	3,784,889	3,151	65,137	8,331	172,217	30,935	639,483	1,627,050	33,634,108	42	868	182	3,762	1927
1928...	1,890,592	39,082,005	196,617	4,064,434	1,290	26,667	60,006	1,240,434	34,364	710,367	1,578,434	32,629,126	68	1,406	19,813	409,571	1928
1929...	1,928,308	39,861,663	154,204	3,187,680	2,687	55,545	90,798	1,876,961	35,892	741,954	1,622,267	33,535,234	5	103	22,455	464,186	1929
1930...	2,102,068	43,453,601	164,331	3,397,023	1,272	26,295	141,747	2,930,170	35,517	734,202	1,736,012	35,886,552	.....	.....	23,189	479,359	1930
1931..§	2,695,219	55,715,120	160,594	3,319,773	460	9,509	300,877	6,219,679	44,306	915,886	2,085,818	43,117,684	195	4,031	102,969	2,128,558	1931
Total §	40,312,860	833,340,495	10,551,468	218,118,240	924,668	19,114,666	635,425	13,135,361	8,974,261	185,514,089	19,032,954	393,446,070	15,419	318,737	178,665	3,693,332	

*From Dominion Bureau of Statistics Reports.
**Calculated from the value $1=0·048375 ounces.

§Preliminary figures, subject to revision.
†For the years 1885 and 1886

1910, and produced 1,115,166 ounces of gold between 1919 and 1930. Of the total recorded production of gold in Canada, from 1858 to the end of 1931, about 62·5 per cent has been won since 1909.

Porcupine and Kirkland Lake are by far the most important sources of gold yet found in Canada and they seem likely to be the predominating factors influencing the trend of production for many years to come. The

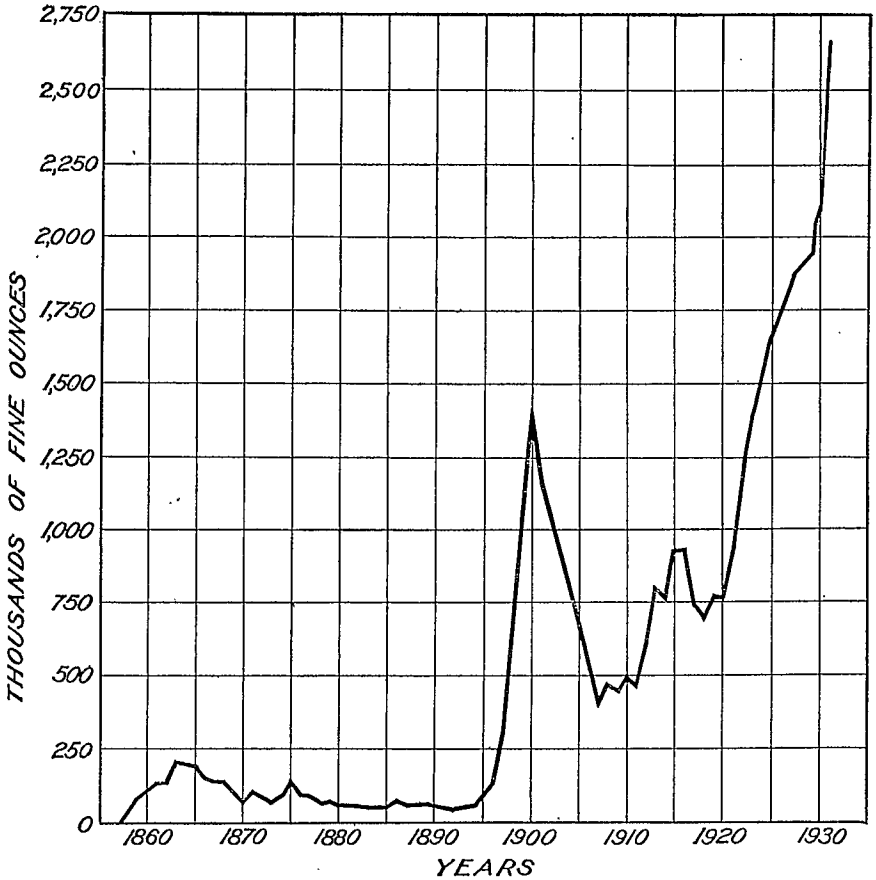


Figure 3. Graph showing Canadian gold production, 1858-1931.

combined production of these two camps to the end of 1931 was about 20,193,750 fine ounces, equivalent to over 50 per cent of the total recorded production of the Dominion; and to over 80 per cent of its production since 1909. In 1931, they produced 74·7 per cent of Canada's gold; and the *increase* alone in their production in 1931 over that of 1930 was practically equal to half the *total* output of all the other gold-producing mines in Canada in the former year.[1]

[1] Preliminary figures, subject to revision, used throughout for 1931 production.

SOURCES OF CANADA'S GOLD PRODUCTION

Gold production may be divided into three general classes according to its source, viz.: (1) that from placers or alluvial deposits; (2) that from lode mines worked primarily for their gold-silver contents; and (3) that recovered incidentally from the working up of base-metal ores.

(1) In large-scale placer operations the auriferous gravels are excavated by hydraulicking or dredging and the gold recovered by simple washing in sluices and other devices, usually with the assistance of mercury to catch the finer particles of gold.

(2) The mines chiefly worked solely or primarily for their gold contents are the so-called quartz mines. The gold in the ores of which is recovered either by leaching the crushed ore with cyanide solution or, in the case of "free-milling" ores by amalgamation. Other essentially gold ores, however, in which the gold is associated with large amounts of sulphide minerals, are smelted in the same way as base-metal ores and the gold afterwards separated from the base metal.

(3) Most by-product gold is recovered from the working of copper ores, with lesser amounts from lead and zinc ores. In some cases where the gold content of such ores is comparatively high it may be difficult to classify them definitely, since they may change their category from essentially base metal to essentially gold ores or vice versa, with variations in metal prices.

Most of the gold produced in Nova Scotia has been recovered from free-milling ores by amalgamation. The largest gold producing mine in Quebec, the Horne, is generally regarded as essentially a copper mine, but in the present condition of the copper market should probably be looked on as primarily a gold mine. Smaller mines in northwestern Quebec operate on quartz ores by amalgamation and cyanidation. In Ontario, all of the larger gold mines are quartz mines employing straight cyanidation, though some of the small producers use amalgamation, and in a few cases a combination of the two methods. Most of Ontario's by-product gold comes from nickel-copper mines and is recovered during the refining of copper. Manitoba's gold is largely by-product metal obtained from the copper-zinc ores of the Flin Flon and Sherritt-Gordon mines. A greater variety of gold ores is mined in British Columbia than in any of the other provinces. Much the greatest part of its production is from what are essentially gold mines. The most important of these is the Premier mine, which though often thought of as a silver mine, in only one year in its history produced silver exceeding in value the gold produced; and gold accounts for about 60 per cent of the gross value of its total output. The gold-silver-lead ores of the Premier are shipped to smelters, partly in the form of concentrates, but at one time a certain amount of gold was also recovered from them by cyanidation. The Pioneer mine, now British Columbia's second largest gold mine, is a quartz mine at which the gold is recovered by cyanidation. By-product gold, which now constitutes about 10 per cent of the output of British Columbia,

has its chief source in the Britannia and Anyox copper mines; also, formerly in the Copper Mountain mine, now shut down. There is also an important amount of placer gold still won annually in British Columbia. With the exception of small amounts contained in auriferous silver-lead ores exported, all Yukon's gold output is from placers.

In 1930, auriferous quartz mines contributed 1,782,875 ounces or 84·8 per cent of the total production of the Dominion; Canadian smelters, in base bullion and blister copper, 172,640 ounces or 8·2 per cent; gold recovered from Canadian ores treated abroad, 104,227 ounces, or 5 per cent; and alluvial deposits 43,324 ounces, or 2 per cent.

TABLE II

Production of Gold in Canada by Provinces and by Sources, 1930 and 1931

	1930		1931	
	Fine ounces	Value	Fine ounces	Value
		$		$
NOVA SCOTIA—				
In gold bullion	1,272	26,295	460	9,509
QUEBEC—				
In blister copper and in gold bullion	141,747	2,930,170	300,877	6,219,079
ONTARIO—				
Porcupine area	859,084	17,758,842	962,252	19,891,514
Kirkland Lake area	830,733	17,172,775	1,051,377	21,733,891
Sudbury area	23,803	492,051	23,385	483,411
Miscellaneous including northwestern Ontario	22,392	462,884	48,804	1,008,868
Total	1,736,012	35,886,552	2,085,818	43,117,084
MANITOBA—				
In gold bullion and in blister copper	23,189	479,359	102,969	2,128,558
ALBERTA	.....	.....	195	4,031
BRITISH COLUMBIA—				
In alluvial gold	7,164	148,093	14,118	291,845
In gold bullion	31,177	644,486	37,376	772,630
In blister copper	25,799	533,313	26,364	544,992
In base bullion and in ores exported	100,191	2,071,131	82,736	1,710,306
Total	164,331	3,397,023	160,594	3,319,773
YUKON—				
In alluvial gold	35,160	726,822	44,061	910,822
In ores exported	357	7,380	245	5,064
Total	35,517	734,202	44,306	915,886
CANADA	2,102,068	43,453,601	2,695,219	55,715,120

TABLE III

Ores Mined and Milled, Crude Bullion Recovered and Crude Bullion and Concentrates Shipped from Auriferous Quartz Mines in Canada, 1929 and 1930

—	Nova Scotia, Quebec, Manitoba	Ontario	British Columbia	Canada
1929				
Number of producing mines	6	21	11	38
Ore mined, tons	88,057	3,952,027	314,660	4,354,744
Ore milled, tons	91,404	3,952,535	209,055	4,252,994
Tailings re-treated, tons	.....	7,290	41,417	48,707
Concentrates produced, tons	32	.....	17,001	17,033
Bullion recovered by amalgamation—crude ounces	17,633	144,294	295	162,222
Bullion recovered by cyanidation—crude ounces	66,606	1,802,155	24,999	1,893,760
Bullion shipped, crude ounces	85,283	1,977,103	25,294	2,087,680
Content of bullion shipped—				
Gold, fine ounces	42,779	1,609,544	17,609	1,669,932
Silver, fine ounces	3,921	256,256	1,363	261,540
Value, $	862,660	33,406,105	325,342	34,594,107
Exchange premium, $	767	157,464	3	158,234
Net value of ores, slags, and residues sold, $	8,796	14,076	2,500,773	2,523,645
Total value of all shipments, $	872,223	33,577,645	2,826,118	37,275,986
1930				
Number of producing mines	8	20	9	37
Ore mined, tons	115,995	3,972,692	384,116	4,472,803
Ore milled, tons	91,838	3,946,590	268,441	4,306,869
Tailings re-treated, tons	.....	85	37,010	37,095
Concentrates produced, tons	.....	10	19,444	19,454
Bullion recovered by amalgamation—crude ounces	25,877	33,592	1,156	60,625
Bullion recovered by cyanidation—crude ounces	47,817	2,179,302	48,007	2,275,126
Bullion shipped, crude ounces	63,304	2,213,302	49,163	2,325,769
Content of bullion shipped—				
Gold, fine ounces	40,224	1,711,155	31,177	1,782,556
Silver, fine ounces	4,375	293,440	2,593	300,408
Value, $	832,557	35,480,663	621,554	36,934,774
Exchange premium, $	5	36,702	.....	36,707
Net value of ores, slags, and residues sold, $	8,013	1,723	2,769,323	2,779,059
Total value of all shipments, $	840,575	35,519,088	3,390,877	39,750,540

TABLE IV

Shipments from Copper-gold-silver Mines of Canada, 1929 and 1930

——	Quantity	Net value	Total metal content as determined by settlement assay				
			Gold	Silver	Copper	Sulphur	Zinc
1929			fine oz.	fine oz.	pounds	tons	pounds
18 mines shipped to Canadian smelters—							
Ores	570,791	6,709,550	67,008	432,951	57,063,264	.....	.....
Concentrates	117,744	4,275,044	9,914	227,113	35,814,481	.....	.....
8 mines shipped to foreign smelters—							
Ores	3,352	57,913	192	5,876	333,719	.....	.....
Concentrates	145,197	10,639,950	20,054	380,834	69,554,222	.....	.....
Pyrites concentrates	76,581	177,450	.....	.....	.....	38,203	.....
Total	913,665	21,859,907	97,168	1,046,774	162,765,686	38,203	.....
1930							
13 mines shipped to Canadian smelters—							
Ores	724,966	4,049,084	109,043	437,034	70,487,335	.....	1,748,920
Concentrates	193,572	4,633,673	42,453	712,825	47,688,698	.....	13,478,000
9 mines shipped to foreign smelters—							
Ores	391	3,513	31	456	26,023	.....	.....
Concentrates	137,332	6,798,210	16,877	335,134	65,656,756	.....	11,527,280
Pyrites concentrates	53,453	145,084	.....	.....	.....	27,682	.....
Total	1,109,714	15,629,564	168,404	1,485,449	183,858,812	27,682	26,754,200

TABLE V

Principal Statistics of the Gold Mining Industry in Canada, 1925-1930

Year	Number of active operators	Number of operating plants or mines	Capital employed	Number of employees	Salaries and wages	Cost of fuel and electricity	Net value of bullion, ore, concentrates, residues and other minerals shipped from the mines and smelters
			$		$	$	$
ALLUVIAL GOLD							
1925	99	1,419	22,095,669	363	347,448	.....	1,270,419
1926	108	1,179	4,702,808	285	339,841	44,482	879,886
1927	94	96	9,653,723	321	472,596	30,834	794,033
1928	82	82	10,384,575	342	538,270	57,179	852,735
1929	68	68	7,237,850	488	586,193	2,969	836,006
1930	79	79	5,881,620	394	612,369	8,272	877,778
AURIFEROUS QUARTZ							
1925	52	52	84,964,062	7,052	11,931,948	1,836,050	35,035,361
1926	60	60	103,945,022	7,663	12,340,623	2,083,811	35,171,561
1927	72	76	118,381,468	8,022	12,935,719	2,222,085	37,452,995
1928	98	100	147,693,710	9,066	14,615,990	2,554,657	36,655,330
1929	80	85	135,166,105	8,660	14,258,733	2,579,481	37,275,986
1930	54	56	119,758,057	8,401	14,034,620	2,364,103	39,750,540

TABLE V—*Concluded*

Principal Statistics of the Gold Mining Industry in Canada, 1925-1930

Year	Number of active operators	Number of operating plants or mines	Capital employed	Number of employees	Salaries and wages	Cost of fuel and electricity	Net value of bullion, ore, concentrates, residues and other minerals shipped from the mines and smelters
			$		$	$	$
COPPER-GOLD-SILVER							
1925	40	41	23,200,580	2,374	3,555,844	413,767	7,758,990
1926	76	84	27,936,685	3,403	4,546,493	541,914	9,973,049
1927	118	125	24,232,169	4,083	5,260,095	596,137	9,822,881
1928	164	174	50,004,340	4,777	6,764,309	731,836	15,281,519
1929	144	152	52,546,697	5,243	8,498,755	1,035,133	21,859,907
1930	61	68	45,844,395	5,694	9,156,759	1,272,262	15,629,564

The Canadian Government maintains a plant for the production of fine gold at its mint in Ottawa. There are also several company-owned plants in the Dominion equipped for the same purpose, including: that of the Consolidated Mining and Smelting Co. of Canada, at Trail, British Columbia, in operation since 1904; that of the Ontario Refining Co., Ltd., at Sudbury, Ontario, in operation since 1930; that of Canadian Copper Refineries, Ltd., at Montreal East, Quebec, in operation since the latter part of 1931; and one on the Hollinger mine at Timmins, Ontario.

TABLE VI

Receipts of Gold Bullion at the Royal Mint, Ottawa, Ont., 1908-1931

Year	From Canadian Sources		From Foreign Countries	
	Crude ounces	Value, gold content	Crude ounces	Value, gold content
		$		$
1908	219·19	3,823 03	.....	.....
1909	5,741·43	94,864 81	38·25	673 98
1910	65,009·35	1,079,223 42	.....	.....
1911	89,463·11	1,469,087 43	511·24	9,128 55
1912	104,825·29	1,676,371 78	742·79	12,451 33
1913	212,076·41	3,363,870 30	633·23	11,609 84
1914	29,762·24	471,042 90	4,750·19	98,062 84
1915	89,231·47	1,402,605 19	871,693·79	15,838,222 01
1916	49,195·39	780,074 19	6,687,758·41	121,513,083 93
1917	55,779·96	840,265 33	8,196,151·04	148,919,793 48
1918	302,785·96	4,982,743 81	3,728,224·05	67,739,887 68
1919	654,906·28	10,865,770 57	8,917·02	134,756 38
1920	724,083·34	11,530,413 82	.....	.....
1921	1,054,277·01	16,914,211 58	53·00	826 87
1922	1,376,863·35	22,469,160 42	345·22	5,387 93
1923	779,466·92	12,632,163 78	295·53	4,935 16
1924	169,239·28	2,297,170 32	90·53	1,395 41
1925	167,375·64	2,489,532 52	192·35	2,900 59
1926	1,766,034·26	28,432,544 12	104·93	1,615 15
1927	1,869,208·25	29,929,047 51	496·75	7,488 31
1928	1,709,468·93	27,392,160 48	25·20	349 79
1929	601,529·06	9,061,523 92	.....	.....
1930	1,121,744·02	(1)	.....	.....
1931	2,121,654·17	(2)	78·04	(3)

[1] 862,074·865 fine ounces. [2] 1,721,166·506 fine ounces. [3] 70·097 fine ounces.

CANADA'S PLACE AMONG GOLD-PRODUCING COUNTRIES

TABLE VII

World Production of Gold, 1926-1930

(From Ann. Repts. of the Director of the U. S. Mint)

—	1926	1927	1928	1929	1930*
	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Fine ounces
NORTH AMERICA—					
United States	2,238,616	2,117,253	2,144,720	2,056,629	2,100,395
Canada	1,754,228	1,844,544	1,890,592	1,028,308	2,102,068
Mexico	772,661	725,175	699,102	654,799	670,488
Total	4,765,505	4,686,972	4,734,414	4,639,736	4,872,951
(1)Central America and West Indies	87,075	72,563	60,469	53,212	58,050
SOUTH AMERICA—					
Argentina(2)	2,419	967	968	1,000	1,000
Bolivia	(3) 332	241	506	1,499	16,479
Brazil	102,108	(2) 100,000	100,115	107,381	96,750
Chile	59,132	(2) 60,000	28,806	10,734	16,686
Colombia	71,658	72,563	40,323	48,375	48,375
Ecuador	62,486	64,242	74,572	67,328	69,998
Guiana—					
British	6,516	5,714	5,325	6,385	6,933
Dutch	7,526	7,684	5,498	2,975	3,948
French	45,235	48,354	45,460	41,136	43,538
Peru	120,241	92,656	66,904	122,138	90,052
Venezuela	30,542	39,366	48,257	43,206	55,946
Total	508,195	491,787	416,734	452,157	449,705
EUROPE—					
Austria	1,318	129	321	.....	.....
Czechoslovakia	7,716	(2) 7,500	6,944	5,015	2,411
France	42,010	45,010	54,013	54,012	54,012
Germany	5,208	(2) 5,000	5,434	5,819	6,076
Great Britain	.....	.....	129	12	.....
Greece	.....	482	482	482	482
Italy	1,704	2,154	1,865	1,534	1,723
Jugoslavia	10,384	12,410	14,468	18,455	23,148
Norway	.....	.....	.....	.....	.....
Poland	.....	.....	.....	.....	.....
Rumania	55,652	66,165	62,628	71,148	71,148
Russia	992,155	1,060,950	(2) 1,200,000	(2) 1,000,000	(2) 1,900,000
Spain	967	967	726	484	484
Swedea	14,789	14,789	(2) 14,000	(2) 10,000	(2) 10,000
Total	1,131,903	1,215,556	1,361,010	1,166,970	1,169,484
ASIA—					
British India	(2) 383,970	384,268	376,058	363,869	329,231
China	110,000	(2) 100,000	(2) 100,000	(2) 50,000	(2) 50,000
Chosen (Korea)	190,620	(2) 190,000	166,412	137,539	159,608
East Indies—					
British	19,350	19,350	.....	.....	.....
Dutch	115,354	113,071	110,242	107,899	110,435
Federated Malay States	14,475	10,706	18,693	24,431	29,597
Indo-China	321	321	257	514	514
Japan	307,862	(2) 303,000	334,061	356,048	356,048
Philippine Islds	91,242	79,314	106,641	160,626	179,204
Sarawak	243	243	(2) 200	1,405	1,730
Taiwan	9,035	(2) 9,000	9,012	15,082	15,082
Turkey	964	964	900	(2) 900	(2) 900
Total	1,243,436	1,215,237	1,222,476	1,218,313	1,232,349
OCEANIA—					
Australia—					
New South Wales	19,435	18,032	12,831	7,496	12,500
Northern Territory	140	174	100	44	44
Queensland	9,086	37,979	13,277	9,476	7,821
South Australia	758	418	532	1,009	1,311
Victoria	49,078	38,538	33,917	26,275	24,119
West Australia	437,343	408,353	393,408	377,176	416,369
Tasmania	4,166	4,860	3,603	5,597	4,467
Papua	6,388	6,150	55,573	See New Guinea	

TABLE VII—*Concluded*

—	1926	1927	1928	1929	1930*
OCEANIA—*Concluded*					
New Guinea—					
Australian	.....	.....	55,573	36,282	30,270
British (Papua)	.....	.....	.....	1,729	2,503
New Zealand	(3) 125,777	129,519	118,714	119,775	122,532
Total	652,171	644,023	687,528	584,859	621,036
AFRICA—					
Ethiopia (Abyssinia)	(2) 20,000	21,605	9,131	4,501	4,501
Belgian Congo	132,201	125,417	138,116	172,838	195,890
Bechuanaland	4,296	3,807	1,748	1,725	1,997
British West Africa (Gold Coast, Ashanti, Nigeria)	199,666	171,607	157,901	208,053	249,483
Egypt	643	64	64	64	546
French West Africa	9,966	6,848	3,279	4,147	5,427
French Equatorial Africa	.....	.....	.....	.....	1,029
Kenya Colony	779	655	814	845	1,789
Madagascar	9,870	10,352	7,169	6,012	7,234
Portuguese East Africa	9,127	9,521	4,239	375	176
Rhodesia—					
Northern	779	350	602	699	7,513
Southern	593,429	581,438	576,112	560,813	547,630
Southwest Africa	.....	984	542	377	222
Swaziland	1,399	1,135	347	90	90
Sudan	3,714	7,166	5,835	2,459	954
Tanganyika	7,202	3,179	12,828	9,581	11,072
Union of South Africa—					
(Transvaal, Cape Colony, and Natal)	9,962,852	10,122,491	10,354,264	10,412,326	10,716,351
Total	10,960,833	11,071,619	11,272,991	11,384,905	11,750,875
Total for world	19,349,118	19,397,757	19,755,022	19,500,152	20,160,355

* Preliminary figures, subject to revision, except Canada.
[1] Estimate based on United States imports of ore and bullion.
[2] Estimate based on other year's production.
[3] Amount exported.

The rapid increase in the rate of production of gold in Canada—a more than sixfold increase between 1907 and 1931—invites examination of Canada's position among great gold-producing countries, past and present. In 1930, Canada's output of gold exceeded that of the United States by a small margin and she thus became the second largest gold-producing country of the world. Her attainment of this place, however, was due in part to declining production in the United States; and her output was still in 1931 only about one-fourth that of the Union of South Africa. In 1930, the last year for which reasonably complete world figures are available, the Union of South Africa contributed about 53·5 per cent of the world's total output; Canada, about 10·43 per cent; the United States, 10·42 per cent; Russia, 6·5 per cent; and Australia, about 2·3 per cent. Canada's maximum annual output is, however, still considerably below not only that of the Transvaal, but also those of the United States and Australia.

Transvaal's maximum annual output was 10,874,145[1] fine ounces in 1931.
United States' maximum annual output was 4,887,604 fine ounces in 1915.
Australia's maximum annual output was 3,836,049 fine ounces in 1903.
Canada's maximum annual output was 2,695,219[1] fine ounces in 1931.

[1] Preliminary figures.

TABLE VIII

Annual Gold Production of the World and of the Chief Gold-producing Countries, 1901-1931

Year	(1) World Total	(2) Union of South Africa	(3) Canada	(1) United States	(4) Australia	(4) Russia
	Fine Ounces	Fine Ounces	Fine Ounces	Fine Ounces	Fine Ounces	Fine Ounces
1901.....	12,740,746	258,032	1,167,216	3,805,500	3,306,205	1,105,475
1902.....	14,354,680	1,718,921	1,032,161	3,870,000	3,487,411	1,090,116
1903.....	15,768,387	2,971,427	911,559	3,560,000	3,836,049	1,191,678
1904.....	16,780,913	3,770,996	796,374	3,892,480	3,777,853	1,199,857
1905.....	18,396,451	4,908,281	684,951	4,265,742	3,663,738	1,078,384
1906.....	19,471,080	5,793,159	556,415	4,565,333	3,451,081	943,142
1907.....	19,997,260	6,452,180	405,517	4,374,827	3,183,601	1,200,854
1908.....	21,430,438	7,057,100	476,112	4,574,340	3,075,237	1,357,027
1909.....	21,982,713	7,296,832	453,865	4,821,701	2,962,552	1,566,443
1910.....	22,022,180	7,531,386	493,707	4,657,017	2,720,695	1,721,163
1911.....	22,348,813	8,251,240	473,159	4,687,053	2,484,031	1,555,333
1912.....	22,549,335	9,108,792	611,835	4,520,719	2,325,932	1,073,875
1913.....	22,249,596	8,798,713	802,973	4,299,784	2,225,716	1,282,357
1914.....	21,240,416	8,396,068	773,178	4,572,976	2,073,198	1,332,367
1915.....	22,760,788	9,096,411	918,056	4,887,604	1,946,975	1,273,362
1916.....	22,107,669	9,296,964	930,492	4,479,057	1,675,700	1,083,437
1917.....	20,289,546	9,018,389	738,831	4,051,440	1,464,208	870,750
1918.....	18,556,920	8,418,379	699,681	3,320,784	1,281,900	580,500
1919.....	17,695,037	8,331,651	766,764	2,918,628	1,079,781	532,133
1920.....	16,205,029	8,158,455	765,007	2,476,166	971,403	57,225
1921.....	15,974,962	8,128,710	926,329	2,422,006	767,571	43,177
1922.....	15,451,945	7,009,858	1,263,364	2,289,235	767,615	146,700
1923.....	17,790,597	9,149,073	1,233,341	2,426,495	724,848	250,673
1924.....	19,031,001	9,575,040	1,525,382	2,446,338	677,625	953,070
1925.....	19,025,942	9,597,592	1,735,735	2,319,920	564,198	985,154
1926.....	19,349,118	9,954,762	1,754,228	2,238,616	526,394	992,155
1927.....	19,397,757	10,122,491	1,852,785	2,117,253	514,504	1,060,950
1928.....	19,755,622	10,354,264	1,890,592	2,144,720	454,065	(5) 1,200,000
1929.....	19,500,152	10,412,326	1,928,308	2,056,629	421,476	(5) 1,000,000
1930.....	(6) 20,160,355	10,716,351	2,102,068	(6) 2,100,395	462,164	(5) 1,000,000
1931.....	.....	(6) 10,874,145	(6) 2,695,219	2,191,881	.....	.....

[1] From Repts. of the Director of the U.S. Mint.
[2] From Year Book of the Union of South Africa for 1929-30.
[3] From Dominion Bureau of Statistics reports.
[4] From U.S. Bureau of Mines: Economic Paper 6, "Summarized Data of Gold Production", to 1927; 1928, 1929, and 1930 from Repts. of Dir. of U.S. Mint.
[5] Estimates based on that of other years.
[6] Preliminary figures, subject to revision.

As regards the sum total of Canada's contribution to the world's stock of gold it stands fifth among gold-producing countries. It has been estimated that the world's total production of gold from the time of the discovery of America in 1492 to the end of 1930 was 1,062,979,458 fine ounces (more than half of it produced since 1902), of which there was contributed:

By the Union of South Africa, 250,676,657 ounces, or 23·6 per cent (since 1883).
By the United States, 219,965,504 ounces, or 20·7 per cent (mostly since 1847).
By Australia, 148,261,585 ounces, or 13·9 per cent (since 1851).
By Russia, 93,096,642 ounces, or 8·6 per cent (since 1741).
By Canada, 37,617,623 ounces, or 3·5 per cent (since 1858).

As to the future it may be taken for granted that the Union of South Africa will continue to be much the most important producer for some

years to come, and that its proportional contribution to the output of the world as a whole will continue to increase. The Rand still has great possibilities and an estimate based on present development alone[1] indicates that a drop in production costs of only two shillings a ton would enable the present rate of output to be maintained for at least another eight or ten years. Canada's production has increased at a remarkable rate in recent years and is still increasing. It is still small, however, compared with that of South Africa and the present *rate* of increase (27·5 per cent in 1931 over 1930), barring entirely unforeseen developments, is likely to show diminution in the immediate future. Gold mining will without doubt continue to be an important industry in Canada for many years, but no forecast sufficiently accurate to be of the slightest practical use can be made of either the rate or the trend of production, say, six or seven years hence. United States production has decreased about 57 per cent since 1915, and, though it may not go much lower, it is not anticipated that it can be raised materially above its present level. Australia's production is little more than an eighth of what it was in 1903, and, while under the stimulus of Government assistance and the premium on gold, it is now slowly increasing, there is nothing to indicate that it will attain anything like its former proportions of 3,346,445 ounces on the average annually from 1901 to 1910. In Russia, which, from about 1820 till it was surpassed by the United States after the discovery of gold in California, was the world's largest gold producer, production is believed to be now increasing steadily, though it is still considerably below the maximum attained in 1910. Russia, like Canada, has vast unexplored and undeveloped possibilities that may in the future make it one of Canada's closest competitors for second place among gold-producing countries.

[1] Year Book of the Union of South Africa, 1929-30, p. 478.

CHAPTER III

CANADA'S CHIEF PRODUCING GOLD MINES

In 1931, seven mines in Canada, each producing over 100,000 ounces of gold, furnished over 78 per cent of the total production of the Dominion; four others, each producing between 40,000 and 100,000 ounces, furnished nearly another 9 per cent; and mines producing less than 40,000 ounces annually furnished, approximately, 13 per cent.

TABLE IX

Larger Producers of Gold in Canada in 1931, in Order of Output

Rank	Ounces produced*	Operator	Province	District
1	533,757	Lake Shore Mines, Ltd. (*a*)	Ont.	Kirkland Lake.
2	487,123	Hollinger Consolidated Gold Mines, Ltd. (*a*)	"	Porcupine.
3	294,422	Teck-Hughes Gold Mines, Ltd. (*a*)	"	Kirkland Lake.
4	253,363	Noranda Mines, Ltd. (*b*)	Que.	Rouyn.
5	229,413	McIntyre-Porcupine Mines, Ltd. (*a*)	Ont.	Porcupine.
6	169,686	Dome Mines, Ltd. (*a*)	"	"
7	140,520	Wright-Hargreaves Mines, Ltd. (*a*)	"	Kirkland Lake.
8	82,394	Premier Gold Mining Co., Ltd. (*c*)	B.C.	Salmon River.
9	73,000	Hudson Bay Mining and Smelting Co., Ltd. (*d*)	Man.	The Pas.
10	43,437	Sylvanite Gold Mines, Ltd. (*a*)	Ont.	Kirkland Lake.
11	41,702	Howey Gold Mines, Ltd. (*a*)	"	Red Lake.
12	Between 40,000 and 20,000 ounces each	Yukon Consolidated Gold Corporation, Ltd. (*e*)	Yukon	
13		Coniaurum Mines, Ltd. (*a*)	Ont.	Porcupine.
14		Siscoe Gold Mines, Ltd. (*a*)	Que.	Harricanaw River.
15		Pioneer Gold Mines, Ltd. (*a*)	B.C.	Bridge River.
16		Kirkland Lake Gold Mining Co., Ltd. (*a*)	Ont.	Kirkland Lake.
17		Vipond Consolidated Mines, Ltd. (*a*)	"	Porcupine.
18		International Nickel Co., Ltd. (*f*)	"	Sudbury.
19		Central Manitoba Mines, Ltd. (*a*)	Man.	Central Manitoba.

* Approximately.

Sources of gold:

(*a*) Dry and siliceous ore.
(*b*) Copper-gold ore.
(*c*) Gold-silver-lead ore.
(*d*) Copper-zinc ore.
(*e*) Placer.
(*f*) Nickel-copper ore.

YUKON

Yukon, the output of which amounted to 44,306 fine ounces in 1931, now stands fifth among Canadian gold-producing provinces; though it was for many years the chief source of gold in the Dominion and its total production, from 1885 to 1931, is exceeded only by those of Ontario and British Columbia.

TABLE X

Total Production of Gold from Yukon, 1885-1931

Year	Fine ounces*	Value	Year	Fine ounces*	Value	Year	Fine ounces*	Value
		$			$			$
1885								
1886								
1887.....	4,837	100,000	1901...	870,750	18,000,000	1916...	212,700	4,396,900
1888.....	3,386	70,000	1902...	701,437	14,500,000	1917...	177,667	3,672,703
1889.....	1,935	40,000	1903...	592,594	12,250,000	1918...	102,474	2,118,325
1890.....	8,466	175,000	1904...	507,938	10,500,000	1919...	90,705	1,875,039
	8,466	175,000	1905...	381,001	7,876,000	1920...	72,778	1,504,455
1891.....	1,593	40,000	1906	270,900	5,600,000	1921...	65,994	1,364,217
1892.....	4,233	87,500	1907...	152,381	3,150,000	1922...	54,456	1,125,705
1893.....	8,514	176,000	1908...	174,150	3,600,000	1923...	60,144	1,243,287
1894.....	6,047	125,000	1909...	191,565	3,960,000	1924...	34,825	719,897
1895.....	12,094	250,000	1910...	221,091	4,570,362	1925...	47,817	988,465
1896.....	14,513	300,000	1911...	224,197	4,634,574	1926...	25,601	529,220
1897.....	120,937	2,500,000	1912...	268,447	5,549,296	1927...	30,935	639,483
1898.....	483,750	10,000,000	1913...	282,838	5,846,780	1928...	34,364	710,367
1899.....	774,000	16,000,000	1914...	247,940	5,125,374	1929...	35,892	741,954
1900.....	1,077,553	22,275,000	1915...	230,173	4,758,098	1930...	35,517	734,202
						1931...	44,306	915,886
					Total.....	.....	8,974,261	185,514,089

*Calculated from the value: one dollar = 0·048375 ounces.

With the exception of a few thousands of ounces contained in auriferous base-metal ores all Yukon's output has been of placer gold, the peak of production from which source was reached in 1900.

Gold quartz claims were staked as early as 1899, and with the gradual decrease in production of alluvial gold efforts were made to develop lode gold mines, in the hope that revenue from this source would replace that from the placers as they became exhausted. So far, however, all attempts to develop gold-quartz mines in Yukon have failed, and such lode-gold production as has been reported consists chiefly of small amounts of gold contained in silver-lead and in copper ores exported. These amounts, which are included in the table of total production given above, are separately recorded in the one which follows:

TABLE XI

Lode Gold Production of Yukon, 1910-1931*

Year	Fine ounces	Year	Fine ounces	Year	Fine ounces	Year	Fine ounces
1910.....	985	1916.....	690	1922.....	86	1928.....	248
1911.....	2,640	1917.....	1,119	1923.....	120	1929.....	222
1912.....	459	1918.....	730	1924.....	.....	1930.....	357
1913.....	518	1919.....	2,782	1925.....	.....	1931**.....	245
1914.....	187	1920.....	28	1926.....	257		
1915.....	370	1921.....	78	1927.....	157	Total.....	12,278

* Compiled from Dominion Bureau of Statistics Repts.
** Figures subject to revision.

In 1930, in addition to a number of individuals working alone or in partnership, two dredging companies carried on large-scale operations. The Yukon Consolidated Gold Corporation operated electrically equipped dredges on Bear, and Upper and Lower Dominion creeks; the other company operated in the Glacier district.

BRITISH COLUMBIA

In 1931, British Columbia produced 160,594 fine ounces of gold, or about 6 per cent of the total production of the Dominion and dropped from second to third place among the gold-producing provinces of Canada.

The earliest recorded discovery of gold in British Columbia was of small gold-bearing quartz veins on Moresby island of the Queen Charlotte group, in 1852; but it was not till the discovery of gold placers on the mainland between 1855 and 1858 that actual gold-production started. From 1858 to 1893, all the recorded production is attributed to placers, though mention is made of the erection of arrastres and small stamp mills in an attempt to work lode deposits as early as the eighteen-seventies. Lode mining, however, did not start in earnest until after the completion of the Canadian Pacific railway across the province in 1885. The first recorded production from lode mines was of silver in 1887, and lode gold does not appear in the records till 1893, nevertheless a 10-stamp mill was producing gold on the Poorman mine, near Nelson, in 1890. In 1893, the province's lode gold production was chiefly from gold-quartz mines in the West Kootenay and Yale districts, among the best known properties being the Poorman, O.K., and Fern in the former, and the Strathyre in the latter district. To these there was added in 1894 the Cariboo-Amelia mine at Camp McKinney in the Yale district, for a number of years the chief gold-quartz mine of the province.

The gold production from the quartz mines was, however, quickly far surpassed by that of the gold-copper mines of Rossland, the first shipments from which were made in 1891, and where a smelter went into operation in 1896. Before the Rossland gold-copper mines were finally closed down in 1928, they had produced about 2,867,000 fine ounces of

gold, over 3,600,000 ounces of silver, and nearly 118,000,000 pounds of copper, or about 40 per cent of the recorded gold production of the province to date. Another formerly important source of gold that came into production a little later than Rossland and continued until 1919, was by-product gold from the low-grade copper ores of the Boundary district which were smelted at Phoenix and Greenwood. Other more recent sources of by-product gold have been the low-grade auriferous copper ores of the Britannia, Anyox, and Copper Mountain mines. In 1903, ten years after it was first recorded, the lode gold production of British Columbia had risen to 232,831 fine ounces, of which latter amount the gold-copper ores of Rossland yielded about 145,353 ounces; the low-grade copper ores and the quartz-mines of the Boundary district, 50,358 ounces; the Nelson district, the output of which was chiefly from free-milling gold ores, 20,114 ounces; and the southern coast district which included such well-known copper-gold mines as the Marble Bay, Copper Queen, and Cornell on Texada island, 13,371. The Marble Bay mine was operated practically continuously from 1897 to 1919; and the Britannia mine which was discovered in 1898 also in this district, on the mainland at Howe sound, is still in operation and is now the largest producer of by-product gold in the province.

Among the first of the gold-quartz mines to be systematically worked on an extensive scale was the Poorman, later called the Granite-Poorman, located on Eagle creek, about six miles westerly from the town of Nelson, on which a 10-stamp mill was built in 1890. This property, during the course of a long and chequered career, in which it passed through many hands and was repeatedly worked by lessees, is estimated to have produced, mostly prior to 1912, over $1,000,000 worth of gold; about 80 per cent of which was recovered by amalgamation and 10 per cent in concentrates. The Fern gold mine also in the Nelson district was profitably worked, producing gold in a 10-stamp mill, in the middle of the eighteen-nineties; while farther west some very rich gold-quartz ore was worked on the O.K. and I.X.L. mines, 2½ miles from Rossland. Early in 1894 the Cariboo-Amelia mine at Camp McKinney, about 32 miles west of Midway and 8 miles north of the International Boundary, for a number of years one of the most successful gold-quartz mines in British Columbia, commenced productive operations which were carried on continuously till 1903. Up to the end of 1902, bullion and concentrates to the value of $1,105,861.58 had been recorded and $509,337.52 paid in dividends from this mine.

In December, 1898, the first cyanide plant to be built in British Columbia was put into operation at the Dorothy Morton mine on Phillips arm about 120 miles north of Vancouver on the west coast of the mainland. After about a year's work, however, during which 9,707 tons of ore were treated and 4,434 ounces of gold and 10,222 ounces of silver recovered, the plant was closed down, the assumed ore-bodies it was erected to treat proving to be merely small pockets.

In 1900 an 80-stamp was put in operation at the Ymir mine on Wild Horse creek, about 27 miles south of Nelson. The working of this property, which was at one time the largest gold mine in Canada, con-

tinued with more or less success till 1906; the mine output being shipped in the varied forms of bullion recovered by amalgamation and cyanidation, auriferous lead concentrates, and direct smelting auriferous lead ore. Other considerable producers of gold bullion and concentrates in the vicinity of Nelson at this time were the Yellowstone mine on Sheep creek near Salmo and the Athabasca mine on Toad mountain, six miles south of Nelson; and in the Lillooet district the Bras d'Or mine on Cadwallader creek, a tributary of Bridge river.

The Nickel Plate mine at Hedley in the Osoyoos mining division, for many years the most important gold-quartz mine in British Columbia, though discovered in 1898, did not become productive till 1904, when a 40-stamp mill for the treatment of a gold-bearing mispickel ore by a combined process of amalgamation, concentration and cyanidation, was put into operation. The Nickel Plate mine and plant were operated continuously and profitably up till 1920; total operating profits up to June, 1919, being $4,089,000. Work in the mine did not entirely cease, however, until 1930, when the known ore-bodies were exhausted.

Between 1906 and 1917, the only large stamp mill operating in the province was that at the Nickel Plate mine. There was, however, a number of smaller mills operating more or less intermittently—some of them for only very short periods of time—at numerous points in the province, chiefly in the Nelson and Lillooet mining divisions. Some of those in the Nelson division were, the Granite-Poorman, Queen, Athabasca, Nugget, Mother Lode, Perrier, Fern, Second Relief, Kootenay Belle, Ymir-Wilcox, and Yankee Girl; in the Lillooet division, the Bras d'Or, Coronation, Pioneer, and Lorne; in the Greenwood division, the Jewel and Carmi; and in Atlin, the Engineer.

The next large gold mine to come into special prominence in British Columbia after the Nickel Plate was the Belmont-Surf Inlet mine, situated about seven miles inland from the head of Surf inlet on the west coast of Princess Royal island, about 150 miles from Prince Rupert, which occupied the centre of the stage as British Columbia's largest gold producer from 1918 to 1921. This though essentially a gold mine was also a considerable producer of copper, and shipped all its output to smelters in the form of auriferous copper concentrates. A 250-ton flotation mill was completed and the first shipments of concentrates made in 1917. In 1918, its output of gold surpassed that of the Nickel Plate, and it continued to be the largest gold mine in the province till, in 1921, its output was in turn surpassed by that of the Premier. In June, 1926, the mine was closed down and the plant dismantled, the known ore-bodies having been worked out after producing some 321,983 ounces of gold, from 836,500 tons of ore treated; and gold, silver and copper to a total value of nearly $8,000,000 of which $1,437,500 was paid out in dividends.

Since 1921, the Premier mine near Stewart, at the head of Portland Canal in the northwestern part of the province has been by far the most important gold mine in British Columbia; its total output of gold since 1922 amounting to well over 60 per cent of the total provincial production for the same period. Though essentially a gold mine, it has also been a great silver mine and to some extent a producer of lead. Next to the Premier, the most important gold mines now producing in British Columbia

are the Pioneer, Union, and Reno. Concerning these four mines, Mr. J. D. Galloway, the Provincial Mineralogist, said in an address delivered at a meeting of the Canadian Institute of Mining and Metallurgy held at Vancouver in November, 1931: "Of these, Premier has only a somewhat limited life, failing new discoveries; Union reserves are not explored, but some important discoveries this year are being energetically developed; Reno is a small operation which may continue for some time; and finally, Pioneer is a new star on the horizon, promising a splendid career."

Concerning the present total lode gold reserves of the province, Mr. Galloway estimates that 800,000 ounces are reasonably indicated in known ore-bodies, and a further 700,000 ounces in possible extensions of these, exclusive of placers; this in addition to probabilities and possibilities in semi-developed mines, prospects, and unprospected areas, that cannot be reduced to figures of any practical value.

The principal placer mining camps in British Columbia are in the Atlin, Cariboo, and Quesnel districts, while less important areas in the Liard, Omineca, Clinton, Similkameen, Fort Steele, and Revelstoke mining divisions also contribute to the output. Alluvial gold now forms only a very small part of the province's gold production, but there has been some increase in activity in placer mining during the past two or three years, and it is believed that there are still very considerable quantities of gold to be won by this method in British Columbia.

A comprehensive report on the gold mines, prospects, and unprospected areas of the province was published by the British Columbia Department of Mines in 1932, under the title: "Lode-Gold Deposits of British Columbia." A copy of this valuable report may be obtained by anyone interested by applying to the Provincial Mineralogist, Victoria, B.C.

In 1931, about 9 per cent of British Columbia's total gold production was derived from placers and 91 per cent from lode gold mines. Of the lode gold production, in turn, about 8 per cent was by-product gold, chiefly from copper mines; about 56 per cent came from the Premier mine; and the remainder from other straight gold mines, chiefly from the Pioneer, Union, and Reno.

TABLE XII

Placer Gold Production of British Columbia, 1858-1931*

1858....	$ 705,000	1877....	$1,608,182	1896...	$ 544,026	1914...	$ 565,000
1859....	1,615,070	1878....	1,275,204	1897...	513,520	1915...	770,000
1860....	2,228,543	1879....	1,290,058	1898...	643,346	1916...	580,500
1861....	2,666,118	1880....	1,013,827	1899...	1,344,900	1917...	496,000
1862....	2,656,903	1881....	1,046,737	1900...	1,278,724	1918...	320,000
1863....	3,913,563	1882....	954,085	1901...	970,100	1919...	286,500
1864....	3,735,850	1883....	794,252	1902...	1,073,140	1920...	221,600
1865....	3,491,205	1884....	736,165	1903...	1,060,420	1921...	233,200
1866....	2,662,106	1885....	713,738	1904...	1,115,300	1922...	364,800
1867....	2,480,868	1886....	903,651	1905...	969,300	1923...	420,000
1868....	3,372,972	1887....	693,709	1906...	948,400	1924...	420,750
1869....	1,774,978	1888....	616,731	1907...	828,000	1925...	280,092
1870....	1,336,956	1889....	588,923	1908...	647,000	1926...	355,503
1871....	1,799,440	1890....	490,435	1909...	477,000	1927...	156,247
1872....	1,610,972	1891....	429,811	1910...	540,000	1928...	143,208
1873....	1,305,749	1892....	399,526	1911...	426,000	1929...	118,711
1874....	1,844,618	1893....	356,131	1912...	555,500	1930...	152,235
1875....	2,474,004	1894....	405,516	1913...	510,000	1931...	291,845
1876....	1,786,648	1895....	481,683			Total..	$78,880,794

*See footnote at end of Table XIII.

TABLE XIII

Lode Gold Production of British Columbia, 1893-1931*

Year	Ounces	Value	Year	Ounces	Value
		$			$
1893	1,170	23,404	1913	272,254	5,627,490
1894	6,252	125,014	1914	247,170	5,109,004
1895	39,264	785,271	1915	250,021	5,167,934
1896	62,259	1,244,180	1916	221,932	4,587,334
1897	106,141	2,122,820	1917	114,523	2,367,190
1898	110,061	2,201,217	1918	164,674	3,403,812
1899	138,315	3,857,573	1919	152,426	3,150,645
1900	167,153	3,453,381	1920	120,048	2,481,392
1901	210,384	4,348,603	1921	135,663	2,804,154
1902	236,491	4,888,269	1922	197,856	4,089,684
1903	232,831	4,812,616	1923	179,245	3,704,994
1904	222,042	4,589,608	1924	247,716	5,120,535
1905	238,660	4,933,102	1925	209,719	4,335,269
1906	224,027	4,630,639	1926	201,427	4,163,859
1907	196,179	4,055,020	1927	178,001	3,679,601
1908	255,582	5,282,880	1928	188,087	3,888,097
1909	238,224	4,924,090	1929	145,339	3,004,419
1910	267,701	5,533,380	1930	160,778	3,323,576
1911	228,617	4,725,513	1931	146,476	3,047,928
1912	257,496	5,322,442			
			Totals	6,972,204	143,915,939

* Both of the foregoing tables are taken from the Ann. Rept. of the Minister of Mines, B.C., for 1930, except the figures for 1931, which are taken from the Preliminary Report on the Min. Prod. of Canada in 1931 published by the Dom. Bur. of Statistics.

PREMIER MINE

The Premier Gold Mining Company's Premier mine includes a large group of mining claims situated about ten miles due north of the north end of Portland Canal, close to the boundary line separating Alaska from British Columbia. It can be reached from the town of Stewart, British Columbia, by an excellent motor road about 17 miles in length, which for the greater part of this distance is built through Alaskan territory.

Metalliferous deposits in the vicinity of Portland Canal first received attention in 1898, at the time of the Klondike rush, but little development work was done before 1907. The original Premier claims were staked and recorded in the summer of 1910, and these together with some other adjoining claims were acquired by the Salmon Bear River Mining Company, Ltd. This company began development work in the spring of 1911, continuing it during the summers of that and the following year. The property lay idle in 1913. During the next three years it was extensively explored by prospective purchasers with, on the whole, unsatisfactory results, though a little high-grade ore was found in 1914. In March, 1917, it was bonded to Messrs. Trites, Woods and Wilson, and shortly after work was started on their behalf a large body of high-grade gold-silver ore was found. In 1919, the American Smelting and Refining Company bought a controlling interest in the mine and proceeded to equip it for production. A 100-ton concentrating mill was built; also an aerial tramway 12 miles long to convey ore and concentrates from the

mine and mill to a shipping pier on tidewater at the head of Portland Canal. Milling capacity was gradually increased until it is now over 400 tons a day. For a time a cyanide plant was operated in connexion with the mill but has not been used since 1925. In 1927, the use of tables in the mill was discontinued and the milling process changed from combined gravity and flotation, to all flotation. The products now shipped are first and second class ore and flotation concentrates.

The ore-bodies, which have a vertical extent of about 1,400 feet, are opened up on six levels by adits; and there are more than 15 miles of underground workings including drifts, crosscuts and raises. The very high-grade ore, found chiefly in the upper levels, has been largely depleted and output is now dependent on the milling of lower grade ores. To quote the last annual report of the Premier Mining Company as to the present conditions at the mine: "It has been made clear that the Premier ore shoot bottomed as to commercial values slightly above the 5th level with a few roots of ore of profitable grade persisting down in the eastern end to the 6th level. But throughout the year 1931, intensive exploration and development, coupled with diamond drilling, was continued in horizons above the 6th level, designed to find and open up various spur and stringer veins on the foot-wall and hanging-wall of the main ore shoot, and while this did not result in opening up as much new ore as in previous years, it was moderately successful." The estimated assured and probable ore reserves on December 31, 1931, were 253,623 tons averaging 0·32 ounces of gold, and 8·83 ounces of silver a ton, as against 369,205 tons averaging 0·36 ounces of gold and 9·40 ounces of silver a ton, on December 31, 1930.

TABLE XIV

Production and Dividend Record of Premier Gold Mines, 1919-1931*

Year	Ore mined, tons	Ore shipped, tons	Concentrates shipped, tons	Cyanide precipitates shipped, tons	Gold and silver produced		Dividends paid, $
					Gold, ounces	Silver, ounces	
1919.....	488	.....	.....	.....	3,209	108,285	.....
1920.....	799	.....	.....	.....	2,283	77,180	.....
1921.....	18,750	4,356	1,000	5	40,104	1,177,978	400,000 00
1922.....	102,334	69,990	4,125	13	127,827	4,474,367	2,773,125 00
1923.....	145,665	87,869	7,175	11·36	117,294	2,746,551	1,738,000 00
1924.....	159,014	97,049	8,524	13·55	139,288	3,015,382	1,715,000 00
1925.....	168,557	112,853	6,357	7·95	119,725	2,559,192	1,600,375 00
1926.....	230,987	108,835	19,997	Nil	126,324	3,187,618	1,600,937 50
1927.....	244,172	96,637	26,051	.....	118,842	3,396,082	1,601,062 50
1928.....	275,811	113,699	17,081	.....	131,744	2,607,645	1,300,898 43
1929.....	266,972	101,829	14,631	.....	93,442	2,429,751	1,210,218 75
1930.....	256,836	104,900	15,616	.....	90,084	2,760,787	1,050,773 43
1931.....	242,317	72,558	20,271	.....	82,394	1,718,376	635,713 14

* Figures from 1922 to 1931 compiled from Annual Reports of the Premier Gold Mining Company, Ltd. According to the Annual Report for 1931, the total output from the commencement of production by the Premier Gold Mining Co. to the end of 1931—a period of twelve years and one month—was 1,201,490 ounces of gold and 31,015,145 ounces of silver from 2,111,585 tons of ore mined and milled or shipped. Total dividendsf or the same period $15,949,603.75.

PIONEER MINE

The property of Pioneer Gold Mines, Ltd., covers approximately 700 acres, situated about 50 miles by road from Bridge River station on the Pacific Great Eastern railway, in the Bridge River area of the Lillooet mining division.

The original Pioneer claim was staked in 1897. For eleven summers it was operated single-handed by the owner, Mr. F. H. Kinder, who managed alone to mine and mill sufficient ore to make a comfortable living, the crushing being done in a small home-made arrastre driven by a waterwheel set up on Cadwallader creek and capable of crushing 400 or 500 pounds of ore a day.

In 1911, Kinder sold the property to the Pioneer Syndicate, who after further developing it, set up in 1916 a 5-foot Chilian mill, with amalgamation plates and a Diester table, all driven by a Pelton waterwheel. Production was continuous from 1916 to 1919, but the mine was idle in 1920. In 1921 it was re-opened by new owners and a cyanide plant added to the equipment. In 1922 a vertical shaft had been sunk to a depth of about 230 feet on the vein, but the developed ore shoots were stoped out, and operations again ceased.

In 1924 arrangements were made by the owners whereby further development was carried on by returns derived from ore mined in the old stopes. By the end of 1926 development had been carried to a depth of 500 feet, with extremely favourable results. In 1928 the property was acquired by Pioneer Gold Mines of British Columbia, Ltd.; a new vertical shaft was put down; and sufficient ore reserves were developed to warrant the building of an 80-ton cyanide mill, the capacity of which was increased to about 125 tons in 1929.

According to the company's annual report, mine development to March 31, 1931, included a main shaft down 1,000 feet, with the chief working levels at depths of 625, 750, 875, and 1,000 feet. Total drifting on all levels amounted to 5,111 feet. On the 750-foot level a continuous body of ore having a length of 1,632 feet had been developed, and on the 875-foot and the 1,000-foot levels, there was continuous ore for 1,400 feet, with all faces still in ore. The average value of the ore exposed over a width of three feet six inches was $20.70 a ton, thus indicating reserves worth over $4,500,000 between the 500-foot and the 1,000-foot levels. Reserves of broken ore above the 500-foot level were valued at $500,000, making a total ore reserve of over $5,000,000.

Since the company's last annual report was issued it is reported that the lateral extent of the ore has been proved over a length of 1,800 feet. A new shaft has been sunk 200 feet below the 1,000-foot level, and it is intended to continue sinking to a depth of 3,000 feet and open up five new levels below the 1,000-foot level. Milling capacity is being increased to enable the treatment of about 300 tons of ore a day. A hydro-electric plant capable of furnishing 750 horse-power has also been installed on the south fork of Bridge river, from which power is transmitted to the mine 3½ miles away.

Up to the time of the resumption of operations in 1924 the Pioneer mine is estimated to have produced bullion to the value of about $1,350,000; and from 1924 to the end of 1931, to the value of approximately $1,491,830, over $600,000 of which was obtained in 1931.

RENO MINE

The Reno mine, the property of Reno Gold Mines, Ltd., consists of sixteen mining claims situated at the head of Fawn creek, a tributary of Sheep creek, about 15 miles by road from the small town of Salmo on the Nelson and Fort Sheppard branch of the Great Northern railway. It is about 30 miles south of the city of Nelson.

Most of the claims now included in the Reno property were staked about 1912 or 1913. The present operating company Reno Gold Mines, Ltd., was incorporated in 1920. Though considerable exploratory work had previously been done, active development of the property did not commence till 1928. In August, 1929, a 30-ton cyanide mill was completed and put in operation, which up to the end of December, 1930, produced bullion to the value of $199,798 from about 11,670 tons of ore.

The early exploratory work done on the vein was through four short adits. Since the beginning of the present operations in September, 1928, underground work has been largely confined to the two lower of these, viz: adit levels Nos. 3 and 4, and to the driving of a new adit, No. 5, about 283 feet vertically below No. 4. No. 5 adit had been driven about 1,000 feet by the end of 1931, and had reached the vein, which is now being drifted on to open up the downward continuation of the ore shoots on the No. 4 level.

The vein being worked is narrow but rich both in its outer oxidized portion and at the inner ends of the adits, where unaltered sulphides are encountered. In this respect it has proved an exception to the general experience in the district where it has usually been found that when workings passed from oxidized to unaltered portions of a vein, there was a sharp decrease in the gold content, which made the working of the primary sulphide ores unprofitable. The richness in gold of the sulphides so far found on the Reno vein, therefore, adds greatly to the possibilities of developing extensive ore-bodies.

The ore now going to the mill, which is treating 45 tons a day as against 32 tons during the first seven months of 1931, consists of oxidized and sulphide material in the ratio of 1·4 to 1·0. Formerly the mill feed was all oxidized ore.

During the year 1931, 11,944 tons of ore of an average value of $18.87 a ton were treated, yielding a total of $201,570 exclusive of premium; the average mill recovery being about 92·4 per cent of the gold in the ore. Of this amount 40 per cent was recovered by amalgamation; 53 per cent by cyanidation; and 7 per cent in concentrates.

UNION MINE

The Union group of claims consisting of the Union, Union Fraction, Paper Dollar, Idaho, Silver Dollar, and Burke, is situated near the Granby river in Franklin camp, about 45 miles north of the town of Grand Forks on the Canadian Pacific railway. The first four of these claims were staked many years ago, the last two more recently.

The Union was worked first as a silver mine and during the years from 1913 to 1920, there was shipped from it to smelters some 3,612 tons of silver-gold ore, valued chiefly for its silver content at $121,677. There was little or no profit in operations, however, after mining costs and transportation and smelting charges had been paid.

Late in 1927 the property was bonded by the Hecla Mining Company of Wallace, Idaho, and for the next three years development work was carried on steadily in the upper levels of the old mine. In 1930 some rich new ore was found, some of it assaying as high as $300 to the ton chiefly in gold; though the original ore in the mine carried only about $9 or $10 to the ton in gold and silver, chiefly the latter. During the year 36,886 tons of ore were milled, yielding 1,104 tons of concentrates in which the ratio of gold to silver was 1 to 36. During 1931, 56,666 tons of ore were milled; and one carload of 55 tons of sorted ore from the new ore-body, sacked and shipped to the smelter, returned 41·05 ounces of gold and 18·65 ounces of silver to the ton, and 8·55 per cent lead. The dimensions of the new ore shoot have not yet been determined. The milling ore is concentrated first on Wilfley tables, the tailing from which is then treated by flotation. The table and flotation concentrates are shipped to smelters. None of the gold in the ore appears to be amenable to amalgamation.

ALBERTA AND SASKATCHEWAN

In Alberta small quantities of alluvial gold were recovered annually for many years by washing material from sand and gravel bars of the Saskatchewan river. Latterly, however, production from this source has been almost negligible. No lode gold has ever been mined in the province.

It seems probable that in the near future there may be a considerable increase in Alberta's output of alluvial gold, as it is reported that the McLeod River Mining Corporation, Ltd., have now nearly completed the building of a dredge by means of which it is intended to work large areas of auriferous gravels situated on McLeod river in the northwestern part of the province.

In Saskatchewan no gold production, from any source, has as yet been recorded. Nevertheless, occurrences of gold-quartz are known to occur in the northern part of the province, and it is reported that a company has recently been formed to develop a deposit of this type found there—at Amisk lake—in 1913. It is also reported that underground workings on the Flin Flon auriferous copper-zinc deposits have now been driven across the Manitoba boundary into Saskatchewan. In all likelihood, therefore, Saskatchewan will before long be added to the list of Canada's gold-producing provinces.

It is also worthy of note that in the northern portions of both Alberta and Saskatchewan there are large areas of Precambrian rocks favourable to the occurrence of gold. About one-third of Saskatchewan's total area of 251,700 square miles is underlain by rocks of this type, and, in Alberta, about 5,000 square miles, in the northeastern corner of the province.

TABLE XV

Production of Gold from Alberta, 1887-1931*

Year	Fine ounces**	Value	Year	Fine ounces**	Value	Year	Fine ounces**	Value
		$			$			$
1887.....	102	2,100	1902...	484	10,000	1917...	.....	.....
1888.....	58	1,200	1903...	48	1,000	1918...	27	558
1889.....	967	20,000	1904...	24	500	1919...	24	500
1890.....	193	4,000	1905...	121	2,500	1920...	.....	.....
1891.....	266	5,500	1906...	39	800	1921...	49	1,013
1892.....	508	10,506	1907...	33	675	1922...	.....	.....
1893.....	466	9,640	1908...	50	1,037	1923...	.....	.....
1894.....	726	15,000	1909...	25	525	1924...	.....	.....
1895.....	2,419	50,000	1910...	89	1,850	1925...	.....	.....
1896.....	2,661	55,000	1911...	10	207	1926...	.....	.....
1897.....	2,419	50,000	1912...	73	1,509	1927...	42	868
1898.....	1,209	25,000	1913...	.....	.....	1928...	68	1,406
1899.....	726	15,000	1914...	48	992	1929...	5	103
1900.....	242	5,000	1915...	195	4,026	1930...	.....	.....
1901.....	726	15,000	1916...	82	1,695	1931***	195	4,031
							15,419	318,737

* From Dominion Bureau of Statistics Repts.
** Calculated from the value: one dollar=0·048375 ounces.
*** Figures subject to revision.

MANITOBA

Though the history of gold-mining in Manitoba is a very short one, nevertheless that province now stands fourth among the gold-producing provinces of the Dominion, its production in 1931 being 102,969 ounces, or nearly two-thirds that of British Columbia, Canada's oldest gold producer. Over three-quarters of the Manitoba output is by-product gold obtained in the course of treatment of low-grade auriferous copper-zinc ores from the Flin Flon and Sherritt-Gordon mines. The remainder is won from gold-quartz mines, at present chiefly from the Central Manitoba mine, the output of which will, however, soon be supplemented by that of at least two other mines of this type, viz., the San Antonio and the Gem Lake. Deposits of alluvial gold are not known to exist in Manitoba.

Local tradition has it that gold was discovered on Black island in lake Winnipeg, just off the mouth of Wanipigow (or Hole) river, in 1881; and on the mainland, on the south side of Wanipigow river near its

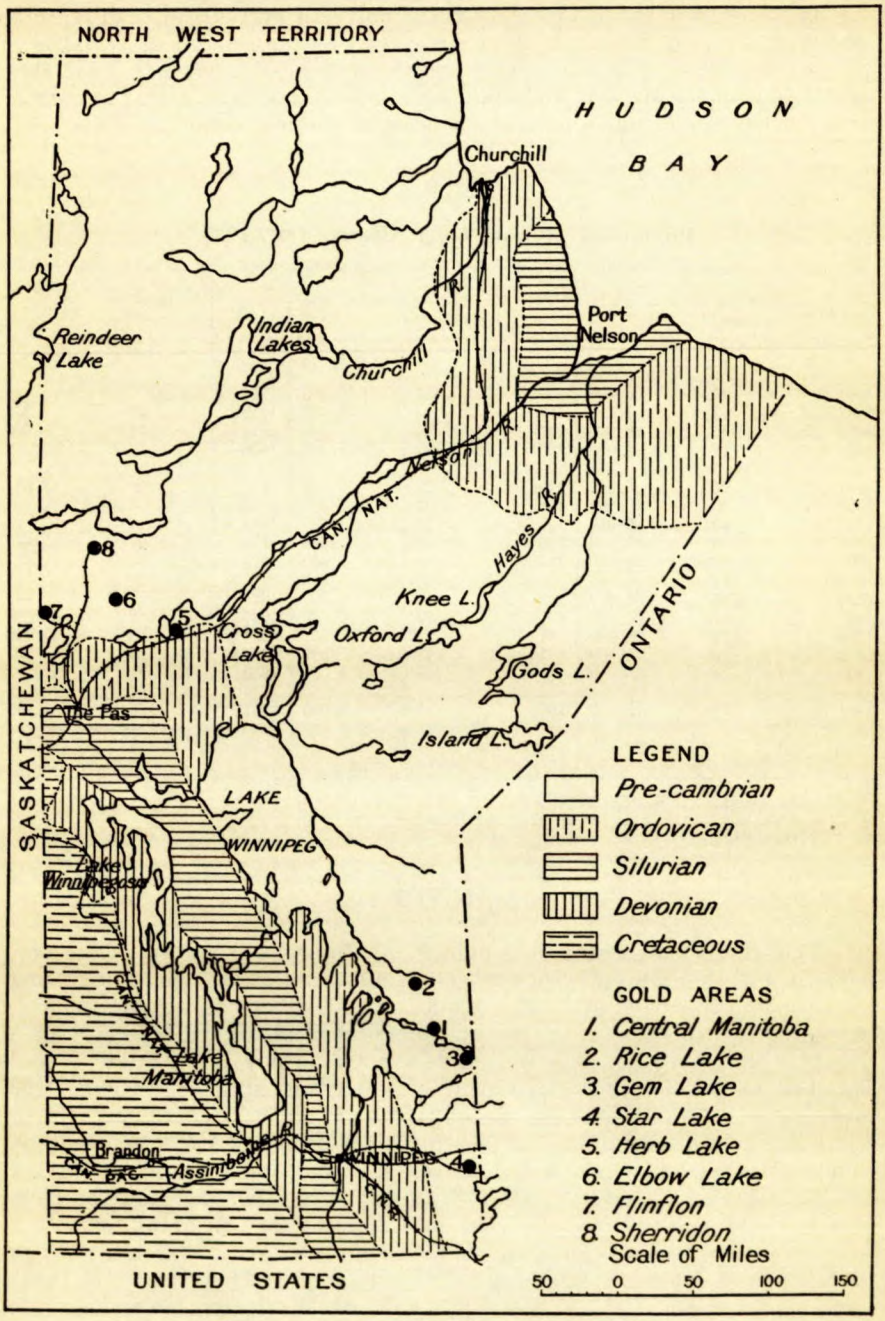


Figure 4. Key map of gold areas in Manitoba.

mouth, in 1895 and 1896. Interest in these early discoveries, whatever they may have amounted to, appears, however, to have died down quickly, and it was not until ten or twelve years later that reports of the discoveries being made in northern Ontario caused prospecting again to become active in Manitoba also. In 1908 a few claims were staked up the Wanipigow river, but no work was done on them. Early in 1911 gold was found on the Gabrielle claim on Rice lake, which was the centre of considerable activity for a few years. Other discoveries followed at intervals: at Gold lake, Long lake, Bulldog lake, Hay lake, etc., until we find to-day a belt of country following the watersheds of the Wanipigow and Manigotagan (Bad Throat) rivers from lake Winnipeg to the Ontario boundary dotted over with groups of gold-mining claims. This stretch of country is now known as the Central Manitoba mineral district. In it small gold mills were built and operated for short periods at various times on the Luleo, or Selkirk, Gold Pan, and Elora (Kingfisher) properties; and on the Penniac property considerably to the south of it, at Star lake, in the Boundary district; but the first mill in southeastern Manitoba, or, for that matter, in the whole province, to maintain a steady output on a large scale was that of Central Manitoba Mines, Limited, which started producing in 1927.

Manitoba's other gold-bearing district is in the northwestern part of the province, north of The Pas and adjacent to the Saskatchewan-Manitoba boundary; in the southwestern corner of territory which was added to the province in 1912: it is commonly spoken of as The Pas mineral belt. Some prospecting was done in this district in 1905, but it was not until gold-bearing quartz veins were found at Amisk lake in the contiguous part of the province of Saskatchewan, in 1913, that any very active interest was taken in the mineral possibilities of the region. In 1914, gold-bearing quartz veins were also discovered on the shore of Wekusko (Herb) lake at the eastern end of the district, in Manitoba, and a period of active prospecting began in that part of the field, further finds being made at Elbow lake, Copper lake, and other points west of Wekusko lake. In the summer of 1915, large auriferous copper-zinc deposits were found at Flinflon lake, and in the autumn of the same year at the Mandy mine on Schist lake, near each other at the western end of the district. The first stakings on the Sherritt-Gordon deposits, on Kississing lake, 30 miles to the north, were not made till 1923, though the deposit had been known for some years previously.

The first recorded production of gold in Manitoba was from The Pas district, in 1917, when some 28 or 29 tons of gold-bearing quartz, worth more than $81 a ton, from the Moosehorn property, and 3,300 tons of high-grade copper ore, carrying about $5 in gold to the ton, from the Mandy copper mine, were shipped to the Consolidated Mining and Smelting Company's plant at Trail, British Columbia, for treatment. The Mandy ore had to be transported 40 miles on horse-drawn sleighs over winter roads, 130 miles on scows by water, and 1,300 miles by rail, to reach its destination. Since 1917, several small gold-quartz mills have been operated for short periods in The Pas district, the most important

being that on the Rex mine which operated intermittently between 1918 and 1926. From 1926 to 1930, there was no gold output reported from northern Manitoba, but late in the latter year production began at the Flin Flon, and early in 1931, at the Sherritt-Gordon mine.

The recorded production of gold from Manitoba is given in the following table:

TABLE XVI

Production of Gold from Manitoba

Year	Fine ounces	Value	Year	Fine ounces	Value
		$			$
1917	440	9,095	1925	4,424	91,452
1918	1,926	39,814	1926	188	3,886
1919	724	14,966	1927	182	3,762
1920	781	16,145	1928	19,813	409,571
1921	207	4,279	1929	22,455	464,186
1922	156	3,255	1930	23,189	479,359
1923	31	641	1931*	102,969	2,128,558
1924	1,180	24,393			
			Totals	178,665	3,693,332

* Preliminary figures, subject to revision.

Of the 440 ounces produced in 1917, 108 ounces were contained in 57,000 pounds of gold-bearing quartz, shipped from the Moosehorn claim on Wekusko lake, and 332 ounces were recovered from the treatment of Mandy copper ore, at Trail. Of the 1,926 ounces produced in 1918, 1,337 ounces came from the Rex mine on Wekusko lake, 537 ounces were recovered from Mandy copper ores at Trail, and 52 ounces came from Moosehorn ore treated in the Rex mill. In 1919, 611 ounces were recovered from Mandy ores at Trail, and 113 ounces from the Gold Pan mine and mill in the Central Manitoba district. In 1920, the Rex mine accounted for 181 ounces, the remaining 600 ounces being contained in Mandy ore. In 1921, the Rex mine produced 87 ounces; the Gold Pan, 101 ounces; and 52 ounces came, probably, from other properties in the Central Manitoba district. In 1922, about 100 ounces were produced by the Kingfisher Mining Company from a small mill on the Elora fractional claim in Central Manitoba district, the remaining 56 ounces produced that year coming from northern Manitoba. In 1923, of the 31 ounces produced, 23 ounces were from the Gold Pan property in central Manitoba; the remainder from northern Manitoba. In 1924, the Rex mill, in The Pas district, produced 1,131 ounces; the Selkirk Mining Company's mill on the Luleo mine in central Manitoba, 45 ounces; and the remaining 4 ounces came from the Gold Pan property and from The Pas district. The total production in 1925 came from The Pas district; 4,386 ounces from the Rex mine, on Wekusko lake, and 38 ounces from the Webb

claims on Elbow lake. In 1926, the whole production again came from the northern district; 128 ounces from the Bingo mine on Wekusko lake, the remaining 60 ounces from various properties. In the years 1927, 1928, and 1929, the entire production was from the Central Manitoba mine. Late in 1930, the Flin Flon mine began producing also, and in 1931, the Sherritt-Gordon.

CENTRAL MANITOBA MINE

Central Manitoba Mines, Limited, is the owner of a group of claims, covering some 1,500 acres, situated about 125 miles northeast of the city of Winnipeg, and within 10 miles of the Ontario boundary, in township 22, range 16, east of the principal meridian. Access to the property in winter, when most of the mine supplies are taken in, is by a road about 55 miles in length which connects it with the railway at Great Falls. During the summer months, freight leaves the railway at Riverton, on the west side of lake Winnipeg, is carried across the lake by boat to English Brook, and thence by boat and portage up the Manigotagan and Wanipigow rivers to the mine, a distance of about 60 miles, about 25 of which is portage by teams and motor trucks. From Lac du Bonnet, on the railway, the mine can be reached by aeroplane in about an hour and a half.

The first development work done on these claims was in 1924, by the WAD Syndicate, who uncovered two major ore-shoots, about 3,500 feet apart, in a mineralized zone some two and a half miles in length, which extends across the property.

In 1925, the results obtained, particularly on the Kitchener claim, were so promising that John Taylor and Sons, the well-known mining firm of London, England, acquired a controlling interest in the property, and later incorporated Central Manitoba Mines, Ltd., to operate it under their management. Ore to a gross value of about $1,100,000 having been developed on the Kitchener vein, a 150-ton cyanide mill was built, which started producing late in October, 1927, and has been operating steadily ever since except for a few days in the fall of 1931, when operations were held up as a result of a fire. Mine and mill are supplied with hydro-electric power from the Manitoba Power Company's plant at Great Falls, by a transmission line 43 miles in length. In 1930, John Taylor and Sons withdrew from the management of the property.

Mining operations have been carried on chiefly on the Kitchener claim, on which the main camp, the mill, and the main, or Kitchener, shaft are located. This shaft, from which most of the ore milled has come, is a two-compartment shaft, 390 feet deep, serving four levels, at depths of 125, 200, 250, and 375 feet. From the lowest level two winzes have been sunk to depths of 425 and 520 feet, respectively.

Besides the main shaft, there are several other shafts on the property. The Tene 6 shaft, 3,600 feet east of the main shaft, is a two-compartment shaft, 292 feet deep, with levels at depths of 60, 140, and 250 feet, through which ore has been mined from the Tene 6 and Tene 2 claims, leased

from the Manitowan Syndicate. Ore from this shaft is hauled to the mill by motor trucks. Sixteen hundred feet east of the Tene 6 shaft, again, a three-compartment shaft is being sunk on the Hope claim, where a mineralized zone has been exposed over a length of about 700 feet.

On April 30, 1931, ore reserves were estimated at only 11,500 tons valued at $111,490. Nevertheless, it has been found possible to maintain production steadily at the rate of nearly $40,000 a month, and no intimation has been given that this rate is likely to be reduced.

The total value of bullion (gold and silver) produced by Central Manitoba mine from the beginning of milling in October, 1927, to October 31, 1931, is approximately $1,736,645. Operations, however, have so far been carried on at a loss.

FLIN FLON MINE

The Flin Flon mine, of the Hudson Bay Mining and Smelting Company, Limited, situated on the Manitoba-Saskatchewan boundary, 91 miles by rail northwest of The Pas, Manitoba, is a copper-zinc mine, the ore from which carries also a small amount of gold that is recovered as a by-product. The rate at which gold is produced at Flin Flon depends, therefore, almost entirely on the rate at which copper and zinc can be profitably produced and sold. At present, it is by far the largest gold producer in Manitoba and, in the aggregate, the amount of gold contained in its known ore-bodies is large, estimated at about 1,332,000 ounces.

The Flin Flon deposit was staked in 1915, on a weathered, gossan outcrop from which gold could be panned, but which was found on further investigation to be primarily a low-grade body of copper, zinc, and iron sulphides. In 1916 and 1917, the property was drilled by parties who held it under option, and the ore-body was thus delimited much as it is known to-day. At that time, however, the deposit was some 70 miles in an air-line from the nearest railway, and as, in addition, the treatment of the ore presented some metallurgical difficulties, there was considerable delay in getting financiers interested in its exploitation. In 1920, an option was taken by the Mining Corporation of Canada, Ltd., and underground development was undertaken in order to check the results of the diamond-drilling. In 1925, the Mining Corporation succeeded in interesting H. P. Whitney, of New York, following which exhaustive experiments were conducted to determine the best method of treating the ore. Early in 1927, a 50-ton pilot mill was built on the property and further extensive tests were made; and at the end of the year the Hudson Bay Mining and Smelting Company, Ltd., was formed to operate the mine.

In January, 1928, the Canadian National Railway started on the construction of a branch line, which reached Flin Flon in October. Following the arrival of the railroad, a concentrating mill, an electrolytic zinc plant, a copper smelter, a cyanide plant, etc., were built at the mine. A hydro-electric plant equipped to generate 44,000 horse-power was built at Island Falls on the Churchill river and connected with the mine by a

transmission line 58 miles in length. Before the end of 1930, there had been completed and put in operation at Flin Flon a plant estimated to be capable of treating 3,000 tons of ore a day, and of producing 30,000,000 pounds of copper, 50,000,000 pounds of zinc, 60,000 ounces of gold, and 900,000 ounces of silver annually. Actual production in 1931, the first full year of operation, was 31,068,556 pounds of copper, 35,056,199 pounds of zinc, 73,000 ounces of gold, and 702,128 ounces of silver; from 1,090,596 tons of ore averaging 1·94 per cent copper, 3·82 per cent zinc, 0·089 ounces of gold, and 1·09 ounces of silver a ton.

The estimated ore reserves in the Flin Flon mine amount to some 18,000,000 tons, carrying 0·074 ounces of gold and 1·06 ounces of silver a ton, in addition to 1·71 per cent copper and 3·45 per cent zinc. It is believed that about one-third, or 6,000,000 tons, of these reserves can be won by open-pit mining.

SHERRITT-GORDON MINE

The Sherritt-Gordon mine, the property of Sherritt-Gordon Mines, Ltd., is situated at Sherridon, on Kississing lake, 45 miles north of the Flin Flon mine, and 97 miles from The Pas by rail. Like the Flin Flon, it is essentially a copper-zinc mine from which gold is recovered as a by-product. Its known ore-bodies are considerably smaller than those at Flin Flon and carry less gold.

Although the existence of the Sherritt-Gordon deposit had been known for some considerable time previously, it was not until 1926 that active steps were taken for its development. After several different parties, in quick succession, had had it under option, Sherritt-Gordon Mines, Ltd., was incorporated to work it, in 1927. A branch of the Canadian National railway reached the mine in July, 1929, following which material and equipment for the erection of a plant designed to handle 500,000 tons of ore a year were brought in. A concentrating mill was built, one unit of which was put into operation about April 1, 1931, producing copper concentrates only, no attempt being made at present to save zinc. The copper concentrates, which also carry the gold, are sent to Flin Flon where they are smelted, under contract, by the Hudson Bay Mining and Smelting Company. Power for mining and milling is obtained, also under contract, from the Island Falls plant of the same company.

During the nine months from April 1 to December 31, 1931, the Sherritt-Gordon mill treated 214,081 tons of ore, the concentrates from which yielded 14,718,387 pounds of copper, 125,845 ounces of silver, and 4,039 ounces of gold.

The ore reserves in the Sherritt-Gordon mine are found in two main ore zones about 3,400 feet apart, known, respectively, as the east zone and the west zone. The east zone is estimated to contain 866,175 tons of ore, averaging 2·16 per cent copper, 5·78 per cent zinc, and carrying gold to the value of 39 cents a ton; the west zone, 3,271,900 tons, averaging 2·90 per cent copper, 2·76 per cent zinc, and gold to the value of 37 cents a ton. All the ore milled up to the present has been drawn from the west zone.

SAN ANTONIO MINE

The San Antonio mine, of San Antonio Gold Mines, Ltd., consists of 17 claims and fractions, some 670 acres in total extent, situated on the north shore of Rice lake, 17 miles northwest of the Central Manitoba mine. It can be reached from the railway by the same general routes as the latter.

The San Antonio claims adjoin the Gabrielle, the first claim to be staked for gold in the Rice Lake area, in 1911. Exploratory work was started on them in 1926 by the Wanipigow Syndicate, and in July, 1927, they were taken over by Wanipigow Mines, Ltd., the name of which was shortly afterwards changed to San Antonio Mines, Ltd. In August, 1931, as a result of the reorganization of the company, the name was again changed to San Antonio Gold Mines, Ltd.

Development of the property has been carried on through two shafts, the No. 1 shaft on the west side of the San Antonio claim, which has been sunk to a depth of 164 feet, and the No. 2, or Island, shaft, sunk on an island in Rice lake, the workings from which have been carried to a vertical depth of about 950 feet. It is now proposed to continue the sinking of the No. 1 shaft to 1,000 feet and use it as the main working shaft.

In 1930, it was estimated that some 61,000 tons of ore, having an average value of about $13.35 a ton in gold, had been indicated in the workings. At the present time, a 150-ton mill is being built at the No. 1 shaft and it is expected that this will be producing gold before the summer of 1932. Electric power to operate the mine and mill is being obtained from the Manitoba Power Company's transmission line to the Central Manitoba mine.

GEM LAKE MINE

The Gem Lake mine of Gem Lake Mines, Ltd., is about 16 miles southeast of the Central Manitoba mine and lies just south of the Manigotagan river. The company's total holdings include some 44 mining claims in Manitoba and 8 adjoining claims in Ontario.

The original discovery on what is now the Gem Lake property was made in 1926, on what is known as the Bon group of claims. These, together with a number of other claims, were acquired by Gem Lake Mining Company, Ltd., who did surface work throughout 1927. In January, 1928, the property passed into the hands of Gem Lake Mines, Ltd., and the sinking of a 3-compartment shaft was started on the Bon No. 1 claim about the middle of the year.

In 1931, underground workings had reached a depth of 750 feet, and a total of about 10,000 feet of drifting and cross-cutting had been done on levels spaced at 125-foot intervals. Some ore has been found on all levels. On the 250-foot level, ore having a value of $44.77 a ton in gold over an average width of 3½ feet was drifted on for 146 feet; on the 500-foot level ore carrying $15.05 a ton in gold over a width of 3½ feet, for a distance of 106 feet.

A 10-ton test mill, in which the ore was treated by amalgamation, was put in operation in the fall of 1931, and a gold brick, valued at $9,000

or $10,000, was shipped before the end of the year. It is now planned to increase the capacity of the mill to 50 tons of ore a day, the treatment to include flotation and cyanidation of the flotation concentrate, as well as amalgamation; also to continue sinking to a depth of 1,000 feet and open up two new levels.

Much additional information concerning Manitoba's gold mines and prospects will be found in the following:

"Mineral Prospects in Southeastern Manitoba," by J. S. DeLury. Published by authority of the Manitoba Government in 1921.

"The Mineral Resources of Manitoba," by R. C. Wallace. Issued by the Industrial Development Board of Manitoba in 1925.

First Annual Report on Mines and Minerals of the Manitoba Department of Mines and Natural Resources; vol. I, 1928 (1930).

"Progress in Metal Mining in Manitoba," by G. E. Cole; Bull. No. 238 of the Canadian Institute of Mining and Metallurgy, February, 1932, pp. 39-57.

ONTARIO

In 1931, the province of Ontario produced 2,085,818 fine ounces or nearly 77·4 per cent of all the gold produced in the Dominion in that year; and it has produced 47·2 per cent of the total recorded Canadian production to date. Over 96 per cent of Ontario's production, in turn, is derived from the Porcupine and Kirkland Lake camps—two small areas lying some 65 miles apart in the northeastern part of the province—the first of which furnished 46·1 per cent and the second 50·4 per cent of Ontario's production in 1931. Outside the Porcupine and Kirkland Lake camps the largest producing gold mine in Ontario is the Howey mine, in the northwestern part of the province, near the Manitoba boundary. The output of the Howey, together with that of a number of small mines and prospects scattered over the province, and by-product gold from the nickel-copper mines, makes up the remaining three and one-half per cent of Ontario's present output.

Though there has been continuous production of more or less gold in Ontario for more than forty years, and sporadic production goes back to 1866, gold mining can hardly be said to have been established as a profitable industry in the province before the discovery of the Porcupine gold-field in 1908. Previous to that time the best-known gold-bearing area was in the Lake of the Woods district, which was the scene of a gold-mining boom in the eighteen-nineties, when three mines, the Sultana, Mikado, and Regina, are reported to have produced gold to the value of between one-half and three-quarters of a million dollars each. This period of activity in the Lake of the Woods district ended in the early ninteeen-hundreds, and by 1909 the gold production of the provinces had dropped to 2,042 ounces, from a previous maximum of 27,594 ounces in 1899.

All Ontario's production has been of lode gold. No placers of commercial value are known to occur in the province, though alluvial gold in

minute quantities has been found in stream and glacial sands at a number of points in northern Ontario. Attempts to work some of these have, however, all ended in failure.

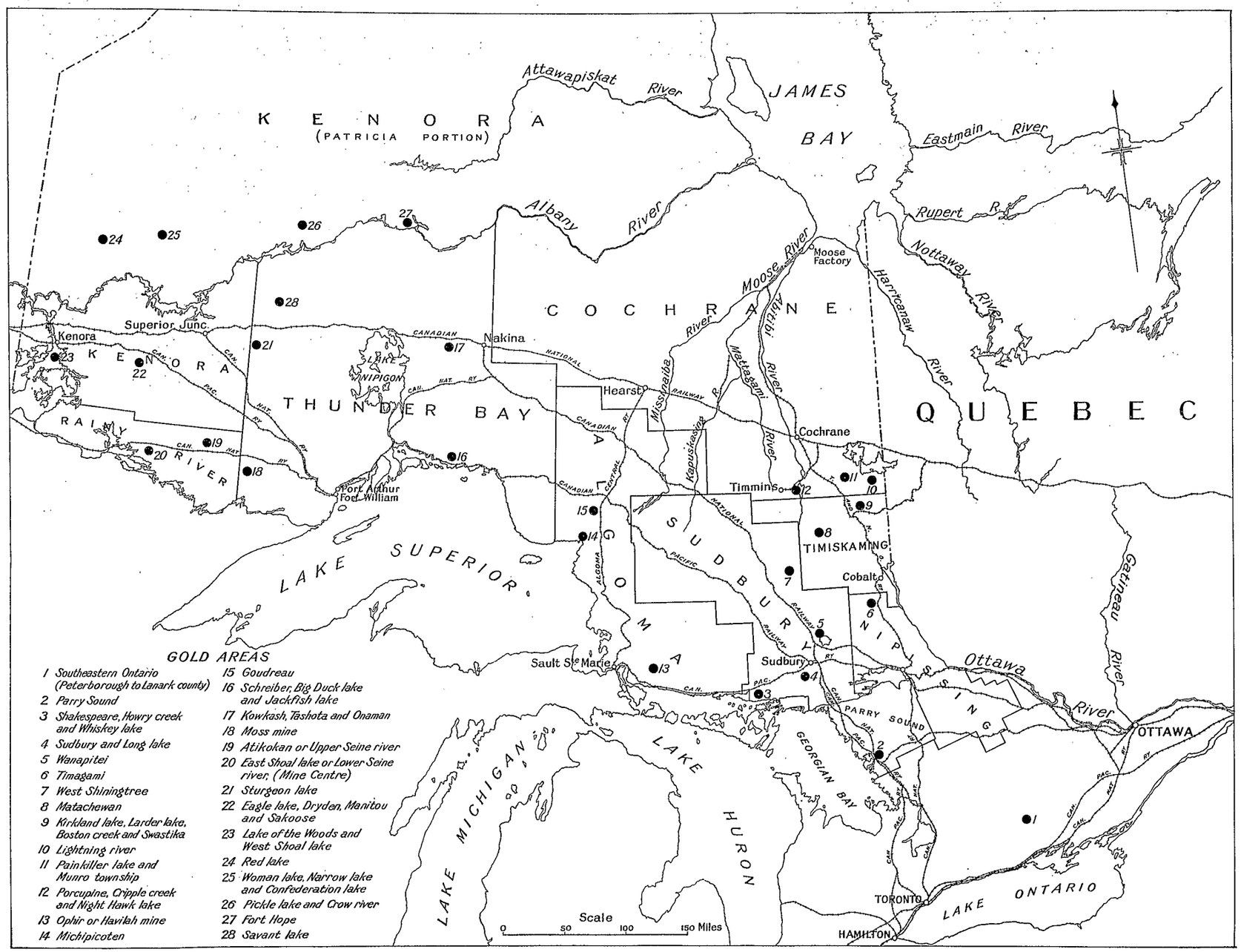
Table XVII, which follows, shows the total value of Ontario's gold production and the amounts contributed to it by the Porcupine and Kirkland Lake camps; Table XVIII, the geographical distribution of the mines now producing and the output of each in 1931.

TABLE XVII

Total Gold Production in Ontario*

Year	Total production $	Porcupine		Kirkland Lake	
		$	Per cent	$	Per cent
1866-1891	(a) 190,258	.....	.....	.....	.....
1892-1909	(b) 2,509,492	.....	.....	.....	.....
1910	68,498	35,539	51·8	.....	.....
1911	42,637	15,437	36·2	.....	.....
1912	2,114,086	1,730,628	81·8	.....	.....
1913	4,558,518	4,294,113	94·1	86,316	1·9
1914	5,544,979	5,206,006	93·8	114,154	2·0
1915	8,501,391	7,462,111	88·6	551,069	6·5
1916	10,339,259	9,391,408	90·8	702,761	6·8
1917	8,698,735	8,229,744	94·5	404,346	4·6
1918	8,502,480	7,767,907	91·4	632,007	7·4
1919	10,451,709	9,942,803	95·1	486,809	4·7
1920	11,686,043	10,597,572	90·7	1,033,478	8·8
1921	14,692,357	13,103,526	89·5	1,524,851	10·4
1922	20,579,569	18,374,658	89·3	2,159,581	10·5
1923	20,136,287	17,313,115	85·9	2,719,939	13·5
1924	25,669,303	22,135,534	86·2	3,446,632	13·4
1925	30,206,432	24,733,120	81·8	5,385,256	17·8
1926	30,950,753	23,680,670	76·5	7,174,083	23·2
1927	33,627,040	23,851,857	70·9	9,674,114	28·7
1928	32,629,111	20,246,319	62·0	12,233,524	37·5
1929	33,535,226	19,281,286	57·6	14,046,596	41·8
1930	35,836,558	17,758,842	49·9	17,172,770	47·9
1931	43,117,698	19,891,521	46·1	21,734,729	50·4
Total to end of 1931	394,238,419	285,042,716	72·3	101,283,015	28·2

* From Preliminary Rept. on Min. Prod. of Ont. in 1931 by Ont. Dept. of Mines.
(a) Estimated.
(b) Maximum yearly output was $424,568 in 1899.



GOLD AREAS

1 Southeastern Ontario (Peterborough to Lanark county)
2 Parry Sound
3 Shakespeare, Howry creek and Whiskey lake
4 Sudbury and Long lake
5 Wanapitei
6 Timagami
7 West Shiningtree
8 Matachewan
9 Kirkland lake, Larder lake, Boston creek and Swastika
10 Lightning river
11 Painkiller lake and Munro township
12 Porcupine, Cripple creek and Night Hawk lake
13 Ophir or Havilah mine
14 Michipicoten
15 Goudreau
16 Schreiber, Big Duck lake and Jackfish lake
17 Kowkash, Tashota and Onaman
18 Moss mine
19 Atikokan or Upper Seine river
20 East Shoal lake or Lower Seine river, (Mine Centre)
21 Sturgeon lake
22 Eagle lake, Dryden, Manitou and Sakoose
23 Lake of the Woods and West Shoal lake
24 Red lake
25 Woman lake, Narrow lake and Confederation lake
26 Pickle lake and Crow river
27 Fort Hope
28 Savant lake

Figure 5. Key map of gold areas in Ontario.

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TABLE XVIII

Sources of Ontario's Gold Production in 1931*

Source	Ore milled, tons	Bullion Shipped				Total value of bullion[1]
		Gold content		Silver content		
		Fine ounces	Value	Fine ounces	Value	
			$		$	$
Porcupine						
Coniaurum	130,585	36,277·81	749,929	5,110	1,423	751,352
Dome	542,600	169,685·66	3,507,712	15,540	4,354	3,512,066
Hollinger	1,640,705	487,123·34	10,069,733	99,402	28,242	10,097,975
Marsh Gold	58,462	10,513·82	217,304	859	246	217,586
McIntyre	617,425	229,413·40	4,742,305	50,686	14,485	4,756,880
Munro-Croesus	550	190·54	3,939	35	10	3,955
Porcupine-United (Rochester)	1,396	262·51	5,427	44	12	5,439
Vipond	100,214	27,236·17	563,021	4,524	1,270	564,291
Wabi Iron Works	9	143·70	2,971	211	61	3,032
Miscellaneous[2]	.....	1,405·49	29,054	255	73	29,127
Total	3,091,946	962,252·44	19,891,521	176,666	50,182	19,941,703
Kirkland Lake						
Barry-Hollinger	31,958	10,849·11	224,217	1,282	362	224,633
Kirkland Lake Gold	52,628	28,314·91	585,321	3,317	929	586,250
Lake Shore	816,580	533,756·57	11,033,728	113,087	31,890	11,065,618
Sylvanite	91,621	43,436·60	897,914	11,222	3,254	901,168
Teck-Hughes	444,410	294,421·57	6,086,234	24,086	6,965	6,093,199
Telluride	80	40·02	827	31	8	835
Trout Creek	1	78·31	1,619	10	3	1,622
Wright-Hargreaves	266,352	140,520·42	2,904,815	17,759	5,022	2,909,837
Total	1,703,630	1,051,417·51	21,734,729	171,394	48,433	21,783,162
Northwestern Ontario						
Tashota	34	15·00	313	6	2	315
Howey (Red Lake)	211,552	41,702·44	862,066	15,963	4,540	866,606
Mikado (L. of Woods)	33	185·90	3,843	41	12	3,855
Minto (Michipicoten)	9,448	3,521·31	72,792	106	32	72,824
Parkhill (Michipicoten)	9,082	3,325·42	68,742	225	69	68,811
Total	1,703,630	48,750·07	1,017,756	16,341	4,655	1,012,411
Total for Gold Mines	5,025,725	2,062,419·54	42,634,006	364,401	103,270	42,737,276
Nickel-Copper and Refineries	.....	23,381·00	483,328	.....	.....	.....
In Concentrates shipped	.....	17·60	364	.....	.....	.....
Grand Total	.....	2,085,818·62	43,117,698	.....	.....	.....

* From Preliminary Rept. on Min. Prod. of Ont. in 1931, by Ont. Dept. of Mines.

[1] The premium received in addition to values quoted to $830,799.04 from Porcupine; $893,518.31 from Kirkland Lake; and $61,857.38 from northwestern Ontario.

[2] High grading.

PORCUPINE AREA

The Porcupine gold-bearing district is an area of somewhat indefinite boundaries, situated in northeastern Ontario, about 450 miles due north of the city of Toronto. It is served by the Temiskaming and Northern Ontario railway, through a branch line about 30 miles long, which leaves the main line at Porquis Junction and extends westward to the town of Timmins, the business centre of the district. All the chief productive mines lie in an area about three miles wide and five miles long extending east from Timmins, with which they are connected by excellent roads. (See Figure 6.)

Previous to 1909, little attention had been given to the mineral possibilities of what is now known as the Porcupine area, and little was known about them, despite the fact that an old portage route, used by the Hudson Bay Company for over 200 years, crossed the area close to some of the auriferous outcrops. In 1906, some prospectors who had wandered far afield from the Cobalt silver camp did a little work on a quartz vein, on what is now the Hollinger mine, but the results not appearing to be promising, they abandoned it. Two years later, some finely divided gold was found in schist cut by veinlets of quartz on the shore of

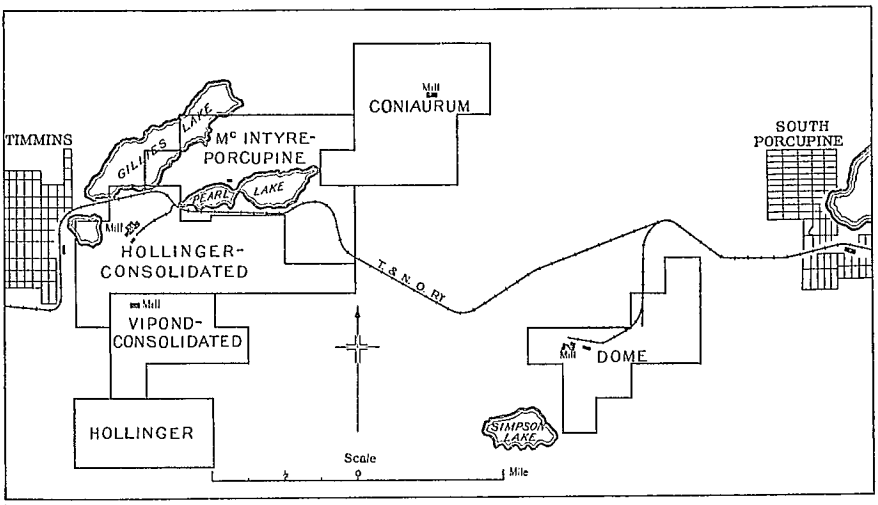

Figure 6. Key map of the gold mines in Porcupine area, Ontario.

Porcupine lake, six or seven miles to the east. In 1909, prospectors attracted by the find made on Porcupine lake in the previous year spread over the district, and, within a few days of each other, the discoveries were made which afterwards led to the development of the Hollinger, Dome, and McIntyre mines. Production started on the Hollinger and Dome in 1910 and soon, after some early setbacks due to forest fires, the camp was fairly launched on its prosperous career, the course of which is indicated in the following tables:

TABLE XIX

Value of Total Production (Gold and Silver) by Mines of the Porcupine Area*

Year	Hollinger	Dome	McIntyre	Vipond	Porcupine Crown and North-crown	Coniaurum	West Dome Lake	Ank-erite	March	Night Hawk Peninsu-lar	Schu-macher (a)	Pay-master	Rea and Newray
	$	$	$	$	$	$	$	$	$	$	$	$	$
1910.....	31,194	4,355	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1911.....	6,000	4,277	.....	5,160	.....	.....	.....	.....	.....	.....	.....	.....	.....
1912.....	909,181	737,499	77,657	16,259	Crown	.....	.....	.....	.....	.....	.....	.....	.....
1913.....	2,488,022	1,242,625	236,299	.....	Crown 326,803	.....	.....	.....	.....	.....	.....	.....	Rea 18,858
1914.....	2,719,355	1,059,238	549,166	73,628	Crown 685,135	.....	.....	.....	.....	.....	.....	.....	Rea 125,255
1915.....	4,206,015	1,530,287	750,812	246,053	Porcupine 602,436	.....	102,880	.....	.....	.....	48,236	.....	.....
1916.....	5,073,401	2,153,820	1,218,073	176,686	Porcupine 578,322	.....	16,814	.....	.....	.....	225,301	.....	.....
1917.....	4,261,938	1,480,174	1,710,204	209,738	Porcupine 377,904	.....	44,434	.....	.....	.....	198,605	.....	New-ray 1,447
1918.....	5,752,371	82,127	1,578,444	82,868	Porcupine 124,474	.....	103,745	.....	.....	.....	92,842	.....	New-ray 1,516
1919.....	6,722,266	1,290,301	1,978,014	.....	Porcupine	.....	23,910	.....	.....	.....	.....	.....	.....
1920.....	6,219,665	2,020,568	2,223,083	.....	Porcupine 71,529	.....	47,169	.....	.....	.....	.....	.....	.....
					Northcrown 97,301								
1921.....	9,051,276	2,290,264	1,827,761	.....	Northcrown 7,943	.....	.....	.....	.....	.....	.....	.....	.....
1922.....	12,274,114	4,178,936	2,021,811	.....	Northcrown	.....	.....	.....	.....	.....	.....	2,800	.....
1923.....	10,446,412	4,374,144	2,550,129	23,876	Northcrown	.....	.....	.....	.....	.....	.....	.....	.....
1924.....	13,433,063	4,307,624	3,604,874	596,803	.....	.....	60,642	.....	.....	268,518	.....	.....	.....
1925.....	15,749,109	4,365,923	3,721,499	565,379	.....	.....	287,758	.....	.....	196,947	.....	.....	.....
1926.....	14,829,655	3,940,053	3,862,074	631,636	.....	.....	220,758	140,588	11,055	111,154	.....	63,551	.....
1927.....	14,539,538	4,031,575	3,965,210	667,724	.....	.....	b)35,252	359,005	19,839	166	.....	135,025	.....
1928.....	10,706,235	3,915,051	4,201,808	694,426	.....	220,534	.....	289,960	133,879	.....	.....	183,271	.....
1929.....	9,455,290	3,590,537	4,295,491	820,667	.....	635,4851	55,797	71,684	256,303	.....	.....	.....	.....
1930.....	10,260,950	774,943	4,696,578	909,414	.....	738,941	18,622	878	306,262	.....	.....	.....	.....
1931.....	10,097,975	3,512,066	4,756,880	564,291	.....	731,352	.....	.....	217,586	.....	.....	.....	.....
Total..	169,233,025	50,886,387	49,825,867	6,284,608	2,871,847	2,346,312	1,114,821	862,115	944,924	566,885	564,984	384,647	147,076

Value of Total Production (Gold and Silver) by Mines of the Porcupine Area*—*Continued*

Year	Porcupine United	David-son	Preston and Clifton	Scottish Ontario	Porcupine Pet	Porphyry Hill	Gold Reef	Tommy Burns	De Santis	Hughes	Miscel-laneous	Total value (c)
	$	$	$	$	$	$	$	$	$	$	$	$
1910												35,549
1911												11,437
1912												1,740,596
1913			Preston ...			4,200						4,316,807
1914			Preston 15,212		5,000							5,231,989
1915					5,551	2,036	1,547					7,495,853
1916												944,241
1917							588	289				8,285,321
1918		15,579										7,833,966
1919		27,089										10,041,580
1920		11,246										10,690,561
1921												13,177,244
1922			Clifton 1,664									18,479,325
1923			Clifton 8,331								(d) 2,756	17,405,648
1924			Clifton 5,270									22,266,894
1925												24,886,615
1926									146	30		23,810,700
1927				5,893							(e)217,350	23,976,577
1928				6,975							(f) 140	20,352,090
1929	44,285										(g) 47,701	19,373,240
1930	56,913										(g) 61,940	17,822,481
1931	5,439										(h) 36,114	19,941,703
Total	106,637	53,914	30,477	12,688	10,551	6,236	2,135	289	146	30	365,881	286,622,602

* From Preliminary Rept. on the Min. Prod. of Ont. in 1931, by the Ont. Dept. of Mines.

(a) Purchased by the Hollinger in 1922. *(b)* Total value of bullion in 1927 was $87,919. Figures shown in above table allow for a deduction of $52,667 due to an erroneous return made in 1925. *(c)* A record of total exchange premiums received in addition to the above amounts shows the following: 1920, $1,265,664; 1921, $1,238,211; 1922, $189,022; 1923, $207,742; 1924, $172,721; 1925, $2,607 discount; 1926, nil; 1928, $2,810.55; 1929, $87,173; 1930, $20,912; and 1931, $1,786,175. *(d)* Huddlestone and Cline. *(e)* Includes "high-grade" recovered from W. P. Wilson. *(f)* Blue Quartz. *(g)* High-grade. *(h)* High-grade, Wabi Iron Works, and Munro-Croesus.

TABLE XX

Dividends and Bonuses Paid by Porcupine Gold Mining Companies, 1912-1931*

Year	[1]Hollinger Consolidated	Porcupine Crown	[2]Dome Mines	Rea	McIntyre	Vipond	Total
	$	$	$	$	$	$	$
1912.....	270,000	.....	.....	.....	.....	.....	270,000 00
1913.....	1,170,000	.....	.....	.....	.....	.....	1,170,000 00
1914.....	1,170,000	240,000	.....	.....	.....	.....	1,410,000 00
1915.....	1,560,000	240,000	400,000 00	12,000	.....	.....	2,212,000 00
1916.....	3,286,000	240,000	800,000 00	.....	.....	.....	4,326,000 00
1917.....	738,000	120,000	300,000 00	.....	541,542 45	.....	1,699,542 45
1918.....	1,230,000	.....	.....	.....	543,042 45	.....	1,773,042 45
1919.....	1,722,000	.....	.....	.....	364,028 30	.....	2,086,028 30
1920.....	2,214,000	.....	416,886 00	.....	546,042 45	.....	3,176,928 45
1921.....	3,198,000	.....	478,947 75	.....	546,042 45	.....	4,222,990 20
1922.....	3,198,000	.....	715,000 00	.....	546,042 45	.....	4,459,042 45
1923.....	3,198,000	.....	1,430,001 00	.....	548,542 45	.....	5,176,543 45
1924.....	3,198,000	.....	1,906,668 00	.....	774,125 00	.....	5,878,793 00
1925.....	4,378,800	.....	1,906,668 00	.....	798,000 00	.....	7,083,468 00
1926.....	5,805,600	.....	1,906,668 00	.....	798,000 00	.....	8,510,268 00
1927.....	6,396,000	.....	1,191,667 50	.....	798,000 00	67,500	8,453,167 50
1928.....	5,412,000	.....	953,334 00	.....	798,000 00	.....	7,163,334 00
1929.....	3,198,000	.....	953,334 00	.....	798,000 00	.....	4,949,334 00
1930.....	3,444,000	.....	953,334 00	.....	798,000 00	.....	5,195,334 00
1931.....	3,444,000	.....	953,334 00	.....	798,000 00	.....	5,195,334 00
Total...	58,230,400	840,000	15,265,842 25	12,000	9,995,408 00	67,500	84,411,150 25

*Compiled from Ont. Dept. of Mines Repts.
[1]Includes $160,000 paid by the Acme in 1015 before amalgamation with the Hollinger.
[2]Does not include repayment of capital of $476,667 in 1922.

Milling

The gold in the Porcupine ores is almost entirely in the native, or metallic state, hence is readily recovered by cyanide treatment. "All slime" cyanidation is the general practice at all the larger mines, supplemented in some cases by the recovery of the coarser particles of gold on blankets and by amalgamation. The usual sequence of milling operations is:

Coarse crushing
Coarse grinding
Fine grinding
Agitation with cyanide solution
Decantation and filtration
Precipitation with zinc dust
Melting and refining

Stamps, which were commonly used for crushing in the early days of the camp, have been superseded by rod and ball mills, except in some of the smaller plants.

The Porcupine ore-bodies are vertical, or nearly so, and the wall-rocks as a rule are strong. Most of the ore heretofore mined in the camp has, consequently, been extracted by means of shrinkage stopes. On the deeper mines, however—the Hollinger and the McIntyre—it has been found advisable to change over from shrinkage to cut-and-fill stopes on the lower levels. Much of the ore now being mined is won by the latter method.

At present, the lowest working level on the Hollinger mine is at a depth of 3,950 feet; the lowest on the McIntyre, at a depth of 3,875 feet. The McIntyre main shaft is down to 4,131 feet. Preparations are being made to continue Hollinger mine workings to a depth of about 5,000 feet and those on the McIntyre to 5,900 feet.

HOLLINGER MINE

The Hollinger mine of Hollinger Consolidated Gold Mines, Ltd., consists of some 560 acres of mineral lands adjoining the town of Timmins on the east. It includes in addition to the original *Hollinger* group of claims the *Acme, Millerton,* and *Schumacher* groups, and other contiguous claims.

In October, 1909, Ben Hollinger, Jack Miller, and Alex Gillies staked the claims later known as the Hollinger Gold Mines (4 claims), Millerton Gold Mines (3 claims), and Acme Gold Mines (3 claims). These three adoining properties together with other adjacent claims were acquired in 1910 by the Timmins-McMartin-Dunlop Syndicate, which was afterwards incorporated as the Canadian Mining and Finance Company, Limited. The Hollinger claims, on which the richest surface showings occurred, were the first to be developed; a two-stamp Tremaine mill being rushed in to this property and put in operation in 1910. A thirty-stamp mill was being built when, in May, 1911, a forest fire swept down on the camp and wiped it out completely. A second fire, that swept the whole Porcupine district in July, 1911, prevented work being resumed till the fall of the year. A new mill having a capacity for the treatment of 300 tons of ore a day was completed and put in operation in June, 1912, the process adopted being: coarse crushing, stamping in cyanide solution, tube milling, concentration, with amalgamation of the concentrates, and finally, cyanidation of both the concentrates and the tailings. In 1912, the first dividend was paid by Hollinger Gold Mines, Ltd.; and at the end of 1914 the management were able to announce that some fifty-four veins had been discovered on the property and that ore reserves having a gross value of well over $13,000,000 had been developed.

In 1916, Hollinger Gold Mines, Ltd., Acme Gold Mines, Ltd., Millerton Gold Mines, Ltd., and Claim 13,147, all of which were owned or controlled by Canadian Mining and Finance Company, Ltd., were merged

TABLE XXI

Production of Chief Mines and Total Production of Porcupine Camp, 1910-1931

Calendar year	Hollinger (including Acme)			Dome			McIntyre			Vipond			Porcupine Crown and Northerown			Coniaurum including Rea and Newray			Ankerite			West Dome Lake			Schumacher			March Gold			Night Hawk Peninsular			Miscellaneous			Total			Calendar year
	Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		
		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver	
1910	813	1,733		247	214	19																												1,060	1,947	19	1910
1911	(1)	300		(1)	207					Porcupine Vipond	432	258																						432	765		1911
1912	45,195	43,690	9,756	75,088	35,515	5,448	14,500	3,742	579		5,168	778	277																					139,951	83,725	16,060	1912
1913	140,131	119,618	26,494	131,149	59,912	7,070	29,669	11,349	2,936					19,715	15,750	2,173																(4)	25	210	323,145	207,748	38,785	1913
1914	211,846	130,853	26,214	221,390	51,026	8,400	62,284	26,398	7,434		9,700	3,552	414		40,857	33,020	5,049															(5)	503	986	558,187	251,867	47,980	1914
1915	441,236	202,606	38,393	317,740	73,726	12,390	101,955	36,094	9,735		35,889	11,871	1,387		46,419	29,032	4,458					11,728	4,949	854	9,240	2,324	342						(4)	139	491	62	964,346	361,093	67,611	1915
1916	661,854	244,140	41,237	444,900	103,809	17,689	136,489	55,756	12,660		43,041	8,509	1,255		51,273	27,877	3,927					6,542	871	45	46,463	10,844	1,701									1,330,562	451,806	78,454	1916
1917	514,301	204,810	34,886	359,570	71,103	10,659	175,893	81,827	17,536		34,971	10,416	1,705		39,111	18,180	2,637	Newray	340	70	9	16,388	2,166	170	37,323	9,551	1,491						(7)	31	44	1	1,177,928	398,257	69,100	1917
1918	578,755	276,045	47,851	Clean-up	3,948	570	170,976	75,556	16,961		15,134	3,977	687		10,907	5,979	941		401	73	9	12,229	5,013	495	19,098	4,463	861						(8)	2,537	752	35	816,037	375,806	68,216	1918
1919	711,882	322,022	60,441	187,580	61,893	9,421	135,018	95,039	20,462													4,433	1,157									(8)	3,831	1,208	80	1,092,744	481,319	90,404	1919
1920	650,295	298,223	55,803	295,220	97,023	14,779	191,032	106,527	21,706					6,220	3,434	801						4,707	2,264	334								(8)	3,003	478	35	1,162,065	512,625	93,972	1920
1921	1,072,493	435,404	80,911	335,680	110,316	15,028	172,287	87,837	20,321					11,678	4,676	514																		1,580,460	633,939	116,929	1921
1922	1,491,381	590,388	104,444	368,400	201,124	29,250	217,208	97,229	17,711						382	69																	(9)	214	44	2,076,989	888,953	151,449	1922
1923	1,366,352	502,680	86,058	399,800	210,010	31,138	201,428	122,528	28,721		2,623	1,149	182																					(10)	540	48	2,060,203	837,507	146,147	1923
1924	1,659,476	645,965	120,223	493,400	207,277	33,666	390,497	173,193	39,118		52,301	28,704	2,696	Merged with Vipond Consolidated in 1927								8,114	2,929	331	Acquired by Hollinger in 1922						38,326	12,426	2,692				2,642,114	1,070,748	198,750	1924
1925	1,929,988	757,306	137,221	530,200	210,051	34,794	419,040	178,550	46,515		61,294	27,244	3,614									35,278	13,582	1,345							39,778	9,460	2,019				3,016,178	1,196,199	225,508	1925
1926	1,932,559	713,421	134,841	555,700	189,632	32,773	498,653	185,685	41,901		79,717	30,452	3,519								23,060	6,785	588	36,946	10,627	1,748				4,655	533	110	21,604	5,365	1,031	28,049	(13) 3,073	350	3,180,943	1,145,573	216,861	1926
1927	2,178,329	699,657	134,604	543,300	194,200	29,993	522,880	190,562	45,525		90,803	32,189	4,090								69,863	17,318	1,797	(14) 16,062	1,935	568				4,566	957	100		8	2	62,189	(14) 17,244	2,890	3,488,972	1,154,120	219,569	1927
1928	1,778,470	515,233	95,996	548,000	188,628	27,348	524,095	201,842	50,634	Vipond Consolidated	88,896	33,465	4,566								52,005	10,634	1,220	66,606	13,986	1,458									32,627	6,460	599	94,305	(14) 9,170	666	3,185,004	979,410	182,978	1928
1929	1,549,157	455,094	91,474	452,900	173,042	25,568	550,100	206,628	46,727		108,225	39,569	5,152								103,293	30,641	3,978	12,912	3,468	355	35,142	7,500	1,406				48,484	12,370	1,165	5,048	(15) 4,430	301	2,865,261	932,732	176,626	1929
1930	1,025,898	494,532	102,542	67,600	(17) 37,416	3,959	565,510	226,266	56,047		114,667	43,883	6,469								122,972	35,064	4,517	Clean-up	42	36	1,413	757	53				53,953	14,794	1,173	7,815	(15) 5,730	1,640	2,559,798	859,084	175,836	1930
1931	1,640,705	487,123	99,402	542,600	169,686	15,540	617,425	229,413	50,686		100,214	27,236	4,524								130,585	36,278	5,110										1,955	2,003	545	3,091,946	962,262	176,666	1931

[1] Compiled from reports of the Ont. Dept. of Mines (Vol. XXXIII, Pt. II, 1924, et seq.)
[2] Tonnage milled and recovery destroyed in forest fire.
[3] Recovered in laboratory.
[4] Porphyry Hill.
[5] Porcupine Pet and Preston.
[6] Gold Reef, Porcupine Pet, and Porphyry Hill.
[7] Gold Reef and Tommy Burns.
[8] Davidson Consolidated.
[9] Clifton-Porcupine and Paymaster.
[10] Clifton-Porcupine and others.
[11] Clifton-Porcupine.
[12] Porcupine-Paymaster, P. DeSantis, and Hughes Gold Mines, Ltd.
[13] Adjusted for erroneous return in 1925. True figures for 1927 are: gold, 4,238 ounces; silver, 572 ounces.
[14] Porcupine-Paymaster, 6,512 ounces gold and 734 ounces silver; Scottish-Ontario, 60 ounces gold and 35 ounces silver; and 10,488 ounces gold and 2,121 ounces silver, chiefly stolen high-grade recovered.
[15] Paymaster, 8,836 ounces gold and 1,078 ounces silver; Scottish-Ontario, 327 ounces gold, and 77 ounces silver; and Blue Quarts, 7 ounces gold and 3 ounces silver.
[16] The Rochester yielded 3,154 ounces gold and 343 ounces silver of this total.
[17] Includes clean-up from burned mill.
[18] Includes 2,985 ounces gold and 619 ounces silver from high grading; and 3,745 ounces gold and 421 ounces silver from the Rochester mine.

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under the name of Hollinger Consolidated Gold Mines, Ltd. Up to this time most of the production had come from the Hollinger claims, though a certain amount of Acme ore also had been treated in the Hollinger mill. The Millerton had not yet been developed to the producing state. The Schumacher mine, which under its original owners had produced some gold between 1915 and 1918, was purchased by Hollinger Consolidated in 1922; it having become apparent that veins on their Acme claims would pass into adjoining Schumacher ground at depth.

Between 1912 and 1927, milling capacity was increased from time to time, from the original 300 tons a day to about 8,000 tons a day. The maximum average daily tonnage of ore milled during any one year to date, however, has been only 6,001 tons, in 1927. The original ore treatment process of concentration, amalgamation and cyanidation also, was changed to all-slime cyanidation treatment. Stamps were entirely discarded for crushing and replaced by rod and ball mills.

Operations on the mine are conducted through four main shafts: the Central shaft 3,160 feet deep, used for hoisting ore, waste, and men; the Main and No. 11 shafts, about 2,750 feet deep, for men and materials; and the Schumacher shaft, 4,040 feet deep, which serves the eastern portion of the mine, where important development work is now being carried on at depth. The total length of underground openings is now over 150 miles. Work has been done on 25 levels, the lowest of which is on the Schumacher portion of the mine, at a depth of 3,950 feet. It is the purpose of the company to continue sinking, through a prospect shaft, to a depth of 5,500 feet as soon as sufficient geological information has been obtained to enable the selection of a site for such a shaft to be made where it will least interfere with subsequent mining.

At present about 30 per cent of the stoping is by slice and fill methods, which are gradually superseding shrinkage stoping; the filling material being sand and gravel brought from the surface and waste rock from development work. Nearly all the ore milled so far has been mined between the 2,600-foot level and the surface. Above the 800-foot level mining is principally in pillars, vein bottoms and some newly discovered veins; the same applies in a lesser degree to the levels between the 800-foot and the 2,750-foot. Below the 2,750-foot level, development by drifting and cross-cutting is being actively pushed.

TABLE XXII

Production Record of the Hollinger Mine*

Calendar year	Total tons ore milled	Average tons milled per day	Average value per ton	Value per ton left in tailings	Cost per ton	Total value of bullion recovered (2)	Estimated ore reserves at end of year		
							Tons	Average value per ton	Gross value
			$	$	$	$		$	$
1911	1,000	.....	.....	.....	.....	46,082 52	462,000	22 14	10,230,00
1912	45,195	.....	21 44	.....	.....	933,682 00	644,540	17 48	11,271,400
(1)1913	138,291	379	18 56	0·723	6 97	2,466,220 24	845,300	13 71	11,604,800
(1)1914	208,936	584	13 68	0·56	5 21	2,688,354 80	1,162,960	11 49	13,358,420
(1)1915	334,750	917	10 11	0·40	3 98	3,169,813 84	1,600,800	10 02	16,031,600
1916	601,854	1,649	8 84	0·40	4 03	5,073,401 25	3,938,540	8 68	34,185,535
1917	508,139	1,409	8 67	0·31	4 44	4,261,938 72	4,494,510	8 95	30,241,435
1918	578,755	1,590	10 24	0·30	4 94	5,752,370 87	4,489,080	9 15	40,231,435
1919	711,882	1,950	9 73	0·33	4 53	6,722,266 81	4,392,680	9 09	39,928,430
1920	650,205	1,777	9 93	0·38	4 84	6,219,664 80	4,087,083	10 20	41,719,670
1921	1,072,493	2,938	9 67	0·31	4 87	10,031,050 57	4,392,917	9 72	42,716,027
1922	1,491,381	4,097	8 53	0·30	4 25	12,274,114 77	4,608,223	9 39	43,269,996
1923	1,366,352	3,764	7 93	0·29	4 86	10,446,412 20	6,337,742	8 97	56,861,936
1924	1,659,475	4,559	8 39	0·30	4 46	13,429,226 87	6,518,393	9 10	59,304,885
1925	1,929,988	5,317	8 51	0·33	4 06	15,786,405 04	7,190,555	9 05	65,068,799
1926	1,932,559	5,295	7 99	0·35	3 95	14,780,636 60	7,779,234	8 49	66,081,733
1927	2,178,329	6,001	6 96	0·28	3 45	15,548,899 71	7,432,899	8 10	60,225,539
1928	1,778,470	4,982	6 28	0·26	4 04	10,712,821 69	6,557,322	7 81	51,210,235
1929	1,549,157	4,268	6 33	0·24	3 95	9,433,767 14	6,360,021	7 52	47,819,398
1930	1,625,868	4,479	6 55	0·24	4 02	10,263,504 75	6,615,193	7 38	48,806,685
1931	1,640,705	4·520	6 39	0·24	4 23	10,528,864 53	6,236,887	7 41	46,241,688

* Compiled from the company's annual reports.
[1] Exclusive of Acme ore treated.
[2] Exclusive of premium on United States funds.

McINTYRE MINE

The McIntyre mine of McIntyre-Porcupine Mines, Ltd., consists of some 626 acres of mineral lands in a single block surrounding and including Pearl lake and lying immediately northeast of the property of Hollinger Consolidated Mines. In addition to the original McIntyre claims it now includes properties formerly known as the Pearl Lake, McIntyre Extension, Jupiter, and Plenaurum groups of claims and the Platt Veteran claim.

The first discovery of gold on the original McIntyre claims was made by Alex. (Sandy) McIntyre in the fall of 1909, on the south shore of Pearl lake, not far from the original Hollinger discovery which was made only a short time before. In March, 1911, McIntyre-Porcupine Mines, Ltd., was incorporated to acquire the property, and in January, 1917, the McIntyre-Jupiter claims (originally Jupiter Mines, Ltd.) and the McIntyre Extension Mines (originally Pearl Lake Gold Mines, Ltd.) were also acquired, the combined properties being thenceforward worked as one, through connected underground workings. In 1924, the company further increased its holdings in the Porcupine camp by the acquisition of the

Plenaurum claims and the Platt Veteran claim, adjoining their previous holdings in the east. In 1912, a 10-stamp amalgamation and concentration mill was built on the south shore of Pearl lake, close to the Hollinger boundary. In 1913, this was replaced by a 150-ton all-slime cyanide mill, which was gradually enlarged as mining operations extended until it had a rated capacity of 1,500 or 1,600 tons of ore a day, when it was dismantled in 1931, having been replaced by an entirely new mill on the north side of Pearl lake, on the Jupiter claims.

The first mining was done on the south side of Pearl lake near the old mill. Later, No. 5 and No. 6 shafts on the northwest side of Pearl lake became the chief centre of underground operations, the ore being carried across Pearl lake to the mill on the south shore by aerial tram. In 1925, underground exploration and development work having indicated that the ore-bearing zone trended to the east and reached great depth on the eastern portion of the property, the sinking of a new central shaft, on the north side of Pearl lake, 2,050 feet east of the old main, or No. 6, shaft, was started in February. This new central shaft—the No. 11 shaft—was completed to a depth of 4,133 feet in March, 1927. It was then equipped to hoist 3,000 tons of ore a day; connected with the old workings by drifts on different levels; and was put in operation in October, 1929. In 1931, a new mill having a rated capacity of 2,000 tons of ore a day was completed and put in operation and the old mill south of the lake dismantled. All the plant and offices of the company have now been removed from the south side of the lake and activities are concentrated about the No. 11 shaft.

In the new mill a notable departure from previous practice has been made by introducing flotation machines between the coarse and fine crushing of the ore.

As soon as the ore has been reduced to, say, 60-mesh it is routed to the flotation section of the mill where a very complete separation is made between the sulphides plus the free and attached gold on the one hand, and the almost barren rock on the other. The latter is immediately discarded as waste, and only the valuable portion amounting to about 15 per cent of the original ore by weight is retained in the mill circuit for fine grinding and cyanidation of the gold content. In other words, the cost of fine-grinding and cyaniding the portion that is discarded at the end of the flotation process is saved, as well as the carrying charges on such additional building and equipment as would have been necessitated by the adoption of the heretofore standard practice. Another advantage is that the treatment provided for the concentrates is under such control that a satisfactory recovery is at all times assured.[1]

In 1931, in addition to other favourable developments, a long crosscut driven 3,000 feet southeast from the No. 11 shaft into Platt Veteran ground on the 3,750-foot level cut ore in a vein known as No. 22 vein, which is entirely separate and distinct from the Pearl Lake ore zone from which all ore has been mined up to the present. Developments on this new vein are regarded as being of major importance and likely to add greatly to the potentialities of the mine. It was intended in the fall of 1931 to start sinking from the 3,785-foot level of the mine a winze through which the workings would be carried to a depth of 5,900 feet. The com-

[1] Nineteenth Ann. Rept. of McIntyre-Porcupine Mines, Ltd. For Fiscal Year ended March 31st, 1931.

mencement of this work, however, has been temporarily postponed until developments on the new No. 22 vein and elsewhere have been advanced sufficiently to enable the most advantageous point for its location to be determined.

On the McIntyre mine, shrinkage, cut-and-fill, and square-set methods of extracting the ore have all been employed, according as each is best suited to the ground to be mined. Up to March 31, 1931, all the ore extracted with the exception of some from development faces came from above the 2,875-foot level and the greater part of it was mined in shrinkage stopes. At that date, however, 50 per cent or more of the ore hoisted was coming from cut-and-fill stopes, the material required for backfilling being supplied by waste rock from development workings. Cut-and-fill methods will, no doubt, be chiefly employed in future. Stoping widths of 50 feet or more are not unknown in the mine, but the average is narrower, perhaps, about 10 feet. The total length of drifts and crosscuts on the McIntyre mine, on all levels, is now over 46 miles.

TABLE XXIII

Production Record of the McIntyre-Porcupine Mine[1]

Accounting period	Tons milled	Value per ton	Recovery per ton	Cost per ton	Total value[2] recovered	Estimated ore reserves at end of accounting period		
						Tons	Aver. value per ton	Gross value
		$	$	$	$		$	$
1912	14,500	7 00	5 25	.....	76,166 38	.....	.....	.....
1913	31,979	7 85	7 05	.....	225,752 25	.....	.....	.....
January 1/14—March 31/15	85,654	8 87	8 39	.....	718,331 71	109,693	7 79	854,436
April 1/15—March 31/16	105,758	7 71	7 38	4 28	779,990 94	201,920	11 12	2,247,128
April 1/16—June 30/17	195,307	10 00	9 55	4 78	1,864,914 28	443,617	11 14	4,943,034
July 1/17—June 30/18	178,327	10 05	9 61	5 15	1,714,258 00	459,276	9 80	4,490,432
July 1/18—June 30/19	179,874	9 78	9 29	5 08	1,671,046 03	433,057	11 00	4,777,324
July 1/19—June 30/20	188,835	11 52	11 02	5 48	2,080,178 44	502,682	11 13	5,595,500
July 1/20—June 30/21	171,916	11 67	11 08	6 33	1,904,326 36	624,422	10 25	6,392,304
July 1/21—June 30/22	193,971	10 69	9 99	6 42	1,937,105 07	718,198	10 37	7,452,467
July 1/22—June 30/23	240,615	9 96	9 35	5 54	2,249,741 63	858,504	9 92	8,514,800
July 1/23—June 30/24	360,140	9 69	9 14	4 96	3,291,178 22	1,167,064	9 70	11,313,816
July 1/24—June 30/25	400,259	9 43	8 86	4 81	3,546,637 52	1,348,283	9 20	12,428,903
July 1/25—June 30/26	460,909	8 72	8 25	4 60	3,804,774 96	1,443,111	9 00	13,038,041
July 1/26—March 31/27	385,409	8 08	7 67	4 15	2,957,060 97	1,675,898	8 43	14,130,220
April 1/27—March 31/28	520,460	8 09	7 66	4 23	3,987,634 94	1,841,215	8 35	15,376,165
April 1/28—March 31/29	538,165	8 24	7 83	4 32	4,212,624 82	2,026,279	8 00	16,179,205
April 1/29—March 31/30	550,495	8 46	8 05	4 42	4,433,626 45	2,345,676	8 30	19,417,424
April 1/30—March 31/31	558,115	8 84	8 30	4 56	4,633,140 73	2,562,465	8 00	20,480,904
April 1/31—March 31/32	655,030	8 00	7 63	4 29	4,997,462 00	2,562,563	7 75	19,859,863
	6,015,718	8 95	8 49	.....	53,957,841 00	.....	.....	.....

[1] Compiled from Ann. Repts. of McIntyre-Porcupine Mines, Ltd.
[2] Includes premium on U.S. funds.

DOME MINE

The Porcupine property of Dome Mines, Ltd., includes eleven claims, covering 438 acres of mineral lands lying about four miles east of the town of Timmins. It is, therefore, somewhat isolated from the other chief producers of the Porcupine camp which are grouped around Pearl lake, just

east of Timmins. The original Dome property consisted of five claims, to which there was added later six others previously known as the Dome Extension property.

It was spectacular discoveries of gold made on the original Dome claims by J. S. Wilson in 1909 that caused the first great rush of prospectors into the Porcupine district. With the exception of some stripping off of the surface soil no work was done on these showings, however, until 1910 when they were taken over by Dome Mines Company, Ltd., a company formed in March of that year to develop them. In July, 1911, the erection of a 40-stamp mill had almost been completed when it, together with all the camp buildings, was destroyed in one of the forest fires of that year. A new mill of steel and brick construction, having a rated capacity of about 300 tons of ore a day was completed in March, 1912. In this the method of treatment was to crush the ore first in gyratory crushers, followed by crushing under forty 1,250-pound stamps, the pulp from which was passed over amalgamation plates to Dorr classifiers. It was next reground in tube mills and again passed over the plates and corduroy blankets. The tailing from these last was then treated by cyanidation in the usual way. About 60 per cent of the gold recovered was caught on the plates and blankets, the remaining 40 per cent being recovered in the cyanide plant.

In 1915 or 1916, the Dome Extension property, which adjoined the original Dome claims on the northeast, was acquired, it having become apparent that the pitching ore zone on the Dome claims would pass into those of Dome Extension at depth. In 1923, the name of the company was changed from Dome Mines Company, Ltd., to Dome Mines, Ltd. In the meantime as the mine developed the capacity of the mill was increased till it was capable of treating some 1,500 tons of ore a day. In October, 1929, this mill was destroyed by fire. The present mill, which was built to replace it, went into operation at the end of October, 1930. It also has a rated capacity of 1,500 tons of ore a day, but in its design stamps and amalgamation were entirely omitted and provision made for recovering the gold by cyanidation only. It was found however that a satisfactory recovery of the gold could not be obtained by cyanide treatment alone, so provision has now been made also for the passing of the crushed ore over blankets, on which the coarser particles of gold are caught, and afterwards recovered from the blanket concentrates by barrel amalgamation.

The ore-bodies on the Dome mine occur erratically in the country rock very much like plums in a pudding, consequently they are difficult to find and when found it is difficult to estimate definitely their extent and value prior to actual mining. They have been found between two levels, though not encountered in either. In width they vary from 15 to 150 feet; continuous horizontal lengths of 600 feet are not unknown; and they have been followed continuously in depth for as much as 800 feet. Quartz in large masses occurs in some of the ore-bodies—the name of the mine had its origin in large dome-shaped masses of quartz found on the surface—but, on the whole quartz constitutes only 10 or 15 per cent of the ore mined, which consists chiefly of mineralized country rock.

The earliest workings on the mine were open pits or "glory holes." These extend on the surface over a length of about 900 feet and a maximum width of 300 feet; and to a depth of over 100 feet. Something over 900,000 tons of ore that yielded approximately $5,000,000 was won in this way. The great bulk of the ore mined, however, has come from shrinkage stopes in underground workings. Development has been chiefly through the No. 3 shaft, which is close to the mill. There are twenty-three levels at intervals of 125 feet. Exploratory workings have been carried to a depth of about 3,000 feet.

Early exhaustion of the Dome mine has been predicted more than once in the past, only to be belied. In so far as known ore reserves are concerned, these are larger now than they have been for several years.

TABLE XXIV

Production Record of Dome Mines, Ltd.[1]

Accounting period	Tons milled	Value per ton	Recovery per ton	Recovery per cent	Operating costs per ton milled	Total(2) value recovered	Estimated ore reserves at end of accounting period		
							Tons	Average value per ton	Gross value
		$	$		$	$		$	$
1910	247	.....	.....	.....	.....	4,355 00	.....	.....	.....
1911	(3)	.....	.....	.....	.....	4,276 61	.....	.....	.....
Nov. 30, 1911 to Mar. 31, 1913(4)	101,812	.....	10 25	.....	4 95	1,043,994 93	566,000	.....	.....
Apr. 1, 1913 to Mar. 31, 1914	145,303	8·77	8 29	94 51	4 20	1,204,597 64	512,600 2,000,000	4 81 3 50	.....
" 1, 1914 " 31, 1915	248,550	4 68	4 25	90·6	2 97	1,055,496 78	2,782,811	4 15	11,576,859
" 1, 1915 " 31, 1916	347,640	5 50	5 12	92·9	2 56	1,778,958 91	2,600,000	6 20	16,120,000
" 1, 1916 " 31, 1917	459,530	5 08	4 73	93·0	2 70	2,171,784 83	2,250,000	5 32	11,979,000
" 1, 1917 " 31, 1918(5)	247,000	4 27	4 17	97·7	2 28	1,030,758 30	1,950,000	5 10	9,945,000
" 1, 1918 " 31, 1919	No ore mined, hoisted, or milled on account of sinking and equipping the No. 3 or Main shaft								
" 1, 1919 " 31, 1920	270,080	6 96	6 57	94·3	3 12	1,773,374 44	3 or 4 years supply at capacity of plant		
" 1, 1920 " 31, 1921	273,700	7 50	7 11	94·7	4 53	1,946,403 06	"	"	"
" 1, 1921 " 31, 1922	360,000	8 20	7 80	95·1	4 56	2,809,452 38	"	"	"
" 1, 1922 " 31, 1923	363,000	12 12	11 79	97·3	5 25	4,728,935 87	"	"	"
" 1, 1923 to Dec. 31, 1923	320,700	10 68	10 43	97·7	4 66	3,345,477 80	550,000(8)	.....	.....
Jan. 1, 1924 " 31, 1924	493,400	8 93	8 73	97·8	4 56	4,307,720 04	550,000(8)	.....	.....
" 1, 1925 " 31, 1925	530,200	8 75	8 55	97·4	4 47	4,366,025 52	620,000(8)	.....	.....
" 1, 1926 " 31, 1926	555,700	7 28	7 09	97·3	4·17	3,940,090 13	Probably 2 years' supply		
" 1, 1927 " 31, 1927	543,300	7 71	7 42	96·2	4 06	4,031,744 06	500,000(8)	.....	.....
" 1, 1928 " 31, 1928	548,000	7 47	7 14	95·6	3 85	3,914,883 38	1,250,000	.....	.....
" 1, 1929 " 31, 1929(6)	452,900	7 88	7 58	96·2	.....	3,432,542 99	1,300,000	.....	.....
" 1, 1929 " 31, 1929	Recovered from ruins of burned mill					157,646 31			
" 1, 1930 " 31, 1930(7)	67,600	6 66	5 89	88·5	4 12	398,063 61	1,900,000	.....	.....
" 1, 1930 " 31, 1930	Recovered from ruins of old mill					377,202 16			
" 1, 1931 " 31, 1931	542,600	6 94	6 42	92·6	3 48	3,486,505 93	1,920,000	.....	.....

[1] Compiled from Ann. Repts. of Dome Mines, Ltd.
[2] Includes premium on U.S. funds.
[3] Recovered in laboratory.
[4] Milling commenced Mar. 31st, 1912.
[5] Mill shut down for four months.
[6] Mill burned Oct. 28th.
[7] Milling started Dec. 1st.
[8] Broken ore only.

VIPOND MINE

The Vipond mine of Vipond Consolidated Mines, Ltd., covers a 320-acre block of mineral lands, lying immediately south of the holdings of Hollinger Consolidated Gold Mines, Ltd. It now includes in addition to the two claims constituting the original Vipond property, what was formerly known as the Porcupine Crown, Thompson-Krist, and Inspiration properties.

The gold-bearing veins on the original Vipond claims were among the first discovered in the Porcupine camp. In 1910, Porcupine Gold Mines Company, afterwards known as Vipond Porcupine Mines Company, Ltd., did considerable development work on them and set up a one-stamp Nissen mill by means of which a little bullion was produced before forest fires destroyed the plant in the summer of 1911. A new mill of about 100 tons daily capacity, designed to treat the ore by plate amalgamation after crushing in ball and pebble mills, was completed and put in operation in July, 1912, but was closed down the following October. After eighteen months of idleness, operations were resumed in August, 1914; the milling process in the meantime having been altered to all cyaniding treatment and the name of the operating company changed to Porcupine Vipond Mines, Ltd. In December, 1916, the property of North Thompson Associated Gold Mines was acquired and a new company known as Porcupine Vipond North Thompson Gold Mines, Ltd., was formed to work the combined properties. The new company continued operations until July, 1918, when the mine was again shut down.

After some four years idleness, the mine was reopened in 1922 by Vipond Consolidated Mines, Ltd., a subsidiary of the Huronian Belt Company of London, England; and the mill, after being remodelled, was put in operation about a year later, in November, 1923, treating about 160 tons of ore a day. About 1925, the property of Inspiration Gold Mines, Ltd. was acquired, to make room for the disposal of mill tailings; and in the following year the capacity of the mill was increased to 300 tons of ore a day. In 1927, the adjoining Porcupine Crown and Thompson-Krist properties were acquired. Since 1923, operations have been continuous.

The property is worked through a main shaft 1,450 feet deep; but no ore has been mined below the 1,000-foot level. The future of the mine would appear to depend on the results that may be obtained from extensive exploratory work now in progress on the 1,450-foot level.

TABLE XXV

Production Record of Vipond Mine[1]

Accounting period	Tons of ore milled	Average value per ton	Recovery per ton	Operating costs per ton milled	Total value recovered	Estimated ore reserves at end of accounting period		
						Tons	Average value per ton	Gross value
		$	$	$	$		$	$
Previous to 1923	.....	.....	.....	.....	808,424 08			
Year ending July 31, 1924	29,783	13 53	.....	10 60[2]	379,075 51	315,423	.....	3,010,347
" " 1925	60,344	10 62	9 66	7 84	582,925 66	250,000	.....	2,400,000
" " 1926	64,522	9 74	8 77	7 60	565,995 60	300,000	.....	2,475,000
" " 1927	95,799	8 21	7 36	5 76	704,899 37	170,000[3]	.....	1,400,000
" " 1928	86,727	8 12	7 46	5 44	646,896 18	116,905	.....	890,000
" " 1929	100,540	8 63	7 93	5 15	797,713 73	127,500	8 16	1,040,000
" " 1930	113,329	8 71	7 91	4 80	896,398 00	163,525	8 23	1,346,000
" " 1931	107,290	7 53	6 64	5 77	712,856 46	Not estimated		

[1] Compiled from Ann. Repts. of Vipond Consolidated Mines, Ltd. Does not include production from the Porcupine Crown previous to its acquisition by Vipond Consolidated.
[2] Mill operated only 8 mos. though mining was carried on for the full year, hence costs appear unduly high.
[3] Reduction in reserves in part due to a revision of former estimates.

CONIAURUM MINE

The property of Coniaurum Mines, Ltd., covers some 640 acres of mineral lands that adjoin the McIntyre mine on the northeast and presumably includes the easterly extension of the McIntyre vein system. It is a consolidation of three old properties, viz., the Newray, or Rea, the Goldale, and the Armstrong-Booth, all of which were staked in the early days of the camp. At the time of their acquisition by Coniaurum Mines, Ltd., in 1924, both the Newray and Goldale mines had main shafts 1,000 feet deep, and there had been a small production of gold from a 10-stamp mill on the Newray between 1913 and 1918. The Armstrong-Booth property, however, was still undeveloped.

Operations by Coniaurum Mines, Ltd., have been carried on through the Newray shaft, which has now (December, 1931) been sunk to a depth of 2,130 feet and levels have been driven from it at depths of 400, 700, 1,000, 1,250, 1,750, and 2,000 feet. Two lower levels, at depths of 2,250 feet and 2,500 feet, have been driven from a winze sunk 533 feet below the 2,000-foot level. The total length of development workings in the mine is over eleven miles.

A number of comparatively small ore-bodies have been found, mostly between the 700-foot and the 2,000-foot levels. A cyanide mill having a daily capacity for the treatment of 500 tons of ore was built and put into operation in July, 1928. The profits made by the mill, however, were not sufficient to cover the costs of development work and the company went into the hands of a receiver in March, 1929. Later in that year a reorganization of the company was brought about by which it came under the control of Ventures, Ltd., in return for capital supplied to carry on development work and exploration. Since 1929, the company has shown a small operating profit, though previously incurred deficits have not yet been entirely wiped out.

TABLE XXVI

Production Record of Coniaurum Mine[1]

Accounting period	Tons milled	Average value per ton	Recovery per ton	Costs per ton	Total value[2] recovered	Estimated ore reserves at end of accounting period[3]	
						Tons	Average value per ton
		$	$	$	$		$
Calendar year 1928	52,005	5 06	4 81	.....	249,889 68	.....	.....
" 1929	103,293	6 68	6 45	.....	666,549 73	70,412	(4)
" 1930	122,972	6 21	5 99	.....	736,727 16	90,610	6 21
" 1931	130,585	6 26	6 02	4 98	829,970 54	117,172	6 53

[1] Compiled from Annual Reports of Coniaurum Mines, Ltd.
[2] Includes premium on U.S. finds.
[3] Broken ore only. On account of the erratic distribution of values in the veins no numerical estimate of unbroken ore is made.
[4] Approximately of present milling grade.

MARCH GOLD MINE

The property of March Gold, Ltd., now consists of five claims situated in Deloro township, about two miles southeasterly from the Dome mine. It has furnished a fairly continuous, if small, production of gold since 1926.

The original claims owned by this company, which was incorporated in December, 1919, were H.R. 823, and H.R. 900. Considerable work was done on H.R. 823 between 1921 and 1923, but no commercial orebodies being found, was discontinued. Meanwhile a fourth claim, H.R. 833, was acquired and in 1924 operations were transferred to it. Early in 1926, two more claims, known as the Maidens-McDonald claims, which adjoin H.R. 833 on the north, were purchased from Coniagas Mines, Ltd. A vertical shaft was sunk on H.R. 833, from which crosscuts were driven to open up veins on the Maidens-McDonald claims, and this is now the main working shaft on the property. It is 723 feet deep, with the lowest working level at a depth of 675 feet.

In July, 1926, a 150-ton cyanide mill was put in operation. Production was at first intermittent, but has been continuous since May 1, 1928.

TABLE XXVII

Production Record of March Gold Mine[1]

Year	Ore milled, tons	Recovery per ton	Value of bullion recovered
		$	$
1926	4,655	2 37	11,055
1927	4,566	4 35	19,839
1928	32,627	4 10	133 879
1929	48,484	5 29	256,360
1930	53,953	5 67	306,266
1931	58,460	3 72	217,586

[1] Compiled from Ontario Department of Mines Reports.

KIRKLAND LAKE AREA

The Kirkland Lake gold camp proper, of which the town of Kirkland Lake is the commercial centre, is situated on a branch line of the Temiskaming and Northern Ontario railway some 315 miles in an air line—398 miles by rail—north of Toronto. For statistical purposes the Ontario Department of Mines now includes under the general heading "Kirkland Lake" not only the main productive area of that name but also the outlying areas of Boston Creek, Larder Lake, and Swastika.

At Kirkland Lake all the producing mines occur within an area some four miles long and three-quarters of a mile broad—strung out along a single main "break," or ore zone. In order from west to east they are: Kirkland Lake Gold, Teck-Hughes, Lake Shore, Wright-Hargreaves, Sylvanite, and Tough Oakes-Burnside mines. Outside of the main camp at Kirkland Lake the only producing gold mine of importance in the district is the Barry Hollinger, situated about 10 miles to the south, near Boston Creek station on the main line of the T. and N.O. railway; though in the past there has also been a small gold production from mines at Larder Lake and Swastika.

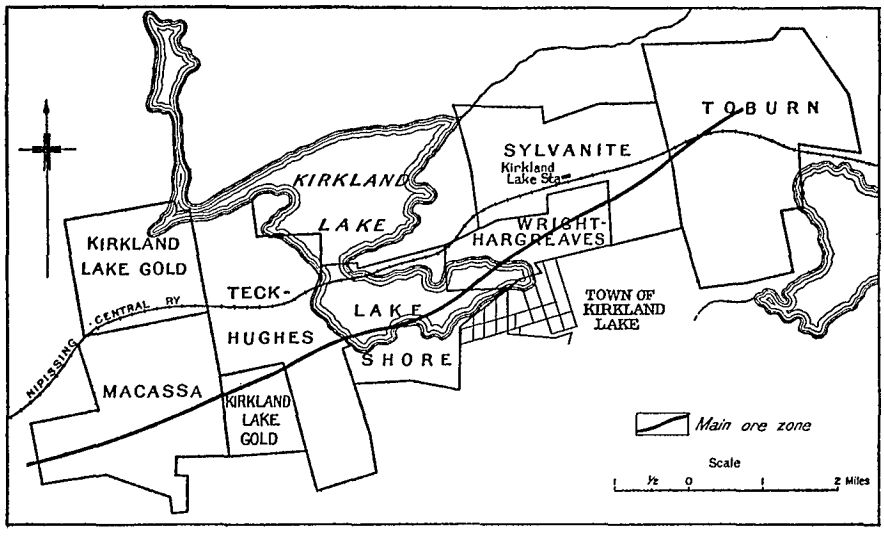

Figure 7. Key map of gold mines in Kirkland Lake area, Ontario.

In 1906, at the time of the silver-mining boom at Cobalt, there was a gold rush to Larder Lake, in the course of which many claims were staked for gold near Swastika also, and northeasterly from Swastika to the lake now known as Kirkland lake. These first stakings were for the most part allowed to lapse and it was not until the success attending developments at Porcupine had revived interest in the possibilities of the district that important discoveries were made. In the fall of 1911, W. H. Wright found gold near the shore of Kirkland lake, on what is now part

of the Wright-Hargreaves mine, and by the end of the year most of the ground in this vicinity had been re-staked. In January, 1912, gold had also been found three-quarters of a mile northeast of Kirkland lake, on the Tough-Oakes claims. In 1913, two carloads of ore shipped from the Tough-Oakes brought returns of some $17,033. A period of feverish prospecting activity on neighbouring claims immediately set in, resulting in new promising discoveries on the Burnside (now included with Tough-Oakes in Toburn mines), on the Robbins (now the Sylvanite mine), on the Wright-Hargreaves, on the Oakes (now Lake Shore mine), on the Teck-Hughes, on the Wettlaufer (later the Orr and now part of Teck-Hughes mine), on the Wood-McKane (now Kirkland Lake Gold mine), and on the Hunton. Electric power was brought into the camp in 1914; and in the following year the first mill, a 125-ton cyanide mill, was put into operation on the Tough-Oakes. The subsequent rapid development of the camp, which was interrupted by a miners' strike in 1919, is epitomised in the following tables.

TABLE XXVIII

Total Production (Gold and Silver) by Mines of the Kirkland Lake Gold Area*

Year	Lake Shore	Teck-Hughes	Wright-Hargreaves	Kirkland Lake	Sylvanite	Tough-Oakes-Burnside	Barry-Hollinger	Argonaut *(a)*	Canadian Associated Goldfields	Lucky Cross	Gold Hill	Ontario-Kirkland	Swastika	Total value *(b)*
	$	$	$	$	$	$	$	$	$	$	$	$	$	$
1913			1,127			66,632				14,006			7,172	88,937
1914						117,644		5,204						122,848
1915						555,539								555,539
1916						711,625								711,625
1917		66,722				342,831								409,533
1918	416,414	80,570				139,683	*(c)* 10,114							646,781
1919	263,354	169,590		56,263				2,631						491,838
1920	503,735	247,757		286,901				26,863						1,065,256
1921	495,276	322,919	468,751	242,417				513						1,529,875
1922	471,341	596,495	762,753	224,396		107,481						10,082		2,172,548
1923	547,600	1,117,963	754,979	223,102		12,174		72,512						2,728,331
1924	1,098,572	1,023,025	1,088,725	46,512		47,547		152,072						3,456,453
1925	1,958,720	996,943	1,913,401			263,064	56,978	214,183						5,403,289
1926	2,775,000	1,601,209	2,150,844	126,999		309,709	86,263	143,387						7,193,411
1927	3,375,053	2,781,962	2,151,916	473,673	429,424	153,215	175,692	127,448	34,595		*(d)* 865			9,703,843
1928	4,073,965	4,948,896	1,838,510	414,596	738,146	82,316	111,767	32,430	17,700		12,784			*(e)* 12,271,110
1929	6,090,189	5,048,420	1,734,728	352,789	689,465		151,758	9,959						14,089,233
1930	7,836,779	5,398,217	2,432,888	533,851	794,459		217,835	1,891						17,215,974
1931	11,065,618	6,093,199	2,909,837	586,250	901,168		224,663							*(f)* 21,783,162
Total	40,971,616	30,493,941	18,208,459	3,567,749	3,552,662	2,909,460	1,035,040	789,039	52,295	14,006	13,649	10,082	7,172	101,639,606

* From Ont. Dept. of Mines reports.

(a) Exclusive of copper values.

(b) Exchange premiums received in addition to the above valuations were as follows: 1920, $110,424; 1921, $121,425; 1922, $19,590; 1923, $37,812; 1924, $24,028; 1925, $231 discount; 1926, $595 discount; 1928, $2,810.55; 1929, $70,283; 1930, $15,791; and 1931, $893,518.

(c) Patricia mine, afterwards called Barry-Hollinger.

(d) Samples shipped in 1923 and 1926 not heretofore reported.

(e) Contains $11,925—estimate of high-grade.

(f) Includes Telluride, $835, and Trout Creek, $1,622.

TABLE XXIX

Dividends and Bonuses Paid by Kirkland Lake Gold Mining Companies, 1915-1931*

Year	Tough-Oakes	Lake Shore	Teck-Hughes	Wright-Hargreaves	Sylvanite	Total
	$	$	$	$	$	$
1915	132,875					132,875 00
1916	265,750					265,750 00
1917						
1918		100,000				100,000 00
1919		100,000				100,000 00
1920		80,000				80,000 00
1921		120,000				120,000 00
1922		80,000		412,500		492,500 00
1923		160,000		206,250		366,250 00
1924		380,000		206,250		586,250 00
1925		600,000		550,000		1,150,000 00
1926		1,000,000	474,714 40	893,750		2,368,464 40
1927		1,400,000	713,571 60	1,237,500		3,351,071 60
1928		2,000,000	2,860,286 40	825,000		5,685,286 40
1929		2,200,000	2,866,286 40			5,066,286 40
1930		3,000,000	2,872,286 40		65,590	5,937,876 40
1931		4,800,000	3,118,143 60	825,000	131,980	8,875,123 60
Total	398,625	16,020,000	12,905,288 80	5,156,250	197,570	34,677,733 80

* From Ont. Dept. of Mines Repts.

Milling

The method universally employed for the extraction of the gold from the Kirkland Lake ores is all-sliming cyanidation, the different mills differing from each other only in details. Neither stamps nor amalgamation are in use. Coarse crushing of material from the rock-breakers is done in rod and ball mills, or by rolls. Fine grinding is done in cyanide solution in tube mills in closed circuit with classifiers. This is followed by agitation, thickening, counter-current decantation, and precipitation with zinc dust. The precipitated gold is recovered in filter presses, melted down, and refined in bullion furnaces.

The Kirkland Lake ores are on the average of considerably higher grade than those of Porcupine but, unlike the latter, a considerable portion of their gold content is in the form of tellurides. As a result of this last feature particularly, loss of gold in the mill tailings was unduly high in the earlier days of the camp, but gradual improvements in milling practice has now largely eliminated this. Old tailings high in gold have been impounded and re-worked in the Teck-Hughes mine; and a separate company has recently been formed to re-work similar material from the Lake Shore and Wright-Hargreaves mines.

Mining

At all the mines at Kirkland Lake entry is by vertical shafts, off which levels are driven at intervals of 100 or 125 feet. As the ore-bearing zone dips at an angle of about 85 degrees, crosscuts from the shafts are

TABLE XXX

Production of Gold and Silver from the Principal Mines of the Kirkland Lake Camp by Mines and Years[1]

Year	Tough-Oakes[2]			Wright--Hargreaves			Teck-Hughes			Lake Shore			Kirkland Lake Gold			Ontario Kirkland[3]			Sylvanite			Totals			Year
	Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		Ore milled, tons	Produced, ounces		
		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver	
1913	2,220	3,164·05	3,890·40	3	42·77	404·2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,223	3,206·82	4,294·60	1913
1914	3,734	5,523·62	6,634·30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,734	5,523·62	6,634·30	1914
1915	26,196	26,658·23	8,922·00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26,196	26,658·23	8,922·00	1915
1916	39,865	33,991·32	13,051·10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39,865	33,991.32	13,051·10	1916
1917	38,695	16,383·60	5,256·90	.....	.....	.....	11,257	3,181·46	1,154·60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49,952	19,565·06	6,411·50	1917
1918	22,000	6,619·52	3,006·68	.....	.....	.....	14,774	3,869·29	669·52	16,749	20,031·01	1,188·62	.....	.....	.....	.....	.....	.....	.....	.....	.....	53,523	30,519·82	4,864·82	1918
1919	.....	.....	.....	.....	.....	.....	18,387	8,156·37	930·10	11,081	12,695·72	932·50	11,324	2,675·05	378·90	.....	.....	.....	.....	.....	.....	40,792	23,527·14	2,241·50	1919
1920	.....	.....	.....	.....	.....	.....	30,646	11,909·65	1,507·90	19,779	24,291.89	1,723·00	40,812	13,795·13	1,852·90	.....	.....	.....	.....	.....	.....	91,237	49,996·67	5,083·80	1920
1921	.....	.....	.....	36,053	11,909·65	1,507·90	34,693	15,582·00	1,304·50	21,817	23,896·46	2,024·60	43,966	11,677·75	1,665·10	.....	.....	.....	.....	.....	.....	136,529	73,773·71	7,060·60	1921
1922	16,108	5,144·26	1,870·40	66,181	36,748·21	4,702·30	41,194	28,779·86	2,321·90	24,279	22,737·17	1,974·50	37,489	10,813·64	1,279·20	6,496	433·25	142·90	.....	.....	.....	191,747	104,706·39	12,291·20	1922
1923	1,803	579·75	293·80	79,242	36,369·82	4,968·20	38,314	53,954·67	4,074·90	23,203	26,430·57	1,917·70	45,449	10,746·66	1,471·20	.....	.....	.....	.....	.....	.....	188,011	128,081·47	12,725·80	1923
1924	8,438	2,280·81	582·90	84,487	52,464·78	6,412·50	44,209	49,350·06	4,116·90	56,168	53,053·43	4,224·90	8,091	2,235·86	452·50	.....	.....	.....	.....	.....	.....	201,393	159,384·99	15,789·70	1924
1925	34,152	12,624·56	3,047·00	147,939	92·286·28	8,519·00	55,220	48,076·84	4,518·00	109,273	94,455·57	8,890·00	.....	.....	.....	.....	.....	.....	.....	.....	.....	346,584	247,443·25	24,974·00	1925
1926	43,871	14,819·25	2,114·00	153,392	103·793·12	8,912·00	80,074	77,266·13	6,450·00	171,197	133,893·00	11,935·00	10,829	6,111·51	1,260·00	.....	.....	.....	.....	.....	.....	459,363	335,883·01	30,671·00	1926
1927	38,999	7,484·00	752·00	209·164	103,789·86	11,387·00	153,881	134,279·27	11,020·00	236,818	162,829·07	15,652·00	52,648	22,778·47	4,971·00	.....	.....	.....	40,479	20,596·23	6,608	731,989	451,756·90	50,381·00	1927
1928	14,396	3,967·04	540·00	256,331	88,530·07	12,778·00	317,213	238,387·56	18,453·00	279,661	196,532·92	19,557·00	57,883	19,961·79	3,390·00	.....	.....	.....	69,791	35,452·43	9,263	995,275	583,381·81	63,981·00	1928
1929	.....	.....	.....	188,238	83,631·42	11,323·00	(4) 337,630	243,744·51	18,733·00	430,170	293,536·51	39,902·00	53,595	16,999·27	2,677·00	.....	.....	.....	74,523	33,167·70	7,242	1,084,156	671,129·41	79,877·00	1929
1930	.....	.....	.....	220,430	117,454·90	13,090·00	338,555	260,774·69	20,243·00	550,501	377,830·89	69,629·00	52,106	25·763·72	3,526·00	.....	.....	.....	81,213	38,303·45	7,181	1,242,805	820,127·65	113,669·00	1930
1931	.....	.....	.....	266,352	140,520·42	17,750·00	444,410	294,421·57	24,686·00	816,580	533,756·57	113,087·00	52,628	28,314·91	3,317·00	.....	.....	.....	91,621	43·436·60	11,222	1,671,591	1,040,450·07	170,071·00	1931

[1] Compiled from reports of the Ont. Dept. of Mines. Includes only mines in Kirkland Lake camp proper, does not include mines in outlying areas, viz., Barry-Hollinger and Gold Hill in Boston Creek area; Argonaut and Associated Goldfields in Larder Lake area; and Lucky Cross and Swastika in Swastika area, though these are now included in the Kirkland Lake area for statistical purposes by the Ont. Dept. of Mines.

[2] Production from Tough-Oakes mine was by Kirkland Lake Proprietary, Ltd., in 1922 and 1923. On Aug. 31, 1923, the property was transferred to Tough-Oakes-Burnside Gold Mines, Ltd. The present owners are Toburn Gold Mines, Ltd., incorporated in January, 1931.

[3] This property was later amalgamated with Montreal Kirkland under the name Montreal-Ontario, which in turn became Kirkland Rand and later Kirkland Premier.

[4] Includes 7,290 tons of tailings re-treated.

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necessary to tap the veins. Little timbering is necessary and is largely confined to shafts and levels, though occasionally bad ground is met with that requires special methods for its removal. In general, the width of ore in the stopes is probably about 10 feet, but widths as great as 60 feet are not unknown. Until recently nearly all ore in the camp was extracted by overhand stoping in shrinkage stopes, but in the Lake Shore mine the shrinkage stoping method is now being replaced by cut-and-fill stoping on all the lower levels. At present the deepest working level in the camp is at a depth of 4,750 feet on the Kirkland Lake Gold mine. On the Teck-Hughes the 32nd level is now being driven at a depth of 3,855 feet and equipment has been put in to carry the workings to a depth of 6,730 feet.

KIRKLAND LAKE GOLD MINE

The Kirkland Lake mine of the Kirkland Lake Gold Mining Company, Limited, is the most westerly producer on the "main break," or ore zone, of the Kirkland Lake camp proper; some 1,400 feet in length of the zone lying within the boundaries of the property.

The first discovery of gold on the Kirkland Lake Gold mine, then known as the McKane claim, was made in 1913 by trenching through some twenty feet of soil on the projected strike of the lode on the Teck-Hughes claims to the east, the actual break being covered with drift for practically the full length of the property. The original operators were Kirkland Gold Mines, Ltd., who after sinking a shaft to a depth of about 80 feet, close to the Teck-Hughes boundary, turned the property over to Beaver Consolidated Mines, Ltd. The latter, in November, 1915, incorporated Kirkland Lake Gold Mining Company, Ltd., to continue development. In 1918, a 100-ton cyanide mill was completed and put in operation, production being first recorded in 1919. With the exception of about four months in 1919, when operations were interrupted by a miners' strike, production was continuous till the end of April, 1924. At that time operations had become unremunerative, through the exhaustion of the known ore-bodies, and the mill was closed down. Exploration to depth, with the expectation of finding extensions of the rich Teck-Hughes ore-bodies was next undertaken, on the advice and under the direction of Mr. J. B. Tyrrell. This expectation was realized. Good ore was encountered at a depth of about 2,100 feet, and the mill, which now has a capacity of about 160 tons of ore a day, was started up again in October, 1926, since when it has been in continuous operation. Mine workings have now reached a depth of 4,750 feet, some of the best and largest ore-bodies yet found being in the lowest levels. Hoisting is done in two stages, a centrally located three-compartment shaft extending down to the 2,475-foot level, below which a four-compartment winze extends to the bottom of the mine.

TABLE XXXI

Production Record of Kirkland Lake Mine*

Accounting period	Tons milled	Average value recovered per ton	Recovery	Costs per ton milled	Total value recovered
		$	%	$	$
Calendar year—1919	11,324	4 97	.....	.....	56,263
1920	40,812	7 03	.....	.....	286,901
1921	43,966	5 51	.....	.....	242,417
1922	37,489	5 98	.....	.....	244,396
1923	45,449	4 91	.....	.....	223,102
1924	8,091	5 75	.....	.....	46,513
1925	.....	.....	.....	.....	.....
1926	10,829	11 73	.....	19 39	126,999
1927	52,648	9 00	.....	6 84	473,073
1928	57,883	7 16	86·6	6 64	414,596
1929	53,595	6 60	90·21	8 03	353,625
1930	52,106	10 24	.....	8 83	534,397
1931	.....	11 14	.....	.....	586,251

* Figures up to 1927 from Ont. Dept. of Mines Repts.; subsequent to 1927 from Ann. Repts. of Kirkland Lake Gold Mining Co., Ltd.

TECK-HUGHES MINE

The Teck-Hughes mine of Teck-Hughes Gold Mines, Ltd., is a 446-acre property lying immediately east of the Kirkland Lake Gold mine, between the latter and the Lake Shore mine. Production so far has been from mining claims L 1238 and T 16626, the last of which was formerly known as the Orr mine. The length of Kirkland Lake main ore zone on Teck-Hughes ground is about 1,500 feet.

The first development work was done on L 1238, in 1912; and in the following year Teck-Hughes Gold Mines, Ltd., was incorporated. For several years exploration of the property met with little success. Several shallow shafts were sunk, some lateral work underground was done, and some small ore shoots were found; but nothing indicated the great future value of the property. In July, 1914, the Nipissing Mining Company took an option on it, but nearly a year of exploratory work yielded such discouraging results that all work was stopped in March, 1915, and the option was dropped. In August, 1915, parties connected with Buffalo Mines Ltd., obtained control of the Teck-Hughes Company. A 50-ton cyanide mill was built and put in operation in 1916, the first production returns being made in 1917. In 1918, both mine and mill were shut down for a short time, owing to a scarcity of labour and the high cost of supplies; and again, in 1919, on account of a miners' strike. On October 1, 1920, bonds that had been issued to provide funds for the development of the mine, were in default—both principal and interest—operations up to this time having

proved unprofitable. A reorganization of the company was effected and money for the further carrying on of development work was raised by means of a new bond issue and the issue of new stock. By 1921, some rich ore shoots were developed in the lower levels of the mine; the outlook had become much brighter; and milling capacity was increased to about 160 tons of ore a day. In 1923, a new company, the Teck-Hughes Gold Mines, Ltd., was incorporated to acquire the assets of the old Teck-Hughes Company and also of Orr Gold Mines, Ltd., into whose property lying immediately south of Teck-Hughes the ore shoots on the latter passed.

At present operations are carried on through three large shafts, of which one, the South shaft has been sunk with a view to extending it to great depth. It is planned to carry on deep mining, in two hoisting stages —the first from the surface to the 30th level at a depth of 3,605 feet; the second, from the 30th to the 55th level, or a total depth of 6,730 feet. A three-compartment inclined winze, started in the foot-wall of the ore zone at the 29th level is now being sunk to open up new levels at 125-foot intervals below the 30th and, from it, drifting on the 31st and 32nd levels is now in progress. A commencement has also been made on a four-compartment extension of the South shaft below the 30th level, designed for hoisting rock in five-ton skips from main-haulage levels to be spaced at 625-foot intervals between the 30th and 55th levels. The total length of underground workings—drifts, crosscuts, shafts, and raises is now nearly twenty miles. Meanwhile, milling capacity has been gradually increased until it is now about 1,300 tons of ore a day.

This mine has the proud distinction of being the lowest cost producer per ounce of gold of any gold mine in Canada and of being one of the two or three lowest cost producers per ounce in the world. An analysis of the cost per ounce in the fiscal year ending March 31, 1931, is as follows:

Development and depreciation	$1·611
Mining	3·322
Milling	1·561
General expense	0·820
Total direct charges	7·314
Depreciation	0·991
Total direct and indirect charges	8·305

TABLE XXXII

Production Record of Teck-Hughes Mine[1]

Accounting period	Tons milled	Recovery per ton	Costs[2] per ton milled	Total value recovered	Estimated ore reserves at end of accounting period[3]		
					Tons	Average value per ton	Gross value
		$	$	$		$	$
Year ending Aug. 31, 1917	6,291	7 70	.....	31,777	.....	.....	.....
" " 1918	15,879	7 87	.....	104,354	.....	.....	.....
" " 1919	16,907	8 86	9 24	149,875	26,600 60,000	10 00 9 70	.....
" " 1920	No Annual Report published						
" " 1921	32,634	9 34	8 95	304,792	98,890	9 17	907,140
" " 1922	43,300	11 11	9 00	481,144	79,974	.....	1,183,176
" " 1923	34,690	28 30	12 63	981,525	131,193	.....	2,533,686
" " 1924	42,381	26 23	12 60	1,111,674	.....	.....	.....
" " 1925	48,718	18 98	11 77	924,581	.....	.....	.....
" " 1926	79,564	18 37	9 54	1,461,367	.....	.....	.....
" " 1927	114,705	18 35	9 60	2,105,545	.....	.....	.....
" " 1928	276,052	16 28	6 32	4,504,707	.....	.....	.....
" " 1929	331,150	14 76	6 58	4,889,127	.....	.....	.....
" " 1930	340,675	15 90	6 41	5,415,970	576,289	17 43	10,044,009
" " 1931	396,200	15 08	6 06	5,973,126	645,384	14 28	9,216,093

[1] Compiled from Annual Reports of Teck-Hughes Gold Mines, Ltd.
[2] Including depreciation but not taxes.
[3] Positive ore only. No estimates of ore reserves published between 1923 and 1930.

LAKE SHORE MINE

Lake Shore Mines, Ltd., owns five claims lying immediately east of the Teck-Hughes mine, between the latter and the Wright-Hargreaves mine, including 2,800 feet in length of the main Kirkland Lake ore zone. The surface plant is on the south shore of the lake, and the mine workings are largely beneath it.

The property was staked by Harry Oakes, who still controls it, and Lake Shore Mines, Ltd. was incorporated in February, 1914. Development work was started in the same year, a shaft being sunk on the South vein, which outcrops on the shore of the lake; the outcrop of the North, or Main, vein lies entirely beneath the lake on the Lake Shore property. It was not till March, 1918, however, that the first mill—a 65-ton cyanide plant—was put into operation. Since 1918, both mining and milling operations have expanded steadily and rapidly, till to-day the Lake Shore mine is the largest gold producer on the American continent and one of the largest in the world.

Operations on the Lake Shore mine are carried on through two principal shafts, the No. 1 and the No. 3, by means of which the deposits are now being opened up to a depth of 3,000 feet. Up to the present, nearly all the ore milled has come from above the 2,000-foot level. The total length of development openings underground including drifts, crosscuts, shafts, winzes, etc.,—is about 25 miles. Vein widths vary from 8 to more than 50 feet. Ore extraction in the upper levels was all by shrinkage stope methods, but this system is now being changed over

to one of cut-and-fill, approximately one-third of the ore treated in 1931 being mined by the latter method. Milling capacity is now in the neighbourhood of 2,400 tons of ore a day. Detailed statements of ore reserves are not given in the company's annual reports, but the mine is believed to have an assured life of many years at the present rate of production.

An analysis of bullion from the Lake Shore mill may be of interest: gold, 82·91 per cent; silver, 6·50 per cent; copper, 2·69 per cent; lead, 2·00 per cent; zinc, 1·91 per cent; and tellurium, 2·00 per cent.

TABLE XXXIII

Production Record of Lake Shore Mine[1]

Accounting period	Tons milled	Average value per ton[2]	Recovery per ton	Operating costs[3] per ton milled	Total value[4] recovered	Estimated value of broken ore reserves only, at end of accounting period	
			$	$	$	$	Tons
Mar. 1918, to Nov. 30, 1918	14,948	.....	24 76	.....	369,680	.....	.....
Dec. 1, 1918, " 30, 1919	11,907	.....	24 67	.....	294,514	185,941	6,035
" 1919 " 1920	18,880	.....	25 61	.....	483,702	520,575	18,702
" 1920 " 1921	21,618	.....	21 22	.....	460,186	700,730	28,298
" 1921, to June 30, 1923	36,825	.....	22 57	.....	833,665	801,568	34,700
" 1923 " 1924	24,223	.....	23 97	.....	578,243	1,127,128	45,069
" 1924 " 1925	96,838	.....	18 72	.....	1,812,495	2,148,260	85,365
" 1925 " 1926	125,676	.....	17 79	.....	2,235,184	4,340,799	181,534
" 1926 " 1927	214,335	.....	14 46	.....	3,105,048	5,079,130	262,053
" 1927 " 1928	237,902	.....	15 25	.....	3,629,318	.....	.....
" 1928 " 1929	367,015	.....	14 90	6 34	5,504,859	6,524,797	.....
" 1929 " 1930	467,648	.....	14 06	5 85	6,576,780	6,105,400	.....
" 1930 " 1931	698,624	.....	13 10	5 16	9,152,035	6,850,000	.....

[1] Compiled from Annual Reports of Lake Shore Mines, Ltd.
[2] Not stated in Company's Annual Reports.
[3] Exclusive of depreciation and taxes.
[4] Exclusive of premiums on exchange.

WRIGHT-HARGREAVES MINE

The Wright-Hargreaves mine of Wright-Hargreaves Mines, Ltd., includes three mining claims aggregating 152 acres lying immediately east of the Lake Shore mine. The main Kirkland Lake ore zone crosses the property over a length of about 4,000 feet.

It was on part of what is now known as the Wright-Hargreaves mine that the first important discovery of gold was made in the vicinity of Kirkland lake, in 1911, by W. H. Wright. This consisted of short, rich ore shoots showing free gold, in narrow quartz veinlets. In 1913, parties who had the claims under option discovered a five-foot vein (now known as the North vein) about 550 feet north of the original discovery; and took from it and shipped to a smelter about three-quarters of a ton of ore that yielded gold at the rate of $331.35 a ton. In spite of this, the option was allowed to lapse; the claims reverted to the original owners and lay idle for several years. In June, 1916, Wright-Hargreaves Mines, Ltd., was incorporated to take over the property, and active development com-

menced. From July, 1918, till the spring of 1920 the mine was shut down, partly to facilitate the building of a new head-frame and a mill, and partly on account of the miners' strike of 1919. The mill—a cyanide mill of 175-tons daily capacity—was finished and put in operation on May 1, 1921. Since then operations have been continuous. Milling capacity had been increased to 700 tons a day in 1927, but milling operations had to be curtailed to about 550 tons a day in 1929, due to lack of developed ore resources. Since 1929, developments under ground have been so favourable that milling capacity has now been brought up to 800 tons a day.

Up to the present the mine has been worked through two shafts, No. 1, 2,000 feet deep, and No. 3, recently finished to a depth of 3,123 feet, but due to increasing scale of operations an entirely new Central shaft is now being sunk, through which it is expected workings will be carried to much greater depths than any yet attained.

TABLE XXXIV

Production Record of Wright-Hargreaves Mine[1]

Accounting period	Tons milled	Average value per ton	Recovery per ton	Costs[2] per ton milled	Total value[3] recovered	Ore reserves at end of accounting period		
						Tons	Average value per ton	Gross value
		$	$	$	$		$	$
Eight months ending Dec. 31, 1921	36,081	13 96	13 00	.....	468,665	.....	.....	.....
Year ending Dec. 31, 1922	66,181	12 49	11 52	6·32	762,752	.....	.....	.....
" " 1923	79,242	10 48	9 52	5·93	754,978	.....	.....	.....
" " 1924	84,487	14 16	12 89	6·33	1,088,725	.....	.....	.....
" " 1925	147,930	14 49	12 93	5·00	1,913,401	.....	.....	.....
" " 1926	153,392	15 66	14 02	5·34	2,150,844	.....	.....	.....
" " 1927	209,164	11 77	10 51	5·47	2,151,916	.....	.....	.....
" " 1928	256,331	8 36	7 20	5·33	1,845,023	.....	.....	.....
" " 1929	188,238	10 29	9 25	7·04	1,741,872	418 877	11 30	4,727,551
" " 1930	220,430	12 20	11 03	5·96	2,431,896	619,605	11 83	7,334,604
" " 1931	266,352	11 73	10 93	6·364	2,912,309	753,510	11 65	8,776,551
Total	1,707,837	11 86	10 67	.....	18,223,280	.....	.....	.....

[1] Compiled from Annual Reports of Wright-Hargreaves Mines, Ltd.
[2] Includes depreciation and taxes.
[3] Exclusive of exchange premium.

SYLVANITE MINE

The property of Sylvanite Gold Mines, Ltd., covers some 208 acres lying immediately east and north of the Wright-Hargreaves mine. It includes some 1,500 feet in length of the main Kirkland Lake ore zone.

The mining claims now constituting the Sylvanite property were originally known as the Wright and the Robbins claims and were among the first to be staked in the Kirkland Lake camp. Visible gold, in narrow quartz veins, was found on them, but on the whole, surface evidence of large ore-bodies was not particularly strong. Sylvanite Gold Mines, Ltd.,

was formed to develop the property in 1913; but for a number of years work was carried on in a more or less desultory way and it was not until 1922 that, stimulated by spectacular developments on neighbouring properties, an extensive program of underground exploration was seriously undertaken. A series of faults has made underground operations rather difficult, but results have been sufficiently successful to warrant the erection of a 250-ton cyanide mill which commenced producing in May, 1927. The mine is served by two shafts, the No. 2, and the No. 4, by means of which it is purposed to carry the workings to a depth of at least 3,000 feet, where it is expected less irregularity will be found in the ore-bodies than has been experienced in the upper levels.

TABLE XXXV

Production Record of Sylvanite Mine[1]

Accounting period	Tons milled	Value recovered per ton	Recovery, per cent	Costs[2] per ton milled	Total value recovered	Ore reserves at end of accounting[3] period		
						Tons	Average value per ton	Gross value
		$		$	$		$	$
Eight months ending March 31, 1928	57,341	10 62	94·4	5·787	609,182	30,437	.....	.....
Year ending March 31, 1929	70,833	10 41	.....	8·096	737,573	49,634	.....	.....
" " 1930	75,408	9 16	.....	8·135	690,400	62,335	.....	.....
" " 1931	83,034	10 08	.....	7·73	837,014	74,250	.....	.....

[1] Compiled from Ann. Repts. of Sylvanite Gold Mines, Ltd.
[2] Does not include depreciation and taxes.
[3] Broken ore only; values not stated.

TOUGH-OAKES-BURNSIDE MINE

The Tough-Oakes-Burnside claims, now the property of Toburn Gold Mines, Ltd., cover 343 areas in one block immediately east of the Sylvanite mine. It is the last mine, going eastward, on which commercial ore-bodies have as yet been developed in the main ore zone of the Kirkland Lake camp. It was the first, and for several years the only important producer at Kirkland lake but operations have so far resulted in only fluctuating success and there has been no production since 1928.

The original Tough-Oakes claims were staked by Harry Oakes, now president of Lake Shore Mines, and the Tough brothers. In January, 1912, shortly after Wright's discovery on the Wright-Hargreaves property, spectacular surface discoveries were made also on the Tough-Oakes—the richest surface showings yet found in the Kirkland Lake camp. For the three following years rich ore, mostly from open-cuts and development shafts and drifts, was hand-sorted on a bumping table; the high-grade sorted material being bagged and shipped to smelters while the residue passed on to a 5-stamp battery equipped with amalgamation plates, which caught about half of the remaining gold. The tailings from the plates were impounded for further treatment. Up to the end of 1914, high-grade hand-sorted ore to the amount of 313·8 tons, having a gross value of $827,811, was shipped; while, during the same period, 5,468 tons of ore

treated in the mill yielded gold and silver to the value of $69,403. The impounded tailings were later treated in a 100-ton cyanide mill that went into operation in March, 1915.

In spite of the splendid showings of rich ore found on the surface and in the upper levels of the mine, no large continuous ore-bodies were developed, and consequently all work ceased on July 13, 1918. The mine was re-opened in 1919, but after three months' operation was again closed, on account of a miners' strike. The next resumption of operations was on April 15, 1921. Control of the property had at this time passed into the hands of Kirkland Lake Proprietary, Ltd., of London, England. In September, 1923, Tough-Oakes-Burnside Gold Mines, Ltd., was incorporated in Canada to take over the Tough-Oakes and Burnside claims from Kirkland Lake Proprietary, the latter retaining a four-fifths stock interest in the Canadian company. With money raised by the sale of the remaining one-fifth of the new company's stock supplemented by such operating profit as could be derived from the mill—the capacity of which had been increased in 1926 to about 220 tons of ore a day—an extensive campaign was undertaken to try and discover new ore-bodies. In December, 1927, further funds for exploratory work were raised by an issue of bonds. Efforts to find new large ore-bodies continued, however, to be unsuccessful and in November, 1928, the mine was closed down by the action of the bond holders. In 1930, Bunker Hill Extension Mines, Ltd., obtained an option on the property from the bond holders, and in January, 1931, in association with the Premier Gold Mining Company, Ltd., of British Columbia, incorporated Toburn Gold Mines, Ltd., to take over the option and carry on further exploratory work. The results of this up to the end of 1931, as given in the Annual Report of the Premier Gold Mining Company for that year, are: that no ore of importance has been found east of a dike-fault that cuts the main Kirkland Lake ore zone on the Tough-Oakes-Burnside ground, about 275 feet east of the Sylvanite boundary; but that some small ore-bodies of good grade have been found in the narrow strip of territory between the fault-dike and the Sylvanite property.

TABLE XXXVI

Production Record of Tough-Oakes-Burnside Mine[1]

Year	Ore milled, tons	Bullion produced	Recovery per ton	Year	Ore milled, tons	Bullion produced	Recovery per ton
		$	$			$	$
1913.....	2,220	66,632	30 01	1923.....	1,803	12,174	6 75
1914.....	3,734	117,644	31 24	1924.....	8,438	47,548	5 53
1915.....	26,196	555,539	21 21	1925.....	34,152	263,064	7 70
1916.....	39,865	711,625	17 85	1926.....	43,871	309,709	7 06
1917.....	38,695	342,831	8 86	1927.....	38,999	153,215	3 93
1918.....	22,000	139,683	6 35	1928.....	14,396	82,316	5 72
1922.....	16,108	107,481	6 05				
				Total.	290,477	2,909,461	

[1] Operated up to 1918 by Tough-Oakes Gold Mines, Ltd.; in 1922 and up to Aug. 31, 1923, by Kirkland Lake Proprietary; after that by Tough-Oakes Burnside Gold Mines, Ltd., till Nov. 1928; now by Toburn Gold Mines, Ltd.

BARRY-HOLLINGER (FORMERLY PATRICIA) MINE

The only mine of any importance now producing in the Kirkland Lake area, outside of those at Kirkland Lake itself, is the Barry-Hollinger. This is a 360-acre property situated about one mile from Boston Creek station on the Temiskaming and Northern Ontario railway and approximately 12 miles south of the Kirkland Lake camp proper.

Development work on this property, then known as the Boston-Hollinger, was started in 1916. In the following year, it was taken under option by the Patricia Syndicate and a 50-ton mill was built to treat the ore by amalgamation and concentration. Crushing was started in June, 1918, but stopped in October, and the property was allowed to revert to the original owners. In July, 1919, the mill and all the surface plant was destroyed by a forest fire. The mine then lay idle till 1923, when Barry-Hollinger Gold Mines, Ltd. was incorporated to acquire the property and work it. Since June, 1923, operations have been continuous and have recently been affording a small operating profit.

In the spring of 1925, a new 50-ton mill was built to treat ore by amalgamation and concentration, but in the following year this was converted into a 100-ton all-cyaniding mill. Underground development is carried on through a shaft 1,000 feet deep, from the level of the bottom of which a winze has been sunk a further 1,125 feet, making the deepest workings about 2,125 feet deep. Developments at depth are said to have improved the outlook for the property.

TABLE XXXVII

Production Record of Barry-Hollinger Mine[1]

Year	Tons milled	Recovery per ton	Total value recovered
		$	$
Previous to 1925	.....	.....	10,082[2]
1925	8,136	7 00	56,978[3]
1926	13,680	6 31	86,263
1927	25,174	6 83	175,692
1928	23,060	4 85	111,767
1929	22,343	6 79	151,758
1930	31,725	6 87	217,835
1931	31,958	7 03	224,633

[1] From Ont. Dept. of Mines Repts.
[2] By the Patricia Syndicate, in 1918.
[3] From 1925 forward, by Barry-Hollinger Gold Mines, Ltd.

OTHER GOLD MINES IN ONTARIO

Despite the fact that gold has been discovered at a great number of points scattered over a wide belt of territory, stretching from Manitoba to Quebec, outside of the Porcupine and Kirkland Lake areas, and exclusive of mere prospects, there are only four gold mines at present actually pro-

ducing in the province and a fifth about to become a producer. Of the presently producing mines, the Howey in the Patricia district is the most important; the Minto and the Parkhill, in the Michipicoten district, are small operations; and the Moss in Thunder Bay district, is also a small mine, which has just been brought into production. The Ashley mine, in the Matachewan area, is a partly developed property on which a small mill is now being built.

HOWEY MINE

The Howey mine of Howey Gold Mines, Ltd., is situated at the south-east angle of Red lake in the Patricia district, of northwestern Ontario. The property, which consists of some twenty-three claims, in the unsurveyed townships of Heyson and Dome, is about 75 miles due north of Favel station on the Canadian National railway, but is 175 miles from the railway by the power-boat and portage route by which supplies are brought into the camp from Hudson in summer. In winter, supplies are brought in on snow roads that follow in part the summer water route, but are shorter. By aeroplane, the camp can be reached in about an hour and a half from Sioux Lookout, on the railway, both summer and winter.

The discovery of gold on the Howey claims was made in July, 1925, by the Howey brothers of Haileybury, who were prospecting for the Howey Red Lake Syndicate. Shortly after the discovery was made the property was optioned by Dome Mines, Ltd., but after some surface trenching and diamond-drilling had been done the option was dropped in 1926. J. E. Hammell then organized Howey Gold Mines, Ltd., and raised money for development purposes. Shaft-sinking started in 1927. Underground developments were so favourable that the building of a 500-ton cyanide mill was decided upon in 1928—the Hydro-Electric Power Commission of Ontario agreeing to develop a water-power at Ear falls, 41 miles away, to supply the mine and plant with electric power. This reached the camp early in 1930, and on April 2 the first unit of the new mill went into operation. Milling results were at first disappointing, but some additions to the mill equipment and the introduction of hand-sorting prior to crushing the ore, now permits a very satisfactory profit to be made. Up to the present, mine development has been confined to work above the 1,000-foot level, but it is now intended to sink farther and establish another main haulage level at a depth of 1,350 feet—a program that will take probably two years to complete. Milling capacity which is now approximately 600 tons a day is to be brought up to 900 tons a day by adding new equipment.

Production on the Howey for the nine months from April 2 to December 31, 1930, was $460,428 recovered from 110,438 tons of ore milled, or an average recovery of $4.17 a ton, while operating charges, including interest on bonds issued, but exclusive of depreciation and write-offs, amounted to $4.23. During the year ending December 31, 1931, 211,552 tons of ore were milled, yielding $866,606 exclusive of exchange premiums, or an average of $4.45 a ton; as against a cost per ton milled of $3·127 exclusive of deprecia-

tion and write-offs, or a total cost of $4·164 if the latter items are included. The average recovery during the year represents 92·5 per cent of the total gold in the ore, the average tailing loss being 35 cents per ton milled. Total ore reserves at the end of 1931, were estimated at 855,655 tons worth $3,636,533.

MINTO MINE

The Minto mine is one of several adjoining properties, including also the Jubilee and the Cooper, owned by Cooper Gold Mines, Ltd., a subsidiary of the Pioneer Mining Corporation. It is situated on Wawa lake in the Michipicoten district and can be reached from Sault Ste. Marie, via Hawk Junction, and the Algoma Central railway.

Some work was done on the Minto group of claims as early as 1899 and 1900, but they had lain idle for many years before being acquired by the present owners in 1926. A new vertical shaft was sunk on the Minto vein to a depth of 340 feet and at the end of 1928 some 59,400 tons of ore of an average value of $9.80 was reported as having been developed on three levels.

Meantime, a shaft had also been started on the Jubilee vein, in November, 1927, and at the end of February, 1929, a 20-ton test mill was set up near the Jubilee shaft to test the ore from the Jubilee vein. Between February, 1929, and March 1, 1930, 2,462 tons of ore were put through the mill, yielding some $8,743 worth of bullion. On March 29, 1930, operations at the Jubilee shaft—now 546 feet deep—were suspended, the pumps withdrawn, and the mine allowed to flood.

In June, 1930, John Knox, Jr., obtained a working option on all mineral rights in the properties owned by Cooper Gold Mines. All the mining and milling plant at the Jubilee mine was moved to the Minto and sufficient new machinery was purchased to convert the old 20-ton test mill into a 75-ton cyanide plant. Early in 1931, the Minto mine, which had been idle since 1928 was reopened, and stoping started to supply the mill. During the year 1931, 9,448 tons of ore were milled yielding bullion to the value of $72,824, or $7.71 a ton.

PARKHILL MINE

The Parkhill mine is a 165-acre property, formerly known as the Longbottom, which adjoins the property of Cooper Gold Mines on the southeast. It was acquired in 1929 by Parkhill Gold Mines, Ltd. (incorporated in April of that year), and a test shipment of 33 tons of high-grade ore was made, which yielded some $62 to the ton in gold. On May 1, 1930, a shaft was started; and was sunk during the year to a depth of 262 feet on an inclination of 40 degrees. Levels were opened at depths of 120 feet and 240 feet on the incline. In 1931, a 60-ton cyanide mill was built, from which the first gold brick was shipped in August. Up to the end of the year 9,082 tons of ore had been milled, yielding gold bullion to the value of $68,811, or at the rate of about $7.58 a ton.

It is now proposed to carry the inclined shaft to a vertical depth of 600 feet and open up new levels.

The ore shoots are narrow—3 to 3½ feet thick—but high-grade. It is estimated that indicated ore reserves amount to 30,000 tons valued at $20 a ton and 25,000 tons valued at $10 or $12 a ton.

MOSS MINE

The Moss, originally known as the Huronian mine, now owned by Moss Gold Mines, Ltd., is a 900-acre property situated in the township of Moss, about 75 miles west of Port Arthur, in the Thunder Bay district. It can be reached from Kashabowie station on the Canadian National railway, from which it is about 25 miles distant. 12 mi. S. of Keagor.

The first recorded discovery of gold in northwestern Ontario was made at the Moss mine, in 1871. Between 1882 and 1885 an attempt was made to work the property by a company known as the Huronian Mining Company. Two shafts were sunk, one 50 feet, the other 143 feet deep; and a 10-stamp amalgamation and concentration mill was built. Between 800 and 900 tons of ore are said to have been put through the mill, but little gold was caught on the plates, most of it going into the concentrates. It was then proposed to build a chlorination plant to treat the latter, but owing to the, at that time, inaccessible situation of the mine and the consequent high operating cost, as well as to the fact that the company had run out of funds, it was decided instead, in 1885, to close down the mine and await more favourable conditions.

The mine remained idle for 40 years, till 1925, when it was acquired by the Shield Development Company, by whom, after some further development work had been done, it was transferred to Moss Mines, Ltd. There is now a three-compartment vertical shaft on the property, sunk to a depth of 500 feet, which it is proposed to continue to a depth of 775 feet. It has been estimated by the management that some 5,650 feet of lateral work done on three levels, at depths of 125, 250, and 375 feet, has exposed 50,000 tons of ore of an average value of about $15 a ton. A cyanide mill having a minimum capacity for the treatment of 100 tons of ore a day has been built and was put in operation early in 1932.

ASHLEY MINE

The Ashley mine, of the Ashley Gold Mining Corporation, Ltd., a subsidiary of the Mining Corporation of Canada, comprises 950 acres of mineral lands situated in Bannockburn and Argyle townships in the Matachewan gold-bearing area. The camp is reached from Elk Lake, the terminus of a branch line of the Temiskaming and Northern Ontario railway, by a combined water and land route about 45 miles in length, in summer, and by snow road in winter.

Gold was first discovered in the Matachewan area in 1916; and between 1922 and 1926 there was considerable activity in prospecting and developing a number of showings. Following 1926, interest in the area waned until in October, 1930, promising new discoveries made on the Ashley claims in Bannockburn township, by prospectors in the

employ of the Mining Corporation of Canada, again attracted widespread attention to the district. Diamond-drilling of the new find was at once undertaken by the Mining Corporation, the principal owners, with such encouraging results that before the spring breakup in 1931 complete equipment for shaft-sinking and underground development had been sent into the property and erected. By the end of 1931, a three-compartment inclined shaft had been sunk to a depth of 500 feet and lateral work on four levels had exposed sufficient ore to warrant the building of a mill. Tests having shown that the ore is readily amenable to ordinary cyanide treatment, all the material necessary for the building of a 150-ton cyanide mill was taken into the property during the winter of 1931-32, and it is expected that construction will be completed and the plant in operation before the end of the year.

QUEBEC

Though the province of Quebec has a long record as a gold producer in a small way—first of placer gold from the valley of the Chaudiere river, later of by-product gold from the working of copper, lead, and zinc ores in various parts of the province—it is only within the last three or four years that its output of that metal has attained important dimensions. Due, however, to recent outstanding developments in the northwestern part of the province, Quebec is now Canada's second largest gold producer; its output of 300,877 fine ounces in 1931 surpassing that of British Columbia for the first time and constituting between 11 and 12 per cent of the total output of the Dominion in that year.

TABLE XXXVIII

Production of Gold from Quebec Ores, 1877-1931

Year	Fine ounces*	Value	Year	Fine ounces*	Value	Year	Fine ounces*	Value
		$			$			$
1877.....	583	12,057	1896...	145	3,000	1915...	1,099	22,720
1878.....	868	17,937	1897...	44	900			
1879.....	1,160	23,972	1898...	295	6,089	1916...	1,034	21,375
1880.....	1,605	33,174	1899...	238	4,916	1917...	1,511	31,235
			1900...	.....	.....	1918...	1,939	40,083
1881.....	2,741	56,661				1919...	1,470	30,388
1882.....	827	17,093	1901...	145	3,000	1920...	955	19,742
1883.....	860	17,787	1902...	391	8,073			
1884.....	422	8,720	1903...	180	3,712	1921...	635	13,127
1885.....	103	2,120	1904...	140	2,900	1922...	.....	.....
			1905...	191	3,940	1923...	667	13,788
1886.....	193	3,981				1924...	883	18,253
1887.....	78	1,604	1906...	165	3,412	1925...	1,602	33,116
1888.....	181	3,740	1907...	.....	.....			
1889.....	58	1,207	1908...	.....	.....	1926...	3,680	76,072
1890.....	65	1,350	1909...	193	3,990	1927...	8,331	172,217
			1910...	124	2,565	1928...	60,006	1,240,434
1891.....	87	1,800				1929...	90,798	1,876,961
1892.....	628	12,987	1911...	613	12,672	1930...	141,747	2,930,170
1893.....	759	15,696	1912...	642	13,270	1931**.	300,877	6,219,679
1894.....	1,412	29,196	1913...	701	14,491			
1895.....	62	1,281	1914...	1,292	26,708			
						Total.	635,425	13,135,361

*Calculated from the value: one dollar=0·048375 ounces. **Preliminary figures, subject to revision.

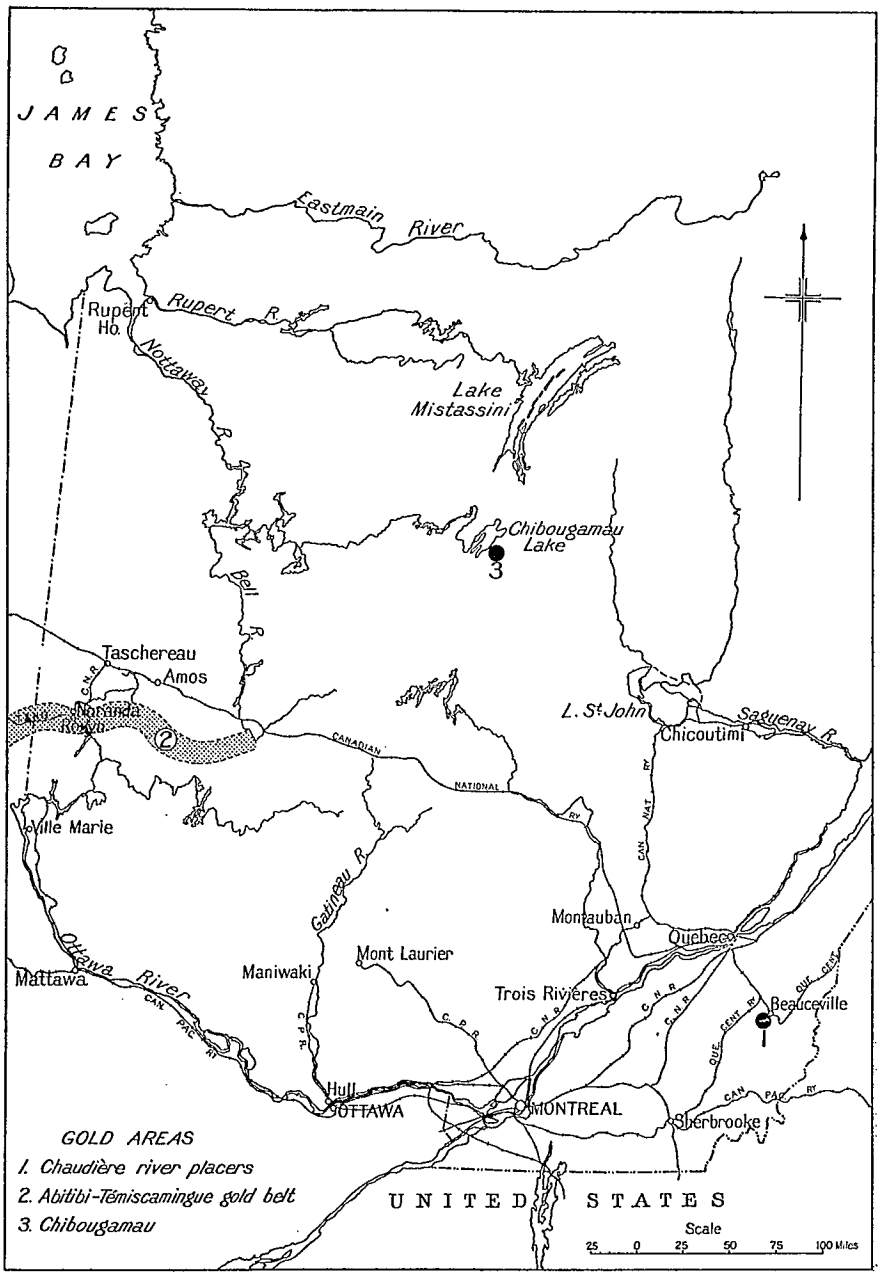

Figure 8. Key map of gold areas in Quebec.

All Quebec's recorded production up to and including 1900 was placer gold; from 1901 to 1914 it was chiefly lode gold; and since 1914 it has all been lode gold.

Quebec's present high rank among Canada's gold-producing provinces is largely due to the gold production of the Horne mine, at Noranda, which, though essentially a copper mine, is at present, due to the depressed condition of the copper market, producing gold to a value considerably in excess of that of its copper production and is now, temporarily, being worked chiefly for gold. In addition to the Horne copper-gold mine, several gold-quartz mines also have recently come into production, or are now being equipped for production in northwestern Quebec. Chief among the actual producers are the Siscoe and Granada mines and it is expected that to these there will be added before the end of 1932 at least two others—the Beattie and the O'Brien mines. Production from the Horne mine at Noranda began in 1927; from the Siscoe mine in 1929; and from the Granada mine in 1930.

THE NORANDA (HORNE) MINE

The property of Noranda Mines, Ltd., in northwestern Quebec, consists of some 1,509 acres of mineral lands, at and adjacent to the town of Noranda in Rouyn township. A branch line 44 miles in length connects it with the main line of the Canadian National railway at Taschereau, Quebec, while a second branch line 60 miles in length connects it with the Temiskaming and Northern Ontario railway at Swastika, in Ontario.

The nucleus around which the present property of Noranda mines has grown up was a group of claims, known as the Horne group, the first of which was staked in August, 1920, on an outcrop of gossan near the shore of Osisko lake, by E. H. Horne, a prospector from Ontario. The average value of the surface outcroppings, however, proved to be low and little attention was paid to the discovery until 1923, when surface trenches and diamond-drilling by the original promoters of the present operating company revealed the presence of solid sulphides rich in copper and gold beneath the lean gossan outcrop. Following this, the development of the property was carried on as rapidly as its, at that time, isolated situation would allow. The results were so favourable that by the end of October, 1926, the Canadian National railway had completed a branch line to the mine, where a smelter was already under construction; and early in December of the same year the Canada Northern Power Corporation had completed a transmission line over which hydro-electric power was brought to the camp from their generating station on the Quinze river, 50 miles away. In the late fall of 1927, the Temiskaming and Northern Ontario Railway's branch line to the mine had also been completed; and in December the first unit of the smelter was put into operation, the first copper being poured on December 17, 1927. In October, 1928, a mill for the concentration of ore too low-grade for direct smelting was completed and put into operation.

At the present time the mine is operated through two main shafts—the No. 3 and the No. 4—about 880 feet apart. From these, levels are

driven at intervals of 100 feet in the upper, and 125 feet in the lower portions of the mine, to develop the numerous known ore-bodies. At the end of 1931, the No. 3 shaft had been sunk to a depth of 2,527 feet; and work was being resumed in the sinking of the No. 4 shaft, then 1,557 feet deep. Smelting capacity is now approximately 2,000 tons of ore and concentrates a day; smelting being done in reverberatory furnaces and the copper cast into anodes for shipment to the refinery. The capacity of the concentrator, originally 250 tons of ore a day, has been increased to about 1,000 tons a day, and it is now proposed to further increase it to about 2,000 tons.

The production record of the smelter since it first went into operation in December, 1927, is as follows:

Output of the Noranda Smelter

Year	Tons of ore and concentrates smelted	Produced		
		Fine copper	Gold	Silver
		Pounds	Fine ounces	Fine ounces
1927	10,740	552,345	767	2,644
1928	271,926	33,065,261	52,949	186,277
1929	428,221	51,223,115	68,732	334,279
1930	734,072	75,509,373	117,393	691,920
1931	765,544	62,859,355	253,363	558,801

In addition to ore from the Horne mine a certain amount of custom ore is smelted also, but gold production comes chiefly from Horne mine ores and concentrates.

Indicated Ore Reserves of the Horne Mine[1]

At end of year	Ore	Average valuable metal content per ton	
		Gold	Copper
	Tons	$	%
1924	611,500	5 57	5·66
1925	944,525	5 54	6·7
1926	1,022,425	5 03	7·5
1927	1,198,375	5 44	6·73
1928	3,097,000	3 68	7·31
1929	3,426,000 direct smelting ore	3 29	7·53
	3,000,000 concentrating ore	3 00	2·00
	238,000 siliceous fluxing ore	2 43	1·00
1930	3,433,000 direct smelting ore	3 01	7·02
	4,448,000 concentrating ore	3 52	1·83
	294,000 siliceous fluxing ore	5 72	0·8
1931	3,580,000 direct smelting ore	3 45	7·10
	6,350,000 concentrating ore	3 62	1·54
	1,030,000 siliceous fluxing ore	4 42	0·32

[1] From Ann. Repts. of Noranda Mines, Ltd.

The sulphide ores of the Horne mine are classified as direct smelting and concentrating ores largely on the basis of their copper content, but the actual routing of any particular lot of ore through the plant is determined by metal market conditions. In 1931, a considerable amount of ore, classified as concentrating ore due to its low copper content, was sent direct to the smelter by reason of its high gold content. The actual shipments from the Horne mine to smelter and concentrator in 1931 were:

—	Tons	Containing		
		Copper	Gold per ton	Silver per ton
		%	$	Ounces
Direct smelting, sulphide, ore	426,008	5·94	6·86	0·91
Concentrating, sulphide, ore	317,892	2·13	3·87	0·35
Siliceous fluxing ore	268,105	1·03	5·26	0·26
Total	1,012,005			

SISCOE MINE

The property of Siscoe Gold Mines, Ltd., includes approximately 1,174 acres in the Harricanaw River section of the Northwestern Quebec gold-bearing belt. The mine shafts and surface plant are situated on an island in DeMontigny lake, an expansion of the Harricanaw river, and can be reached from the town of Amos on the main line of the Canadian National railway, some 42 miles away, by motor boat up the Harricanaw in summer and by a snow road in winter.

Gold was found on the shores of lake DeMontigny as early as 1912, but it was not until 1915 or 1916 that it was also found on the island which is now the scene of operations of Siscoe Gold Mines, Ltd. The first development work was done by the Siscoe Mining Syndicate, which, in 1920, was incorporated as Siscoe Gold Mines, Ltd. For some time the results of exploration of the property were inconclusive; high-grade ore was found, but the ore shoots were apparently small and very irregular. Some four or five shafts were sunk, of which the "C" shaft, a single compartment inclined shaft 600 feet deep measured on its slope of 42 degrees, was the chief working shaft up to 1930. In 1929, a new three-compartment central shaft was started, and this, which had reached a depth of 600 feet in 1931, is now the main working shaft.

In 1928, sufficient ore being indicated in the workings to warrant such action, the erection of a 100-ton mill was begun. This went into operation on January 8, 1929, and with some changes, including an increase in capacity to 180 tons of ore a day, has been in operation ever since. The present method of ore treatment is cyaniding, with the preliminary recovery of most of the gold, approximately 86 per cent in 1931, by amalgamation and on blankets. It is proposed to further increase milling capacity to 400 tons a day.

The production record of the mine is as follows:

Production of the Siscoe Mine,[1] 1929-1931

Calendar year	Ore milled	Average value mill heads per ton	Average value per ton lost in tailings	Cost[2] per ton milled	Total value recovered[3]
	Tons	$	$	$	$
1929	29,836	10 53	0·230	7 62	307,403 76
1930	33,744	11 11	0·230	7 75	367,266 20
1931	55,675	13 63	0·285	6 63	742,811 76
Totals	119,255	.....	.....	.....	1,417,481 72

[1] Compiled from Ann. Repts. of Siscoe Gold Mines, Ltd.
[2] Exclusive of depreciation and taxes.
[3] Exclusive of premium on gold.

On account of the erratic distribution of the gold, accurate estimates of ore reserves are difficult to make, nevertheless, 150,000 tons of proved ore as well as a considerable tonnage of indicated ore, all presumably of milling grade, were reported at the end of 1931.

GRANADA MINE

The property of Granada Gold Mines, Ltd., successor to the Granada-Rouyn Mining Co., includes some 6,000 acres of mineral lands in a single block, in Rouyn township, four miles and a half south of the town of Rouyn.

The claims constituting this property were staked in 1922 by R. C. Gamble, president of the present operating company. In 1924 they were under option to McIntyre-Porcupine Mines, Ltd., but after some exploratory work had been done, the option was dropped. Late in 1926, Granada-Rouyn Mining Company was formed by the owners to develop the property. The sinking of a two-compartment shaft was started on the Edna Bathurst claim (T-371) in 1927. This shaft, off which levels have been driven at intervals of 125 feet, had reached a depth of 925 feet early in 1932. It is proposed to continue sinking till a depth of 2,000 feet is reached.

In June, 1930, a small mill capable of treating about 70 tons of ore a day, was put in operation and has run continuously since. In October, 1931, it was reported that the mill, since the commencement of operations, had produced bullion to the value of $350,000 from 30,000 tons of ore, or at the rate of about $12 a ton. Practically all the ore treated so far has come from the 600- and 500-foot levels. The method of treatment is by amalgamation and concentration.

More recently, it is reported that milling capacity has been increased to 150 tons of ore a day and that about 100 tons a day are now being treated.

In July, 1931, a reorganization of the Granada-Rouyn Mining Company was effected, and its name changed to Granada Gold Mines, Ltd.

Estimates of ore reserves are not published.

O'BRIEN MINE

The O'Brien mine consists of a group of claims in the western part of Cadillac township, about 30 miles southwesterly from Amos on the main transcontinental line of the Canadian National railway. It can be reached from Amos by road in winter, and by a water route, via the Harricanaw river, in summer.

These claims were staked in 1924, on behalf of O'Brien and Fowler, Ltd., who completed the purchase of the mineral rights in 1928. In 1925 a shaft was sunk to a depth of 110 feet, and between 1925 and 1929 some 5,000 feet of drifting, cross-cutting and raising, as well as some stoping, was done on the 100-foot level. In October, 1929, lateral work from this shaft was stopped but stoping was continued into 1930. A new three-compartment vertical shaft situated some 300 feet east of the old shaft was started in 1930. This new shaft has been equipped with a substantial headframe and heavy hoisting machinery and was completed to a depth of 328 feet early in 1931. Levels have been driven from it and considerable lateral work done at depths of 208 and 308 feet (the 2nd and 3rd levels). Also, a stope has been started on the 3rd level.

The first gold was produced from this property in 1925; when a bar of gold bullion weighing 7½ ounces was recovered from specimens. In 1926, 465 pounds of high-grade ore shipped from the property yielded 58·32 fine ounces of gold. Since then a number of shipments of selected high-grade material have been made, the total value of which is reported to run into the hundreds of thousands of dollars. A very considerable tonnage of lower grade ore is stored on the property awaiting the building of a mill. The concrete foundation for a small mill had been poured early in 1932 and it is not unlikely that the superstructure will be finished and milling started before the end of the year.

BEATTIE MINE

What is known as the Beattie property consists of a block of six claims near the north end of lake Duparquet in Duparquet township, about 20 miles due south of the town of La Sarre on the main transcontinental line of the Canadian National railway. In summer, the property can be reached by a water route from La Sarre, via the La Sarre river, Abitibi lake and Abitibi river; in winter by snow road. The Quebec Government is reported to be now building a motor road which will connect it with the railway all the year round.

The Beattie claims are said to have been first staked previous to the Great War. Later, during the Rouyn rush, attention was again attracted to them, and in 1927, 1928, and 1929 considerable exploratory work in the way of trenching and diamond-drilling was done by the Consolidated Mining and Smelting Company of Canada. Results were unsatisfactory, however, and the Consolidated Company withdrew its men. In October, 1930, John Beattie, while prospecting about a quarter of a mile from the scene of previous operations made a new discovery which led to Ventures Ltd., becoming interested in the property. Diamond-drilling of the new find, financed by Ventures Ltd., was started in December, 1930, and continued throughout 1931. Thirty-five holes had been put down at the end of the latter year and these are reported to indicate the presence of an ore-body containing over 3,000,000 tons of ore averaging $3.50 a ton in gold, or, if lower grade material is included, over 5,000,000 tons averaging $3.07 a ton.

Towards the end of 1931 Beattie Gold Mines, Ltd.—a company of which 50 per cent of the stock is held by Ventures Ltd.; 40 per cent by Nipissing Mines Co., Ltd., and 10 per cent by the vendors—was incorporated to equip and work the property. It is estimated by the promoters that 90 per cent of the gold in the ore can be recovered at a cost of $2.25 a ton or less. During the summer of 1932, a mill probably capable of handling between 1,000 and 1,500 tons of ore a day is to be built. This it is expected will be only the first unit of a much larger mill probably one capable of treating 5,000 tons of ore a day, for which it will serve as a pilot plant.

The Beattie mine will be the first in Canada equipped with the design of treating at a profit—through large-scale production—gold ore as low grade as $3.07 a ton. The results attained will, therefore, be looked forward to with considerable interest.

NOVA SCOTIA

The province of Nova Scotia has the longest continuous record of lode-gold production of any province in the Dominion, more or less gold having been produced from the working of gold-quartz mines in each and every year for the last seventy years. The output has, however, never been large as compared with that of some of the other gold-producing provinces, and latterly has fallen to almost insignificant proportions. The most productive period was from 1885 to 1903, when the average annual output was well over 20,000 fine ounces. Immediately following 1903 there was a rapid decline in production, which reached its lowest ebb in 1921, when only 439 ounces was produced. During the last decade attempts have been made to revive Nova Scotia's gold mining industry, which, if never large, was formerly one of considerable importance to the province; but such attempts have met with little success, and in 1931 production had again fallen to 460 ounces. The total recorded production to date is only 924,668 ounces, or less than half that of Ontario in 1931 alone.

TABLE XXXIX

Production of Gold from Nova Scotia Ores, 1862-1931[1]

Year	Fine ounces*	Value	Year	Fine ounces*	Value	Year	Fine ounces*	Value
		$			$			$
1862.....	6,863	141,871	1886....	22,038	455,564	1911....	7,781	160,854
1863.....	13,180	272,448	1887....	20,009	413,631	1912....	4,385	90,638
1864.....	18,883	390,349	1888....	21,137	436,939	1913....	2,174	44,935
1865.....	24,011	496,357	1889....	24,673	510,029	1914....	2,904	60,031
			1890....	22,978	474,990	1915....	6,636	137,180
1866.....	23,776	491,491	1891....	21,841	451,503	1916....	4,562	94,305
1867.....	25,763	532,563	1892....	18,865	389,965	1917....	2,210	45,685
1868.....	19,377	400,555	1893....	18,436	381,095	1918....	1,176	24,310
1869.....	16,855	348,427	1894....	18,834	389,338	1919....	850	17,571
1870.....	18,740	387,392	1895....	21,919	453,119	1920....	690	14,263
1871.....	18,139	374,972	1896....	23,876	493,568	1921....	439	9,075
1872.....	12,352	255,349	1897....	27,195	562,165	1922....	1,042	21,540
1873.....	11,180	231,122	1898....	26,054	538,590	1923....	655	13,540
1874.....	8,623	178,244	1899....	29,876	617,604	1924....	1,047	21,643
1875.....	10,576	218,629	1900....	28,955	598,553	1925....	1,626	33,612
1876.....	11,300	233,585	1901....	26,459	546,963	1926....	1,678	34,687
1877.....	15,925	329,205	1902....	30,348	627,357	1927....	3,151	65,137
1878.....	11,864	245,253	1903....	25,533	527,806	1928....	1,290	26,667
1879.....	12,980	268,328	1904....	10,362	214,209	1929....	2,687	55,545
1880.....	12,472	257,823	1905....	13,707	283,353	1930....	1,272	26,295
						1931[2]...	460	9,509
1881.....	10,147	209,755	1906....	12,223	252,676			
1882.....	13,307	275,090	1907....	13,675	282,686			
1883.....	14,571	301,207	1908....	11,842	244,799	Total..	924,668	19,114,666
1884.....	15,168	313,554	1909....	10,193	210,711			
1885.....	20,945	432,971	1910....	7,928	163,891			

[1]From Dom. Bureau of Statistics Reports. [2]Figures subject to revision.
*Calculated from the value: one dollar=0·048375 ounces.

The above record does not take into account any gold won prior to 1862, though actual mining began in 1860; neither does it make any allowance for the stealing of gold by miners, a practice that is said to have been extremely prevalent at one time; nor for clandestine production, an incentive to which is found in the fact that all the gold won was subject to royalty and that in the earlier days the collection of the royalty was not carried out with any very great efficiency. The value of the gold unaccounted for, for these reasons, has been variously estimated by different writers at anything from $1,000,000 to $5,000,000.

When gold was first found in Nova Scotia is not definitely known. Its presence appears to have been at least suspected before the beginning of the nineteenth century, but it was not till rich discoveries in California had caused world-wide excitement that diligent search was made for it in Nova Scotia. As early as 1849 one, John Campbell, succeeded in panning gold from beach sand at several places along the sea-shore; and in the spring of 1860, John Pulsiver made a discovery of lode gold in what is now

known as the Mooseland gold district, which marked the beginning of actual gold-mining in Nova Scotia. Within a year or two numerous other discoveries had been made at points scattered over the southerly half of the province from Ovens on the west to Isaac Harbour on the east. Up to the present time gold has been found in a hundred or more localities, over areas varying in size from less than a square mile to three square miles in extent, dotted over a stretch of country about 275 miles long and from 10 to 75 miles wide.

With the exception of two or three thousands of ounces of placer gold won in the early days, chiefly at Ovens, west of Halifax on the southern coast, all Nova Scotia's output has been of lode gold. There are hundreds of shallow shafts scattered over the different gold-bearing districts from which more or less gold has been won at some time or another during the last seventy years. Few of the workings, however, have reached a vertical depth of more than 300 or 400 feet and in only two cases 1,000 feet. For the most part the ores were free-milling and amenable to amalgamation; but a certain amount of gold was also recovered by cyanidation and chlorination; and some auriferous antimony ore and gold-bearing arsenical concentrates have been shipped from the province.

Probably the most extensive workings on any one mine are those on the Richardson mine, in Guysborough county, where between 1893 and 1910 a lode varying in thickness from 5 to 25 feet was worked to a vertical depth of about 700 feet. During this time some 53,835 ounces of gold valued at $1,002,965 were recovered from 395,831 tons of ore—an average yield of $2.53 a ton.

The deepest workings in the province were those on the Libbey vein, at Brookfield, in Queens county. Here, between 1894 and 1905, an inclined shaft was sunk 1,997 feet, the bottom being 1,062 feet vertically below the surface. During its life this mine produced 36,590 ounces of gold valued at $725,210 from 93,611 tons of ore treated; the average yield being $7.73 a ton.

Also, at Caribou, in Halifax county, workings on the Lake fissure vein were carried to a vertical depth of about 1,000 feet; and 11,854 ounces of gold valued at $225,226 recovered from 47,119 tons of ore; or at the average rate of $4.78 a ton.

A comprehensive, detailed account of the Nova Scotia goldfields is contained in Memoir 156 of the Geological Survey of Canada, viz., "Gold Fields of Nova Scotia" by W. Malcolm (1929).