
GOLD MINES EAST OF THE ROCKY MOUNTAINS.

LETTER

FROM THE

SECRETARY OF THE TREASURY,

ENCLOSING

Report of James W. Taylor, special commissioner for the collection of statistics upon gold and silver mining east of the Rocky mountains.

FEBRUARY 15, 1867.—Referred to the Committee on Mines and Mining and ordered to be printed.

TREASURY DEPARTMENT,
Washington, February 13, 1867.

SIR: I have the honor to transmit a preliminary report upon gold and silver mines and mining in the States and Territories east of the Rocky mountains, by Mr. James W. Taylor, who has been appointed a special commissioner for the collection of statistical information on that subject by this department.

Congress having made provision by the civil appropriation act of July 28, 1866, for the collection, by the Secretary of the Treasury, of "reliable statistical information concerning the gold and silver mines of the western States and Territories," I referred the inquiry in relation to districts west of the Rocky mountains to Mr. J. Ross Browne, whose report was transmitted to the House of Representatives on the 8th of January. There remained for consideration extensive districts of New Mexico, Colorado, Montana, Dakota, and Minnesota, which may be properly designated as "western" States and Territories; and the mineral statistics of those regions, especially in regard to the production of gold and silver, were referred to Mr. Taylor.

The report herewith forwarded also contains some information upon the situation and prospects of gold mining along the eastern slope of the Alleghany range, with some general statements of the production of the precious metals in Canada, Nova Scotia, and other parts of British America—a compilation made by the direction of this department with a view to exhibit all the gold-bearing districts within the territory of the United States or closely related to our northern frontier. The kindred topics of the present and future production of gold and silver in other quarters of the world, and the effect of our own treasure supply upon the internal commerce and communications of the west, are briefly noticed in the report herewith enclosed.

I repeat the hope expressed on a former occasion, that the reports above referred to may prove valuable contributions to the public information in reference to the great mineral resources of the United States.

I am, very truly, your obedient servant,

H. McCULLOCH,
Secretary of the Treasury.

Hon. SCHUYLER COLFAX,
Speaker of the House of Representatives.

SAINT PAUL, *February 8, 1867.*

SIR: In pursuance of your letter of instructions of September 12, 1866, I present some general information in regard to the production of gold and silver in the Territories of New Mexico, Colorado, and Montana, in a district of Minnesota northwest of Lake Superior, of which the lake and river Vermillion indicate the locality, and upon the eastern slope of the Alleghany range in the States of Georgia, South Carolina, North Carolina, Virginia, and Maryland, with some notice of recent discoveries of gold in New Hampshire, Nova Scotia, and Canada.

In a second instalment of this communication a general review of the production of gold and silver in other quarters of the world is submitted, with the purpose of indicating relatively the commercial and social importance of the treasure product of the United States.

A third division presents a summary of the domestic commerce from the Missouri river westward to the interior or mining districts of the United States, having reference prominently to the situation and prospects of railway communication with the Rocky mountains and the Pacific coast.

The brief period and the limited means of information which have been available since the date of your commission will confine the present communication to the form of a preliminary report, postponing a fuller consideration of the topics enumerated to a subsequent occasion.

THE ROCKY MOUNTAINS.

This designation no longer includes the whole breadth of the Andean chain in the United States. It refers only to the formation known in Mexico as the Sierra Madre, or Mother mountain, from which the Sierra Nevada of California, or the western wall of the mountain mass, diverges in northern Mexico, while the intervening plateau of table lands is now recognized as a distinct and characteristic division of the continent. The Rocky mountains, or the cordillera of the Sierra Madre, traverses the territory of the United States in a north-north-west direction, from the 29th to the 49th parallel of latitude. The average elevation of its crest is 12,000 feet above the sea, lifting, for a breadth of 300 miles, above the altitude of its eastern and western piedmonts, which, in the latitude of Denver and Great Salt Lake, is fully 6,000 feet. Those valleys, slopes, and gorges, which supply the sources of the Missouri, Yellowstone, Platte, Arkansas, and Rio Grande rivers, are the prominent features of the Territories of Montana, Colorado, and New Mexico, and will be the first topics of consideration in relation to gold and silver mining east of the Rocky mountains.

NEW MEXICO.

If we compare a map of this Territory with any similar publication of the last century, even as early as a chart in Moll's atlas of 1720, the vicinity of Santa Fé is represented as even more populous than at present. The Spaniards thoroughly explored the valley of the Rio Grande, and their mining settlements were very numerous in the mountains of New Mexico. There is a tradition that the Indians, whose labor had made the mines of gold, silver, and copper available to their Spanish conquerors, were at length driven into insurrection, which was so far successful as completely to interrupt all systematic mining. This was about 1680, and at no subsequent period have the conditions of society and industry been favorable to the resumption of mining enterprises. At this time Indian hostilities prevent permanent labor, and almost exploration, in the remote districts of New Mexico.

Twenty years ago, when Colonel Doniphan led a column of American troops to Santa Fé and Chihuahua, Dr. A. Wizlizenus, who accompanied the expedition as surgeon and for the sake of scientific investigation, reported that gold

was found to a large extent in all the mountains near Santa Fé, south to a distance of about one hundred miles, or as far as Gran Quivira, and north for about one hundred and twenty miles, to the river Sangre de Cristo. Throughout this whole region gold-dust was then abundantly found by the poorer classes of Mexicans, who occupied themselves with the washing of this metal in the mountain streams, while at the Placer mountain, about thirty miles from Santa Fé, gold-bearing quartz was worked. These statements in regard to gold are confirmed by the second annual message of acting Governor Arny, delivered in December, 1866, to the legislature of New Mexico, who also reports the discovery of thirty lodes of gold-bearing quartz at Pinos Altos, paying from \$40 to \$200 per ton; of quartz veins at San José, in the Sierra Madre, intersecting each other in all directions for a mile in width and three miles in length; of a similar formation near Fort Davis, Texas; and of extensive placer mines on the San Francisco and Mimbres rivers.

Governor Arny gives prominence to these gold discoveries, but adds that silver is the prominent and most abundant mineral of the Territory. Lodes of silver, with its many combinations, are very numerous. He thinks it will be the most profitable branch of mining in that Rocky mountain region, and enumerates as prominently argentiferous the districts of the Placer mountains near Santa Fé, the Organ mountains near the Mesilla valley, and the Sierra Madre near Pinos. The first and last of these localities are, as we have seen, gold-producing also. In the Organ mountains over fifty silver mines have been discovered, the ore being generally argentiferous galena. The district near Mesilla valley in the Organ mountains has a mean altitude of 4,400 feet, and is intersected with ravines, affording favorable opportunities for horizontal drifts in opening the veins. There is a belt or series of veins containing six principal veins and many smaller ones, the six larger veins varying from two to fifteen feet in width. On the largest of these veins is the celebrated "Stephenson" mine. This belt of veins crosses the Organ mountains at or near the San Augustine pass, and both sides of the chain of mountains present similar features and equal richness. The country bordering on the north portion of Chihuahua is a rich silver district. Immediately adjoining the new Mexican boundary are the mines of "Coralitos," the most successful silver mines in the State of Chihuahua, having been mined for forty years in a region most exposed to Indian hostility. Near the old town of El Paso, tradition places the locality of one of the richest silver mines known to the Spaniards, but its site was lost during the insurrection of 1680.

Dr. Wizlizenus, writing in 1847, thus proceeds with his enumeration of the mineral resources of New Mexico: "In Spanish times, several rich silver mines were worked at Avo, at Cerillos, and in the Nambe mountains, but none at present. Copper is found in abundance throughout the country, but principally at Los Tijeras, Jemas, Abiquin, Guadelupita de Mora, &c.; iron, though also abundantly found, is entirely overlooked. Coal has been discovered in different localities, as in the Raton mountains, near the village of Jemez, southwest of Santa Fé, and near, but south of, Placer mountain. Gypsum, both common and selenite, is found in large quantities, extensive layers of it existing in the mountains near Algodones, on the Rio Grande, and in the neighborhood of the celebrated Salinas. It is used as common lime for whitewashing, and the crystalline, or selenite, instead of window-glass. About one hundred miles south-southeast of Santa Fé, on the high table-land between the Rio Grande and Pecos, are some extensive salt lakes, or salinas, from which all the salt (muriate of soda) used in New Mexico is procured."

Governor Arny, in his late message, observes of the production of copper, that, before the late civil war, two copper mines were extensively worked—the Santa Rita and the Hanover—turning out about twelve tons of copper per week, and employing jointly about five hundred hands. Other copper mines had been

opened, and were about to commence operations. A copper mine has lately been discovered a short distance from Fort Union, the specimens indicating a rich deposit. The locality of this discovery will render it very valuable, as it is convenient for the return wagons from Santa Fé and Fort Union to the Missouri river.

The indispensable conditions to the development of the mines of New Mexico are, first, Indian pacification; second, railway communication with New Orleans, Vicksburg, Memphis, and St. Louis; third, a geological reconnoissance.

Some additional statements, on the authority of Doctor Wizlizenus, in regard to the mineral production of the adjoining State of Chihuahua, are valuable as indicating what may be reasonably anticipated in New Mexico. Referring to the rich silver mines of Chihuahua, he remarks that they are found principally in the western part of the State throughout the length of the Sierra Madre, and in a mean breadth of thirty leagues. The ores occur generally as sulphurets, with iron or lead, sometimes as native silver and muriate of silver, and are found either entirely in porphyritic rocks, or in stratified rocks, (limestone,) passing at greater depth into igneous rocks. They are worked either by amalgamation or by fire in common furnaces. For the latter process they need generally an addition of greta, (litharge or oxyd of lead,) which forms, therefore, a valuable article of trade.

The celebrated mine of Santa Eulalia, near the city of Chihuahua, produced in seventy-two years, from 1717 to 1789, \$52,800,000. The abundance of lead found in Santa Eulalia makes the smelting of the ore very convenient. These mines are not exhausted; but from intrusion of water, want of capital, and the attraction of new mines, they are but little worked. Doctor Wizlizenus describes five other districts where silver ores have been found far superior in richness and extent to the mines of Central Mexico, but in which little has been accomplished on account of the invasions of hostile Indians; and he mentions gold and copper mines as holding a similar relation to the lodes of silver, as prevails in New Mexico. The annual production of silver and gold in 1846 was estimated at about \$1,031,251.

COLORADO.

The summits and valleys of Colorado are the sources of the rivers Platte and Arkansas, which are affluents of the Mississippi, and of the Rio Grande, directly tributary to the Gulf of Mexico, and of the Colorado, which falls into the Pacific gulf of that name. No similar area of the Rocky mountains is more imposing in scenery or physical relations than Colorado. Its mineral development is fully commensurate.

The traveller by the route of the Union Pacific railway, in approaching the Rocky mountains, will first traverse a formation of coal and iron. For over one hundred and fifty miles, from the Arkansas to the Cache le Poudre, bituminous coal, or a superior quality of lignite, has been discovered, at many points accompanied by iron ore. Next in situation westward—quite within the mountains, but much below their snow-covered summits—is a mineral range from five to fifteen miles wide, and extending from Long's Peak two hundred miles southwardly in Colorado, within which most of the discoveries of gold, especially of auriferous quartz, have occurred. Crossing the snowy range, on the western slope, extensive silver mines have been discovered. Governor Evans, of Colorado, in November, 1866, remarked at a public meeting in Chicago: "I have just returned from visiting a district about one hundred miles by ten or fifteen in extent, lying across the main mountain range west of Denver City, which is pervaded throughout by extensive and rich veins of silver; some are of pure silver ores, but the majority of them are argentiferous galena ores, varying in richness, many of them yielding in the smelting furnace as high as six hundred

dollars of silver to the ton of ore." Salinas, or extensive deposits of salt, are accessible, as in New Mexico; and even petroleum is found near the eastern base of the mountains. The forests supply timber even for exportation to Kansas, and the mountain streams are generally available for the uses of machinery and irrigation.

The area of Colorado is 67,723,520 acres, and the most sanguine view of its future agriculture is comprised in a statement by Surveyor General Pierce, in 1866, that "there are about 4,000,000 acres of agricultural land susceptible of irrigation, which will make productive farms." 250,000 acres were entered under the homestead and pre-emption acts in 1866, and 141,000 acres in 1865. A much larger area is suitable for the sustenance of domestic animals. "The whole of the plains," according to the testimony of Governor Evans, "and the parks in the mountains of Colorado, are the finest of pastoral lands. Stock fattens and thrives on them the year round, large herds and flocks being kept there in the finest possible condition. In some parts, it is true, the snow covers the grass for a part of the winter, but in other places cattle and sheep are wintered without feeding, with entire success. The celebrated parks, North, Middle, South and San Luis, are fine agricultural valleys for grass and small grains."

Gulch or placer mining, although the first form of gold discovery in 1859, has been prosecuted in Colorado with less success than in California—a remark applicable to all the districts east of the Rocky mountains, with perhaps the single exception of the Confederate gulch near Helena, in Montana Territory. This may be owing to the less degree of disintegration to which the veins, or gold geologically *in situ*, have been exposed. It has been observed that on the eastern flank of the great Rocky mountain mass volcanic and other igneous action has been less violent, the country is less abrupt, and the action of the elements has been less marked than on the Pacific slope, and therefore placers are not so frequent or productive. Whatever may be the force of this explanation, the discoveries and developments of auriferous quartz lodes in the Gregory district have mostly contributed thus far to the settlement of Colorado. This district extends from Gold Hill to Empire City, about thirty miles along the base of the snowy range, and is, on the average, about ten miles in width an area of three hundred square miles of gold-producing mountains, in which many quartz mills are in operation. It is now generally admitted that the range of gold-bearing quartz is not limited to the Gregory district, but is as extensive as the snowy range itself.

The successful reduction of auriferous rock is a problem of the future. The immense production of Siberia, California, and Australia is mostly washed from the sands of rivers or the adjacent detritus, nature, in each case, having overcome the mechanical and chemical difficulties presented by the matrix of gold. In the reduction of Colorado ores the chemical are the chief difficulties. The auriferous quartz of the Sierra Nevada, when pulverized, yields the gold readily to the attraction of quicksilver—the gold is "free;" but, with hardly an exception, a Colorado mine exhibits a most refractory combination of gold with the sulphurets of iron and copper. Nor are these the only mineral associations which often baffle all former appliances for the separation of baser metals. Quartz mining in Colorado has hitherto been unsuccessful from the failure of numerous processes and methods of desulphurization and amalgamation which had proved efficient in Europe and even in California; but during 1866 several American inventions, or new combinations of existing methods, have been introduced, and are now in course of trial. I shall not venture to describe their practical operation or decide upon their success. Hereafter, as a result of personal examination and a full comparison of opinion, it may be practicable to do so; but at present there is no subject which would more appropriately command the attention of a scientific commission.

The mechanical obstructions to working a gold mine in Colorado are very

great. In working a vein or lode, the iron or copper pyrites are usually separated from surface quartz by what is called cap, or a shutting up of the vein by the wall rock. This is the great difficulty in opening a mine—it recurs in descending, but the intrusion is less and less. The Montgomery district in southern Colorado will afford an illustration. First, the blossom rock, desulphurized by the action of the atmosphere, was readily crushed and yielded its gold to amalgamation; but soon the surface ore was exhausted; it became necessary to traverse the cap rock, often 150 feet deep, which was a tedious and expensive process, but at length the indurated pyritous ore was reached, very productive of gold, but requiring to be removed and reduced at a great cost of time, labor, capital, and skill. Still, as some compensation, the testimony is quite general that the mine widens and grows more productive of gold at its lower stages.

The auriferous veins of Colorado are represented to be from six inches to nine feet in width. Governor Evans claims that in most of the lodes now worked the quartz rock yields an average of thirty-six dollars per ton, but that a production threefold greater may be expected when the reduction of ores reaches the perfection of a scientific assay. Lodes in California with present facilities of labor, transportation, and supplies, are found to pay the owner, if \$10 per ton gross can be obtained from the rock. In Nevada, over the mountains, only 300 miles from the coast, and with very considerable advantages of transportation by turnpikes, a lode must yield \$25 gross per ton to reward the owner for working it; and this statement may be made in regard to quartz mining in Colorado, while in New Mexico and Montana, even with security from Indian hostilities, a lode must yield \$40 per ton to pay. If the advantages in prices, freights, &c., which exist in California, were supplied to the interior by railroads, all the mining territories would profitably develop their quartz mines at \$10 per ton gross product.

MONTANA.

Of the streams which unite to form the Missouri river, the Jefferson, or most western tributary, has been the principal scene of gold discovery. In the summer of 1862 a party of Minnesota emigrants crossed the northern plains destined to the Salmon river mines. On reaching the Rocky mountains they found parties of prospectors upon the Prickly Pear and Beaver Head branches of the Jefferson, and in the Deer Lodge valley, upon remote tributaries of the Columbia. In September these explorations were successful on Grasshopper creek, a tributary of the Beaver Head, and the placer mines of Bannock City soon attracted a considerable mining population. In May, 1863, a discovery of bar or placer mines was made about fifteen miles west of Bannock, on Horse Prairie creek, another branch of the Beaver Head. It was of limited extent, but quite productive. In June, 1863, there were further discoveries of placer mines about seventy miles east of Bannock, on Alder creek, a tributary of the Jefferson. These have proved of much larger extent and richness, extending continuously more than fifteen miles. Virginia City is in their vicinity. These two districts are respectively about fifty miles eastward from the summits of the Rocky mountains, being within the semicircular park which the Rocky mountains enclose between latitudes 44° to 46° and longitude 112° to 114° . A still more remarkable development of gulch or placer mining occurred in 1865 at Helena, a district about one hundred and thirty miles east of north from Virginia City, but still two hundred miles southwest of Fort Benton, ascending the course of the Missouri and the Jefferson. Some of the statements in regard to Confederate gulch, near Helena, are difficult of belief. It is said that during three months of the summer of 1866 three miners took 2,100 pounds of gold, or \$441,000, from a space three rods square, on Montana bar, in Confederate gulch. A total production of \$15,000,000 to \$20,000,000 for 1866 is also claimed.

There are many inducements to exaggeration in these statements. For some years after the California discovery the demand for coinage induced large deposits at the government mints, but for the last half of the period since 1848 a great proportion of the gold and silver product in the United States has been cast into bars or ingots by private assayers. This proportion may now be stated at fully one-half. Since, therefore, the United States mints and assay office report \$5,505,687 30 from Montana for the fiscal year ending June 30, 1866, it will be safe to double that amount as the probable production in that year. A communication to the Treasury Department from an intelligent citizen of Montana only claimed \$6,000,000 as the production of 1865. The following statement is more likely to be correct than the bulk of newspaper reports :

1863.....	\$2, 000, 000
1864.....	5, 000, 000
1865.....	6, 000, 000
1866.....	12, 000, 000
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	25, 000, 000
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Considerable progress has been made in quartz mining. Over two hundred lodes have been opened sufficiently to prove their value. The average yield of the vein-rock is stated at forty dollars per ton. There are seventeen quartz mills in the Territory, of which ten are in operation. Thirty are in process of erection. In the vicinity of the mining centres enumerated—Bannock, Virginia, and Helena—2,500 lodes represented to be gold-bearing have been prospected and titles recorded.

About the first of June, 1864, ores of argentiferous galena, of which some indications had been previously observed, were discovered to be valuable. The first silver mines were opened on Rattlesnake creek, a branch of Beaver Head river, about fifteen miles north of Bannock. Then followed, during the summer of 1864, discoveries of similar veins in the Prickly Pear region, within three or four miles of Bannock, in a district about twenty-four miles northwardly of Virginia City, near gulches known as the Mill and Wisconsin, and upon the mountains enclosing Deer Lodge valley. These silver veins, although bearing more or less gold, are not necessarily connected with the gold districts hitherto explored; and a geological exploration would probably show that the silver deposits of Montana are more extensive, with a probability of becoming more productive, than the gold mines. The assays of argentiferous galena have exhibited results from \$100 to \$1,700 per ton. Three furnaces for smelting silver are in operation—one at Bannock, one at Argenta, on a tributary of the Beaver Head, and the third in the valley of the Boulder, a tributary of the Jefferson.

Upon the foregoing basis of exploration and discovery in Montana, the population may be estimated as follows :

Jefferson and Edgerton counties, including Prickly Pear and Helena districts.....	12, 000
Madison county, Virginia City.....	7, 000
Beaver Head county, Bannock City.....	2, 000
Deer Lodge valley, (western slope).....	3, 000
Bitter Root valley, (western slope).....	1, 000
Fort Benton and vicinity.....	1, 000
Other parts of the Territory.....	2, 000
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	28, 000
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It is now well ascertained that the coal, iron, and petroleum formations observed in Colorado are extended northward under the same conditions and in

equal proportion along the eastern flank of the Rocky mountains and far into British territory. As the general level of the plains at Fort Benton and vicinity is also ascertained to be about four thousand feet above the sea, or two thousand feet less than the altitude of Denver, there is no appreciable difference of climate between those localities, and the remarks in regard to agriculture and stock-raising in Colorado will equally apply to Montana.

In the autumn of 1866 a large number of copper lodes was discovered on the head-waters of the Muscleshell river, which yield from thirty to seventy per cent. of the pure copper, in crevices ranging from four to six feet in width. The metal is found in combination with the oxide and green carbonate of copper. These copper mines are convenient to the wagon road, from Helena to the mouth of the Muscleshell, which is substantially the head of steamboat navigation on the Missouri river.

Near the old Mormon settlement at Fort Lemhi, upon the head-waters of Salmon river, in Idaho, important gold discoveries in 1866 have attracted population—a settlement forty miles distant from Bannock city, and having business relations almost exclusively with Montana.

UTAH.

The dominant ecclesiastical organization of Utah is adverse to mining for gold and silver, although iron and copper mines have been worked successfully in the Wahsatch mountains. The general testimony is that silver will be discovered in many localities. Sixty miles south of Great Salt Lake city veins of argenterous galena in Rush River district have proved valuable, and mining operations, including the construction of furnaces, are well advanced. These ores assay 260 ounces of silver. Coal for the supply of Great Salt Lake city is mined at a distance of forty miles. An extensive silver district, in the southwestern angle of Utah, was lately transferred to the State of Nevada.

DAKOTA.

In addition to the Missouri and Yellowstone mines of Montana, under the average longitude of 110°, the explorations of Lieutenant G. K. Warren, in 1847, and of Captain W. F. Reynolds, in 1859 and 1860, under directions of the United States topographical office, have satisfactorily established that the Black hills of Dakota Territory, situated on the forty-fourth parallel of latitude and between the 103d and 105th meridians of longitude, are rich in gold and silver, as well as coal, iron, copper, and pine forests.

The area occupied by the Black hills, as delineated on a map which accompanies Lieutenant Warren's report, is 6,000 square miles, or about the surface of Connecticut. Their bases are elevated from 2,500 to 3,500 feet, and the highest peaks are about 6,700 feet above the ocean level. The whole geological range of rocks, from the granite and metamorphosed azoic to the cretaceous formations of the surrounding plains, are developed by the upheaval of the mountain mass. Thus, at the junction of silurian rocks, gold becomes accessible, while the carboniferous strata bring coal measures within reach.

With the pacification of the Sioux Indians, and the establishment of emigrant roads, this district of Dakota would doubtless be the scene of great mining excitement, as the gold-field of the Black hills is accessible at a distance of 120 miles from the Missouri river.

SASKATCHEWAN.

As early as 1862 some American explorers washed from the bed of the North Saskatchewan river, at a distance of two hundred miles from its extreme sources in the Rocky mountains, minute particles of gold, but with no return exceeding *one cent to the pan* or five dollars per day. In subsequent years the emigrants from

Selkirk settlement, and a few American adventurers, obtained more satisfactory results, there being frequent instances of ten dollars as a daily average, from bars or gulches nearer the mountains. As the Montana explorations have advanced towards the international frontier, each encampment proving more productive than its predecessors, the opinion has prevailed that the sources of the Saskatchewan would develop rich deposits of gold and silver, especially near the great centre of physical disturbance, where Mount Hooker reaches an elevation of 16,000 feet, and Mount Brown 15,700 feet above the sea, and from which the waters of the Saskatchewan, Peace, Frazer, and Columbia rivers diverge to three oceans. So prevalent is this belief in Montana that a sudden migration of thousands may at any moment be anticipated. Probably the intelligence received in Oregon during November, 1866, that American prospectors at the Kootonais mines had passed the mountains on or beyond the boundary of 49° and found rich washings, returning even \$60 daily to the hand, on the sources of the South Saskatchewan, will, if fully confirmed, be the signal of a movement over the border into the Saskatchewan basin as remarkable as that which filled the valley of Frazer river with miners from California and Oregon in 1859.

VERMILLION DISTRICT.

In 1865, attention was directed to discoveries of gold and silver northwest of Lake Superior, in the State of Minnesota. Lake Vermillion, an expansion of a stream of that name, is the centre of the district in question. The outline of this lake is very irregular. With a diameter of thirty miles, its surface is so studded with islands, its shore so broken with bays and headlands, that the entire coast line cannot be less than two hundred miles in extent. In 1848, Dr. J. G. Norwood, of Owens's geological survey, passed from the mouth of the St. Louis river, at the western extremity of Lake Superior, to the sources of the Vermillion river, and descending through the lake to the Rainy river, furnished a sketch of its natural features and mineral exposures. His statements are repeated, so far as they record the usual indications of a gold formation.

Before entering Vermillion lake from the south, Dr. Norwood mentions a perpendicular fall of eight feet over "silicious slate, hard and gray, with minute grains of iron pyrites sparsely disseminated through it." This rock bears east and west, with thin seams of quartz between the laminae running in the line of bearing. There are also irregular patches of quartz from eight to ten feet long, and from six to twelve inches wide, which cross the strike at right angles. The river is broken by falls three-quarters of a mile above, or south of, Lake Vermillion.

The islands in the lake indicate very distinctly volcanic action, one of them being an extinct crater. The prevalent rocks are talcose slate, which Dr. Norwood describes as "eminently magnesian, thinly laminated and traversed by numerous veins of quartz from an inch to five feet wide, some of which contain beautiful crystals of iron pyrites." He adds, that "from some indications noticed, other more valuable minerals will probably be found associated with it." A specimen obtained about midway of the lake is catalogued as "quartz of reddish brown color; cristalline, with yellow iron pyrites, crystallized as well as foliated, disseminated through it."

These quartz veins were ascertained in 1865-'66 to be auriferous. A specimen weighing three pounds, containing copper pyrites, was forwarded by the governor of Minnesota to the mint in Philadelphia, and upon assay, was found to contain \$23 63 of gold and \$4 42 of silver per ton of 2,000 pounds. The State geologist, Mr. H. H. Eames, reports an abundant supply of quartz equal in richness. Other assays in New York—in one instance, by officers of the United States assay office—show results from \$10 to \$35 per ton. There are rumors of larger proportions, but the above are fully authenticated. Professor J. V. Z.

Blancy, of Chicago, describes a vein ten feet in width, at the foot of a shaft of fifty feet, which is "indubitably gold-bearing;" and adds, "that specimens taken from its central portion, as proven by assay, would be sufficient in California, Colorado, and other successful mining regions, to warrant further exploration." Washings of the drift near the veins opened have produced gold, but in limited quantities.

The productiveness of the Vermillion mines is not yet determined, but will be tested by several mining organizations during the current year.

CANADIAN MINES.

When in 1862 gold was discovered upon the sources of the Saskatchewan, a newspaper at Selkirk settlement, the *Norwester*, published statements of the existence of gold between Lake Superior and Lake Winnipeg. Since the Vermillion discovery, rumors of its extension into British America are prevalent, and suggest a probability that the mountain chain known to geographers as the Laurentian, which separates the waters of the St. Lawrence and its lakes from the tributaries of Hudson bay, may reveal to future explorers extensive deposits of gold and silver. The basin of the St. Lawrence, including the sandstones of Lake Superior, is a lower silurian formation; that of Hudson bay, granitic or primary, with many evidences in Minnesota, and along the Canadian shore of Lake Superior, of eruptive or igneous agencies.

Sir Roderick Murchison has frequently advanced the opinion that the productive gold districts of the world occur where the silurian, and perhaps the lower strata of devonian rocks are in contact with, or have been penetrated by, greenstones, porphyries, serpentine, granitic and other rocks of the primary formation. Gold, especially when traced to its original matrix, is found to occur chiefly in veins or lodes of quartz rising from beneath and cutting through the secondary strata or beds of which the surface was previously composed. These conditions are observed in the Vermillion district, and Professor Owen, as early as 1850, traced in this locality of Minnesota, and northeastwardly along the north shore of Lake Superior, in Canada, what he denominated a "great plutonic chain," and "the main axis of dislocation," from which silurian sandstones extend southwardly through Wisconsin and Minnesota, while on the north the streams which are turned towards Hudson bay traverse a region exclusively granitic, or primary. If in Minnesota an auriferous belt has marked this line of junction, we may with reason anticipate its extension eastwardly into Canada, and northwestwardly towards Lake Winnipeg. Indeed, as English explorers trace this contact of primary and silurian formations along the basins of Lakes Slave and Athabasca, and the channel of the Mackenzie to the Arctic ocean, it becomes an interesting problem for future solution, whether the auriferous deposits of British Columbia and Saskatchewan may not be extended with various degrees of productiveness along the crest which separates the waters of the Gulfs of Mexico and St. Lawrence from those of the Arctic ocean and Hudson bay, quite as the discoveries of this century now follow the Ural mines eastward through Siberia to the Pacific.

The intrusion of granitic rocks is not confined in Minnesota to the northeastern angle of the State. It has been traced southwestwardly, near Sauk Rapids, upon the Upper Minnesota, and even to the northwestern boundary of Iowa, in a wedge-like shape, although covered in most places by the mass of drift which constitutes so large a portion of the surface of Minnesota. A similar granitic cape, with its associated minerals, may be the explanation of the alleged gold deposits in the township of Madoc, near Kingston, in Canada West.

In regard to the Madoc mines, the only facts fully established at the date of this report are, that Chicago parties have become purchasers of fifteen acres the principal locality of the alleged discovery, for the sum of \$35 000; that a

an excavation of six feet, made originally in search of copper, gold in considerable quantities has been found in coarse sand, in decayed quartz, and also in a cream-colored quartz that abounded in a crevice and its surroundings; and that an assistant of Sir William Logan, the government geologist, has written a letter to *L'Ordre*, of Montreal, in which he says that the mine—"the Richardson"—"is as remarkable for its richness as for the manner of its existence," and that "he sees in the Richardson the best as well as the most encouraging of all indications for the search of gold in Upper Canada." A correspondent of the New York Tribune, apparently disinterested, and writing from the vicinity January 22, 1867, asserts that "some thousands of dollars of native gold have already been secured from this mine and other adjacent localities, and sold in Belleville, Canada West, to jewellers, who pronounced it a very good quality, fully equal to that of Australia." This section of Canada is also known to abound in copper, iron, lead, slate, and marble.

The Chaudiere mines, near Quebec, are probably a development of the Alleghanian range. They have hitherto been confined to placer or alluvial mining on the tributaries of the Chaudiere. Quartz mining has not been prosecuted to any great extent, although an official publication by the Canadian government reports assays at \$21, \$37, and even \$95 per ton.

NOVA SCOTIA.

The gold fields of Nova Scotia consist of some ten or twelve districts of quite limited area in themselves, but lying scattered along the southeastern coast of the province. The whole of this coast, from Cape Sable on the west to Cape Canso on the east, a distance of about two hundred and fifty miles, is bordered by a fringe of hard, slaty rocks, slate and sandstone in irregular alternations, sometimes argillaceous and occasionally granitic. These rocks are always, when stratified, found standing in a high angle, sometimes almost vertical, and with a course in the main very nearly due east and west. They seldom rise to any great elevation, the promontory of Aspatagon, about five hundred feet high, being the highest land on the Atlantic coast of the province. The general aspect of the shore is low, rocky and desolate, strewn often with large boulders of granite or quartzite. This zone of metamorphic rocks varies in width from six or eight miles at its eastern extremity to forty or fifty at its widest points, presenting in its northern boundary only a rude parallelism with its southern margin, and composing about six thousand square miles of surface, the general outline of what may, geologically speaking, be called the gold region of Nova Scotia.

A contributor to the Atlantic Monthly magazine for May, 1864, enumerates Tangier Harbor, Wine Harbor, Sherbrooke, Ovens, Oldham, Waverly, Stormont, and Lake Loon—a small lake only five miles distant from Halifax—as localities which have fully determined the auriferous character of the district already described, and selects for specific description, and as a specimen of other veins, the Montague lode at Lake Loon. The course of this is E. 10° N., that being the *strike* of the rocks by the compass in that particular district. It has been traced by surface-digging a long distance—not less, probably, than half a mile. At one point on this line there is a shift or fault in the rocks, which has heaved the most productive portion of the vein about thirty-five feet to the north; but for the rest of the distance, so far as yet open, the whole lode remains true and undisturbed.

"Its dip with the rocks around it is almost vertical, say from 85° to 80° south. The vein is contained between walls of slate on both sides, and is a double or composite vein, being formed, first, of the main leader; second, of a smaller vein on the other side, with a thin slate partition-wall between the two; and third, of a strongly mineralized slate foot-wall, which is in itself really a most valuable portion of the ore-channel.

"The quartz which composes these interposed sheets, thus separated, yet combined, is crystallized throughout, and highly mineralized; belonging, in fact, to the first class of quartz lodes recognized in all the general descriptions of the veins of this region. The associated minerals are, here, *cuprite* or yellow copper, green *malachite* or carbonate of copper, *mispickel* or arsenical pyrites, *zinc blende*, *sesquioxide of iron*, rich in gold, and also frequent 'sights' or visible masses of gold itself. The gold is also often visible to the naked eye in all the associated minerals, and particularly in the *mispickel* and *blende*.

"The main quartz vein of this interesting lode varies from three to ten inches in thickness at different points on the surface-level, but is reported as increasing to twenty inches thick at the bottom of the shaft, already carried down to a depth of forty feet. This very considerable variation in thickness will be found to be owing to the folds or plications of the vein, to which we shall hereafter make more particular allusion.

"The minerals associated with the quartz in this vein, especially the *cuprite* and *mispickel*, are found most abundantly upon the foot-wall side, or underside, of the quartz itself. The smaller accompanying vein before alluded to appears to be but a repetition of the larger one in all its essential characteristics, and is believed by the scientific examiners to be fully as well charged with gold. That this is likely to come up to a very remarkable standard of productiveness, perhaps more so than any known vein in the world, is to be inferred from the official statement in the Royal Gazette of Wednesday, January 20, 1864, published by authority at the chief gold commissioner's office in Halifax, in which the average yield of the Montague vein for the month of October, 1863, is given as 3 oz. 3 dwt. 4 gr.; for November, as 3 oz. 10 dwt. 13 gr.; and for December, as 5 oz. 9 dwt. 8 gr., to the ton of quartz crushed during these months, respectively. Nor is the quartz of this vein the only trustworthy source of yield. The underlying slate is filled with bunches of *mispickel*, not distributed in a sheet or in any particular order, so far as yet observed, but developed throughout the slate, and varying in size from that of small nuts to many pounds in weight—masses of over fifty pounds having been frequently taken out. This peculiar mineral has always proved highly auriferous in this locality, and a careful search will rarely fail to detect 'sights' of the precious metal imbedded in its folds, or lying hidden between its crystalline plates.

"Nor is the surrounding mass of slate in which this vein is enclosed without abundant evidences of a highly auriferous character. Scales of gold are everywhere to be seen between its laminae, and, when removed and subjected to the proceeds of 'dressing,' there can be little doubt of its also yielding a very handsome return. In fact, the entire mass of material, which is known to be auriferous, is not less than twelve to fifteen inches at the surface, and will doubtless be found, as all experience and analogy in the district have hitherto shown to be the case, to increase very considerably with the increased depth to which the shafts will soon be carried. No difficulties whatever are apprehended here in going to a very considerable depth, as the slate is not hard and easily permits the miner, in his progress, to bear in upon it without drilling upon the closer and more tenacious quartz.

"The open cut made by the original owners of the Montague property, and by which the veins have been in some degree exposed, absurd and culpable as it is as a mode of mining, has yet served a good purpose in showing in a very distinct manner the structure of these veins—a structure which is found to be on the whole very general in the province. The quartz is not found, as might naturally be supposed from its position among sedimentary rocks, lying in anything like a plain, even sheet of equal thickness. On the contrary, it is seen to be marked by *folds* or plications, occurring at tolerably regular intervals, and crossing the vein at an angle of 40° or 45° to the west. Similar folds may be produced in a sheet which is hung on a line, and then drawn at one of the

lower corners. The cross-section of the vein is thus made to resemble somewhat the appearance of a chain of long links, the rolls or swells alternating with the plain spaces through its whole extent. Perhaps a better comparison is that of ripples or gentle waves as seen following each other on the ebb-tide in a still time on the beach.

"The distribution of the gold in the mass of the quartz appears to be highly influenced by the peculiar wavy or folded structure. All the miners are agreed in the statement that the gold abounds most at the swells or highest points of the waves of rock, and that the scarcely less valuable mispickel appears to follow the same law. The spaces between are not found to be so rich as these points of undulation; and this structure must explain the signal contrast in thickness and productiveness which is everywhere seen in sinking a shaft in this district. As the cutting passes through one of these swells the thickness of the vein at once increases, and again diminishes with equal certainty as the work proceeds; below this point destined again to go through with similar alternations in its mass."

The gold of Nova Scotia is remarkable for its great purity, it being on the average twenty-two carats fine, as shown by repeated assay. The bars or ingots are current in Halifax at \$20 an ounce. Assays by Professor Silliman, of Yale College, have ascertained values of \$19.97 and \$20 25, and the gold commissioner of Nova Scotia assumes \$19.50 as the basis of his calculations of the gold product of the province.

The official returns of the deputy gold commissioners for the several districts to the chief commissioner at Halifax are unusually exact and reliable in regard to the most important point of the whole subject, namely, the average yield per ton of quartz crushed at the mills. By regulations of the mining department, every miner, or the agent or chief superintendent of each mine, is required, under penalty of forfeiting possession of the mine, to make a quarterly return of the amount of days' labor expended, the number of tons raised and crushed, and the quantity of gold. These returns are not likely to be exaggerated, as a government royalty of three per cent. on the gross product is exacted. Besides the miner's report, all owners of quartz mills are also required to render official returns under oath, and in a form minutely prescribed by the provincial law, of all quartz crushed by them during each month, stating particularly from what mine it was raised, for whose account it has been crushed, and what was the exact quantity in ounces, pennyweights, and grains. Upon this basis it appears that the average for all the mining districts is \$30 per ton; while the maximum yield at some of the prominent mines has been \$1,000 per ton at Wine Harbor, \$240 at Sherbrook, \$220 at Oldham, and \$100 at Stormont, during the months of October, November and December, 1863. These results are independent of the great waste which attends the reduction of pyritous ores. The cost of reduction at this time does not exceed \$7 per ton, owing to the moderate scale of prices for labor, supplies, and fuel in Nova Scotia.

The writer in the *Atlantic Monthly*, already referred to, accounts for the absence of alluvial gold by the peninsular formation of Nova Scotia. The action of the glacial period would only transport the detritus of auriferous rocks beneath the Atlantic ocean. Therefore, the gold of Nova Scotia is to be successfully sought under the application of the most scientific and systematic methods of deep quartz-mining. His summary of these methods is so suggestive that it will be cited:

"The ill-considered system of allotting small individual claims at first adopted by the colonial government was founded, probably, on a want of exact knowledge of the peculiar nature of the gold district, and the consequent expectation that the experiences of California and Australia in panning and washing were to be repeated here. This totally inapplicable system in a manner compelled the early single adventurers to abandon their claims as soon as the surface-water began to accumulate in their little open pits or shallow levels, beyond the con-

trol of a single bucket or other such primitive contrivance for bailing. Even the more active and industrious digger soon found his own difficulties to accumulate just in proportion to his own superior measure of activity, since, as soon as he carried his own excavation a foot or two deeper than his neighbors, he found that it only gave him the privilege of draining for the whole of the less enterprising diggers, whose pits had not been sunk to the same level as his own. Thus the adventurers who should ordinarily have been the most successful were soon drowned out by the accumulated waters from the adjacent and sometimes abandoned claims. Nearly all of these early efforts at individual mining are now discontinued, and the claims thus shown to be worthless in single hands have been consolidated in the large companies, who alone possess the means to work them with unity and success.

"The present methods of working the lodes, as now practiced in Nova Scotia, proceed on a very different plan. Shafts are sunk, at intervals of about three hundred feet, on the course of the lodes which it is proposed to work, as these are distinctly traced on the surface of the ground. When these shafts have been carried down to the depth of sixty feet, or, in miner's language, ten fathoms, horizontal *drifts* or *levels* are pushed out from them, below the ground, and in either direction, still keeping on the course of the lode. While these subterranean levels are being thus extended, the shafts are again to be continued downwards, until the depth of twenty fathoms, or one hundred and twenty feet, has been attained. A second and lower set of levels are then pushed out beneath, and parallel to, the first named. At the depth of thirty fathoms a third and still lower set of levels will extend beneath and parallel to the second. The work of sinking vertical shafts, and excavating horizontal levels to connect them, belongs to what is denominated the 'construction of the mine,' and it is only after this has been completed that the work of mining proper can be said to begin.

"The removal of the ore, as conducted from the levels by which access to it has thus been gained, may be carried on either by 'direct' or by 'inverted grades'—that is, either by breaking it up from underneath, or down from overhead, in each of the levels which have now been described, or, as it is more commonly called in mining language, by 'understopping' or by 'overstopping.' When the breadth of the lode is equal to that of the level, it is perhaps not very material which plan be adopted. But when, as at Oldham, Montague, or Tangier, the lodes are only of moderate width, and much barren rock, however soft and yielding, has of necessity to be removed along with the ore, so as to give a free passage for the miner through the whole extent of the drifts, we shall easily understand that the working by inverted grades, or 'overstopping,' is the only proper or feasible method. In this case, the blasts being all made from the roof, or 'back' as it is called, of the drift, the barren or 'dead' rock, containing no gold, is left on the floor of the drift, and there is then only the labor and expense of bringing the valuable quartz itself, a much less amount in bulk, to the surface of the ground. The accumulating mass of the dead rock underfoot will then be constantly raising the floor of the drift, and as constantly bringing the miners within convenient working distance of the receding roof. In the case of 'understopping,' however, in which the blasts are made from the floor of the drift, it will be perceived that all the rock which is moved, of whatever kind, must equally be brought to the surface, which entails much greater labor and expense in the hoisting; and gravity, moreover, instead of co operating with, counteracts, it will be understood, the effective force of the powder."

There is quite a concurrence of testimony that the quartz seams increase in richness as they descend, although the excavations have not, as yet, been carried to depths exceeding one hundred feet.

The mining statistics of Nova Scotia exhibit very accurately the average yield per man, which, in 1863, was 95 cents a day; in 1864, \$1 39; and in

1865, \$2 13. At the rate per diem last mentioned, each man employed produced \$684 80 per annum. The Australian estimates of the production per man of the mining population do not exceed an annual average, since 1851, of \$500.

The value of gold produced in Nova Scotia during the year ending September 30, 1865, was \$509,080, (paying \$18,038 in rents and royalties;) in 1864, \$400,440; in 1863, \$280,020; and in 1862, \$145,500. The earliest discovery of gold occurred in 1860. The productiveness of the mines was not diminished during 1866.

ALLEGHANY GOLD-FIELD.

It can only be determined by a geological exploration, which shall embrace Lower Canada, Maine, New Brunswick, Nova Scotia, and Newfoundland, whether the gold formation of Nova Scotia is associated with the Laurentian range, or is an extension of the auriferous belt which, first observed upon the Coosa river in Alabama, extends in a general northeast direction along the eastern flank of the Alleghanies to the Potomac river, with some partial developments in Maryland, Pennsylvania, Vermont, and New Hampshire, and upon the Chaudiere river, of Lower Canada. In the latter case, the mining experience of Nova Scotia may yield valuable suggestions in regard to the auriferous lodes which are known to be very numerous in the talcose and chloritic schists of the southern Alleghanies. Since the California discovery of 1848, little attention has been given to alluvial mining in Virginia, the Carolinas, and Georgia; and until recently capitalists have acquiesced in the opinion, so confidently expressed by Sir Roderick Murchison in "Siluria" and other publications, that, notwithstanding numerous filaments and traces of gold near their surface, the Alleghany vein-stones held no body of ore downwards which would warrant deep quartz mining. At present, with twenty years' experience in gold mining; with the testimony of miners in Colorado that a lode apparently closed by cap-rock can be recovered, with increased richness, at a lower depth; with other analogies, however imperfect, from the successful treatment of pyritous ores in Nova Scotia; and with the earnest application of inventive minds to new and improved processes of desulphurization, it is evident that the working of the southern mines will be resumed, perhaps with the encouragement of a scientific survey under the auspices of the general government.

The deposits of gold at the United States mint and its branches between 1804 and 1866 from the States traversed by the Appalachian gold-field are reported as follows:

Virginia	\$1, 570, 182 82
North Carolina	9, 278, 627 67
South Carolina	1, 353, 663 98
Georgia	6, 971, 681 50
Alabama	201, 734 83
	<hr/>
	19, 375, 890 80
	<hr/>

If we admit that an equal quantity passed into manufactures or foreign commerce without deposit for coinage, the aggregate production would be about \$40,000,000, of which fully three-fourths, or \$30,000,000, was mined between 1828 and 1848.

It is not the purpose of this report to enumerate the enterprises now organizing for the development of the Alleghany mines, but to recall some evidence, mostly compiled before the California discovery, in regard to their situation and mineralogical characteristics.

VIRGINIA.

The gold veins of Virginia extend through Fairfax, Prince William, Fauquier, Culpeper, Orange, Spottsylvania, Louisa, Fluvanna, Goochland, Buckingham, and a few adjoining counties.

In 1837 Professor Benjamin Silliman published (Journal of Science, first series, vol. 32, p. 98) the results of a personal examination of mines in the vicinity of Fredericksburg, of which a brief summary will be given. He describes the gold-bearing quartz as embedded in talcose and mica slate, principally the latter. In far the greater number of cases the eye detects nothing but quartz, or sometimes metallic sulphurets of iron, zinc, or lead, and the observer, unless previously instructed, would never suspect the presence of gold, either distinct or in the metallic sulphurets. In the vicinity of the quartz veins rich washings occur. In Spottsylvania county, on a branch near the Whitehall mine, \$10,000 was taken in a few days from a space twenty feet square, and \$7,000 was found near Tinder's mine, in Louisa county, in the course of one week. It often happened that successful alluvial mining preceded the discovery of vein mines. Of the latter several are described:

1. *Busty's mine*, situated fifty miles from Richmond and fifty-three miles from Fredericksburg, in solid quartz veins, fifteen to eighteen inches thick, at depth of twenty-two feet; structure of vein coarsely granular, like loaf-sugar, free from foreign matter except inherent gold, and so white that even when pulverized it showed no tint of color; yield on one trial \$80 per ton; on another trial \$240 per ton.

2. *Moss mine*, near the above; situated in decomposed slate-rock; surface of vein little else than red clay, but firmer, and stratified below; inclination of rock and included quartz vein about 45°; direction by compass north by east, and south by west; diameter of vein sixteen, eighteen, twenty-four, twenty-seven, and thirty inches, averaging twenty-four inches; quartz laminar, easily broken and separated from slate by blasting, but showing no signs of gold, though examined by a magnifier; three tests returned \$100, \$140, and \$200 per ton, yet in neither case was gold visible in quartz or ore.

3. *Walton mine*, situated in Louisa county, forty miles southwest of Fredericksburg; quartz vein firm and compact; one foot wide; occasionally porous and interspersed with iron pyrites and a dark iron ore, probably proceeding from their decomposition; penetrated by two shafts of seventy and forty feet; first trial of poor ore, \$80; second trial of average ore, \$160; third trial of ore taken at random, \$400; fourth trial of specimen, showing gold to the naked eye, \$2,660 per ton; average of the series of assays, \$820 per ton.

4. *Culpeper mine*, situated eighteen miles west of Fredericksburg, upon the Rapidan; a tract of 524 acres; hydraulic power for a twenty-stamp mill; four adits with connecting shafts; main vein ten feet wide, but prone to divide into strings not larger than a finger, nearly parallel and separated only by portions of the slaty rock; gold more abundant in these strings than in larger veins; much iron accompanying the ore; pulverized quartz always red or brown; iron pyrites in some places fresh and brilliant, elsewhere decomposed; strata nearly perpendicular; specimens from fourteen localities, mixed together, returned \$30 per ton; specimen from a vein considered rich, but showing no sign of gold, gave \$80 per ton.

In the following paragraph, Professor Silliman only anticipates the experience of miners at this day:

"Gold is often found in pyritical ores in which the gold is embedded in fine particles. This mass when reduced to fine powder gives a residuum of oxidized iron about equal in weight to the fine gold, the latter being malleable or flattened, while the former, being brittle, remains rounded or angular. In washing this mixture in the pan the gold generally remains on the upper side of the

mass, and is therefore more liable to be washed off by the slightest ripple of the water. On the other hand, when the gold is embedded in quartz ores, especially those with fine fractures, called in Virginia 'sugar ore,' or more properly granular quartz, the gold being of a similar form, is more quickly disengaged, and appears in larger grains.

"On the contrary, the ferruginous grains, or iron sand, are so fine as to be scarcely visible, and are invariably found at the bottom of the mass or residuum, and therefore, as well as on account of their greater weight, are much less liable to be carried off by the ripple of the waters."

Several successful instances of alluvial mining near the Rapidan are also mentioned; on a Hempstead farm, \$4,000 in 1831-'32, of which nearly \$3,000 in sixty days; another instance two or three miles from Rapidan, \$12,000; a third, \$40,000; all in the vicinity of the Culpepper mine.

The most remarkable of the foregoing statements relate to the assays of ores from the Walton mine. Professor Rogers, of the University of Virginia, inspected this mine in 1836, and ascertained that in the lower adit leading from the main shaft, the auriferous vein was twelve inches in width, and that the talcose rock underlying the vein was also auriferous to a distance of six inches, and sometimes more, from the quartz. He also observed the continued yield from the quartz, and the uniform dissemination of the gold throughout the vein, and the lower enclosing rock. An assay of Professor Rogers returned \$280 per ton.

A writer in Harper's Monthly Magazine for December, 1865, describes the gold mines in the vicinity of Richmond; having previously given some general information of the conditions under which gold has been discovered and mined. "Sienite, gneiss, greenstone, and porphyry," he says, "appear to be the primary sources, and the pyrites are evidently the immediate matrix of gold. All iron pyrites contain gold, and often silver, only excepting those of the coal formation; and the extensive gold deposits of Virginia may be said to be literally one continuous belt or accumulation of veins of iron pyrites.

"Most of the gold-bearing rock which has hitherto been enmined in Virginia is principally a kind of talcose slate, somewhat resembling soapstone, but not so greasy to the touch. This slate is red and ferruginous at the surface, but at a greater depth is filled with small crystals of iron pyrites which are decomposed near the surface and appear as peroxyd of iron, giving the slate a brown or yellow tinge. This slate is a metamorphic rock, and runs in a regular belt parallel with the Alleghany mountain chain.

"The gold found in the State of Virginia occurs in exceedingly small grains, often so fine as to be not only invisible to the naked eye, but undiscernible even by the assistance of a strong lens. This is the case even when the ores are worth three or four dollars per bushel. Some veins of the slate region contain coarse gold in grains as large as the head of a pin, and even larger. These are generally found in veins of quartz in which the pyrites are concentrated into larger masses. Where the pyrites are disseminated in fine crystals through the mass of the rock, the gold is found to be very fine. In the first pyrites the gold is often invisible, even if after separation it appears to be coarse. By natural or artificial decomposition the gold becomes visible, the pyrites are converted into oxyd of iron, and, by aid of a lens, the gold can be detected embedded in the oxyd of iron. Another form in which the native gold is not unfrequently found in Virginia is in quartz, in which it is embedded. Solid white quartz, both in veins and in crystals, is found, in which the gold appears in spangles, plates, grains, and also in perfectly developed crystals. Throughout the gold regions of Virginia copper pyrites are found in all the metallic deposits. It invariably accompanies the gold-bearing iron pyrites, and is always considered a good indication of richness. Cases have often occurred in which the largest amount of treasure has been abandoned, because the miners had not the knowledge of proper appliances for separating the precious yield of gold and copper."

The writer of the article here quoted proceeds to give many interesting details of the gold mines of Goochland, Buckingham, and Fluvanna counties. Among these are the Belzoro mine, developing seven veins, which vary in width from two feet six inches to thirty feet; Marks mine, with four gold-bearing quartz veins; Waller mine, vein of brown oxyd of iron, six feet thick; Tellurium mine, sold in 1848 to Commodore Stockton, who is reported to have extracted \$250,000 in nine years; Snead gold mine, of three veins, one of them being four feet wide, and composed of white quartz, which contains argentiferous galena, copper sulphates, and gold; Ford mine, revealing copper pyrites largely; and Lightfoot mine, with four well-known and very rich veins; all of which have been worked successfully at different periods since 1828.

The mineral wealth of Virginia in other respects is unsurpassed by Pennsylvania or any part of the Union.

NORTH CAROLINA.

The gold district of North Carolina extends from northeast to southwest in the general direction of its leading counties, namely: Guilford, Randolph, Davidson, Rowan, Stanly, Cabarrus, Mecklenburg, and Union.

In 1825 Professor Denison Olmstead designated as the district within which alluvial mining was prosecuted, the counties of Montgomery and Anson, and the eastern portions of Mecklenburg and Cabarrus as then organized. Gold was first discovered in a "thin stratum of gravel enclosed in a dense clay, usually of a pale blue, but sometimes of a yellow color." This description is easily recognizable as the detritus of the gold-bearing rock afterwards discovered further to the west. Many facts of the early success of placer mining on the tributaries of the Pedee might be adduced, but it must suffice, in this connection, to repeat from Wheeler's History of North Carolina an enumeration of the nuggets which have been obtained since the first discovery in 1799:

Years.	Pounds.	Years.	Pounds.
1799.....	4	1826.....	16
1803.....	28	1826.....	9½
1804.....	9	1826.....	8
1804.....	7	1835.....	13¾
1804.....	3	1835.....	4½
1804.....	2	1835.....	5
1804.....	1½	1835.....	8

No more intelligible account of the placers of North Carolina exist than the communication of Professor Olmstead in 1825, from which a few paragraphs will be given. After describing the gold-bearing alluvium as "gravel enclosed in pale blue or yellow clay," he adds: "On ground that is elevated and exposed to be washed by rains this stratum frequently appears at the surface, and in low grounds, where the alluvial earth has been accumulated by the same agent, it is found at the depth of eight feet; but where no cause operates to alter its original depth it lies about three feet below the surface. A miner sometimes meets a stratum of the ferruginous oxide of manganese in a rotten, friable state. In some instances the clay is deep red."

Very soon, however, these gold deposits were traced to the auriferous lodes traversing a belt of talcose, micaceous, chloritic, and hornblende slates, which passes through several counties on the east side of another belt of granite and west of one of trap. These veins, as early as 1828, were described as follows by Charles E. Rothe, a miner and mineralogist from Saxony: "They occur in greenstone formation often from two to four feet in thickness and a mile or more in length, which give assurance that they sink to a considerable

depth. Their general direction is east and west, dipping occasionally 40° to 50° north. The ores and minerals in these veins are rhomboidal iron ore, prismatic iron ore, pyramidal copper pyrites, and prismatic iron pyrites. In the last two is a mechanical mixture with each other. They show distinct signs of having been changed from their original form. Where the atmosphere could have any influence on the pyrites we find that one part of the sulphur has escaped, the consequence of which is, the metallic appearance of the pyrites is changed to that of brown-reddish oxide of iron, and owing to this color we can see the fine particles of gold, and ascertain the richness of the deposit. But where the pyrites have not undergone this change, then the gold cannot be discovered, owing to the color being nearly the same. The greenstone near the vein is most generally decomposed, and mixed with a great number of loose crystals of prismatic iron pyrites. Between the greenstone and the vein, or at the place of junction, the gold is most generally found."

The gold district of North Carolina is the second belt of the table-land, its positions moderately elevated, and it is very seldom that the highest hills of Davidson, Randolph, Rowan, Cabarrus, and Mecklenburg counties are traversed by vein fissures.

In 1856 a report by Ebenezer Emmons, upon the geology of the midland counties of North Carolina, was published, which gives a detailed description of thirty mining localities. Abstracts of his observations upon the leading mines of Guilford, Randolph, Davidson, Rowan, Stanly, Cabarrus, Mecklenburg, and Union counties will best illustrate the characteristics of the auriferous belt through the State. The order in which these counties are named coincides with their geographical position, commencing on the north :

1. *McCulloch mine*, in Guilford county, brown or desulphurized ore, to a depth of one hundred and thirty feet; vein two feet wide at surface, increasing to twenty-four feet, with a dip at angle of forty-five degrees; brown ore, soft and easily crushed, yielding \$30 to \$40 per ton, and sometimes \$100; at level of one hundred and thirty feet, there are six inches brown ore on foot-wall, then copper pyrites, then a belt of brown ore containing nodules or concretions of pyrites more or less changed the middle of which is rich in gold, and then the principal mass of porous quartz against hanging wall, which, though sometimes showing films of gold, is usually poor; wall rock, sienitic granite.

2. *Fisher Hill*, in Randolph county; veinstone quartz, with white sulphuret of iron mixed irregularly through it; free from copper pyrites; burnt to advantage; two to four feet wide near surface; brittle, and when burnt easily pulverized; average sixty dollars per ton, and gold worth ninety cents to pennyweight.

3. *Conrad Hill*, in Davidson county, six miles east of Lexington Court-House; situated eighty-eight feet above plain to the south; five gold-bearing veins from eighteen inches to two feet at surface; third vein fifteen inches at surface, widening to eighteen feet at depth of one hundred feet, and finally developing sulphurets of iron and copper rich in gold; only four feet rich in gold; wall-rock talcose slate, but adjacent country traversed by trap.

4. *Gold Hill*, on southern border of Rowan county; product to 1856, \$2,000,000; three strong and well-defined veins, one mile east of granitic belt; angle of dip 80° ; strata undisturbed by eruptive rocks; veins associated with sulphurets of iron and copper; Earhardt vein worked 400 feet, expanding from six inches to seven feet, a succession of lenticular segments overlapping at their edges; chief difficulties, fineness of gold and heavy sulphurets; if sand saved and exposed for a year the sulphurets are decomposed and metal liberated; in 1854 \$136,636 76 obtained in thirteen months from Gold Hill, expenses \$60,331 06, profit \$76,305.

5. *Parker mine*, in Stanly county; most productive parts of rock are natural joints or quartz seams; pieces in proximity to natural joints sometimes weighing a pound; "not a vein, but a decomposed mass with gold distributed in seams;"

has produced \$200,000; some masses at rate of eighty to one hundred dollars per ton.

6. *Reed mine*, in Cabarrus county; productive alluvial mining, as already stated; a vein at depth of ninety feet yields twenty-two dollars per ton. A *Phoenix mine*, in Cabarrus, was rich to 140 feet, twenty to sixty dollars per ton; but at that level white quartz and sulphate of barytes replaced the brown ore, reducing yield to five dollars per ton. The *Pioneer mine*, also in Cabarrus, is a fissure in granite sixteen to seventeen feet wide, but true veinstone eight to ten inches; gold in pure quartz mixed with sulphurets; yield sixty-three dollars per ton.

7. *Howie and Lawson mine*, in Union county, near the line of South Carolina; fine, white, and granular quartz which near contact with slate-wall rock is mottled with brown oxide of iron; on this surface gold visible; width of vein six to thirty inches; average sixty dollars per ton; some specimens two hundred and twenty dollars; traced three-quarters of a mile; sold in 1856 to Commodore Stockton.

8. *Rudisill's mine*, near Charlotte, Mecklenburg county; three veins, three or four feet wide; gangue slaty, with stripes of quartz and copper pyrites, yielding twenty dollars per ton; quartz brittle and readily crushed; "arrangement of ore in the lode is usually in rich bunches, connected by strings." *Dunn mine*, seven miles from Charlotte, remarkable for limonite produced from iron pyrites, but unproductive of gold. The gold in the vicinity of Charlotte is worth one dollar the pennyweight.

Copper mining has also received attention in North Carolina—the most persistent and prosperous enterprise of the kind being in Guilford county. The "Washington silver mine," in Davidson county, produces a great variety of metals in association with silver, which are difficult to treat metallurgically; but the attempt will doubtless be resumed with the aid of improved methods of amalgamation.

The mineral wealth of North Carolina is by no means confined to the eastern slope of the Blue Ridge. West of that range, between the Snowy mountain and the Blue Ridge, and its transverse from the upper waters of the French Broad river to the Lookout mountain, containing 5,000 square miles, there is a field presented to the mineralogist not perhaps equalled for extent and interest in the United States. Smoky mountain constitutes the line between primitive and transition rocks, and its acclivities are steep and broken, developing familiar auriferous combinations. Gold has been taken from all its streams; and where the spurs and belts of this mountain have been cut by denudation, veins of quartz running with talcose slate are very apparent. Gold is often found in quartz rock, out of place, and much decomposed. Coco creek is a very rich deposit. Rumors of silver deposits were current in the army, during the late military campaigns. This remote interior district will amply reward exploration.

SOUTH CAROLINA.

The auriferous belt already traced from Fredericksburg to Charlotte extends to the vicinity of Abbeville, in South Carolina—more restricted in width, but with indications of greater richness.

Mines of Mr. William Dorne, in the Abbeville and Edgefield districts, yielded gold of the value of \$300,000 in fifteen months preceding July, 1853. The ore was highly ferruginous and silicious, and the gold was found among the layers of the vein in streaks and pockets of extraordinary richness. It was supposed to have been exhausted; but during 1866 work was resumed with satisfactory results.

Professor Lieber, State geologist of South Carolina, has reported that the most auriferous rocks are clay and talcose slates, catawberite, (a compound of talc and magnetic iron,) specular iron, schist and itaberite. None of the later

formed rocks contain gold, and the mica slates, and other older formations, contain comparatively little. This is in accordance with the views of Murchison, already referred to, who refers the position of gold universally to veins in altered silurian slates, chiefly lower silurian, and most frequently near their junction with eruptive rocks.

The first mint deposits from South Carolina were \$3,500 in 1829; the aggregate of such deposits to June 30, 1866, was \$1,353,663 98.

GEORGIA.

The width of the gold range through the southern States is not yet defined. If narrower in South Carolina, it is wider in Georgia than elsewhere. A line crosses the State from Augusta on the Savannah, by Macon on the Ocmulgee, to Columbus on the Chatahoochee, north of which is a platform of granitic and palæozoic rocks, which stretches to the Alleghanies, within which gold occurs in almost every county. Near this southern limit a gold mine has been worked in Columbia county, not far from Augusta, which has been continuously productive for eighteen years. But with this breadth to the general auriferous formation, there is evidence of two belts, which are separated by unproductive metamorphic rocks. Probably the district of Georgia and Alabama, which is most distinctly and remarkably gold-bearing, is from latitude 34° to 35° and between longitude 83° and 86° .

Gold was first discovered in Habersham county about 1831. It was followed by numerous developments along a line of hornblende slate from Alabama, northeast through Cass, Cherokee, Hall, and Hart counties, and extending to the Blue Ridge. Within this limit are the productive counties of Gilmer, Lumpkin, Habersham, and Rayburn.

A mint was established at Dahlonega, in Lumpkin county, in 1837, which has received \$600,000 in a single year, with an aggregate coinage to February 28, 1861, of \$6,121,919. Of this amount, \$5,825,747 was received during the period from 1838 to 1857.

Placer mining has been prosecuted in northern Georgia in a manner and with a success not unlike the experience of California. Besides the true veins, which traverse the strata in which they lie in various angles of dip and direction, there are many depositories of gold in all directions around Dahlonega, which are auriferous beds of slates, often decomposed, and sometimes containing pyrites, and the gossan resulting from its decomposition. In Lumpkin and Habersham counties especially, these metalliferous beds have been worked like open quarries, and the gold, in some instances, has been collected with the rocker or the pan, without recourse to crushing; worked, in fact, like deposit mines. They contain rich nests and fine gold, most unequally diffused through the different layers among the slates; some are perfectly barren, in immediate contact with other streaks that may yield many dollars to the hundred-weight of material; but they are so intimately mixed that all must be treated alike when worked on the large scale. The immense quantities in which these materials are obtained, and the ease with which they are quarried, sometimes render it an object to work them, though their yield is, on the whole, very small. These conditions are very favorable to the application of hydraulic mining, as carried to perfection in California.*

* See article "Gold," in Appleton's American Cyclopædia. The writer, who refers to his personal experience in Georgia mines, adds that when the ores are not pyritiferous, and there are facilities for stamping such as are used in cement mining by Californians, these materials can be profitably worked, when only producing eighty cents or one dollar per ton, or 1.8 part in \$1,000,000; but, of course, where the material is hard quartz, and more especially if it is pyritiferous, the expense of working would be more than quadruple. Prof. W. P. Blake in 1857 published a pamphlet, advising the improved methods of sluice-washing for use in Georgia.

Waiving further details, the following general observations may accompany this brief review of the Alleghany gold mines :

1. There is yet much room for the vigorous and intelligent prosecution of alluvial mining. Especially in Georgia, where the country is abrupt and nature has subjected the auriferous rocks to much dislocation and atmospheric exposure, not only the beds of the rivers, but the adjacent detritus of their valleys, will unquestionably give large returns to the new and powerful methods for washing ponderous masses of earth. It is understood that companies are now organized, who propose to introduce these hydraulic appliances upon the Chestatee and other tributaries of the Chattahoochee river.

2. There is abundant evidence also that the upper portions of auriferous lodes have been in a remarkable degree desulphurized, and may be worked to a considerable depth with great advantage before the intrusion of what is called "cap" in Colorado, or before the main body of the vein becomes obstinately pyritiferous. Surface quartz mining, if the phrase is admissible, will warrant considerable investments, whatever subsequent experience shall demonstrate in regard to the refractory sulphurets. It may be admitted that, hitherto, a quartz so modified in chemical constitution as to be "honey-combed," having become cellular and brittle from the decomposition of pyrites, with the gold set free from its matrix, is the only material which it is profitable to reduce; but the testimony is ample that immense quantities of ore in this favorable situation are accessible in the Alleghany gold district.

3. There are no grounds for the opinion that the auriferous lodes, strongly marked as they are by native sulphurets, will not prove true fissure veins, improving in quantity and quality with their depth. Professor Frederick Overman, in a work entitled "Practical Mineralogy," published in 1851, claims that the pyritous veins of Virginia and other south Atlantic States will be more sure and lasting than the gold-bearing localities of California. If the lower beds of Colorado mines can be raised and reduced with profit, deep sinking will be equally successful in the Carolinas.

NEW HAMPSHIRE AND OTHER LOCALITIES.

In the townships of Franconia and Lisbon, lying immediately north of Mount Washington on the lower Ammonoosuc river, gold has recently been discovered in quartz rock and a shaft sunk by a company of Boston capitalists to the depth of seventy-five feet. A correspondent of the *American Exchange and Review*, a monthly publication of Philadelphia, describes the gold-bearing quartz as traversing talcose slate, and containing sulphurets of iron and copper and seams of magnetic iron. Some extraordinary statements of recent assays from this locality have been published—one by Dr. Hays, State assayer of Massachusetts, at \$867 of gold per ton, and another specimen of mixed quartz talcose slate, gossan, pyrites, &c., at \$312 42 per ton. In the adjacent township of Waterford, surface quartz yielded \$30 per ton; quartz taken at nineteen feet below the surface \$45. Gulch mining has been successfully prosecuted in the vicinity.

If the New Hampshire discovery should warrant investments, there may be a renewal of exploration and experiment in Vermont, where the Appalachian mountain system is likewise largely developed.

During the year 1863 lodes of argentiferous galena were traced in the vicinity of Marquette, on Lake Superior. This district is from ten to twenty feet in breadth and about fifty miles in length, and is situated between the schistose or iron range and Lake Superior. Assays reveal from ten to thirty pounds of silver to the ton of metal. In the same vicinity east of Marquette the Huron mountains were reported in 1864 to be gold-bearing; but the rumors have led to no practical results.

A geological exploration of Arkansas undertaken a few years since indicated

the probability of profitable mining for silver, and perhaps gold, in the Ozark mountains of that State.

A district of Alabama, in the northeastern portion of the State, is a well-defined extension of the Appalachian gold-field. Its production of gold deposited in the United States mint and branches has amounted to \$201,734 83, with an equal amount probably diverted to commercial channels.

METALLURGICAL TREATMENT OF GOLD ORES.

A few general suggestions on the treatment of gold ores, and more particularly the auriferous sulphurets so prevalent in the formations east of the Rocky mountains, are submitted.

The direct method of attacking these ores is by *fire*, as is always done by the assayer in his laboratory, when he wishes to extract from a sample of ore *all* the metal which it contains. Undoubtedly, when the cost of fuel, fluxes, and labor is reduced to something near the standard which prevails in the seaboard States, the richer ores of Colorado, Montana, &c., will be reduced by *smelting*. At present, however, there is reason to believe that the proper economic conditions for smelting do not exist, except possibly in the case of argentiferous galena; although experiments recently made at Swansea, England, upon large quantities of pyritic ores sent from Colorado have proved entirely successful. In conducting these experiments, and estimating their cost, care was taken to make the conditions as to fuel, fluxes, labor, &c., the same as those existing in Colorado. It is stated that smelting works upon a large scale, upon the Swansea plan, are to be started immediately in Colorado. If this should be done, there will ensue a subdivision of labor in the business of mining gold and silver, as is now the case in iron mining. The miner will limit his efforts to the raising of ore from his mine, and the smelting furnace will afford a market where the ore will command its price. This will be better for all parties than the method hitherto pursued of raising and reducing ores under one administration.

But it will be a long time before the great mining regions of the Rocky mountains will have a sufficient number of smelting works to meet the wants of our enterprising miners, who are constantly prospecting new fields; and there will always be a class of ores too poor to bear the cost of smelting.

The cheaper process of amalgamation, now universally employed in all our mining districts, (and, when no sulphurets are present, the very best process,) will continue to be very generally resorted to. This process consists in reducing the ore to a fine powder by means of stamps, arastras, Chilian mills, or other mechanical contrivance, and subjecting it to a continuous agitation with mercury, with water enough to give a pasty consistency to the mass, the object being to expose as fully as possible the fine particles of gold and silver to the attractive power of the mercury, with which they form an *amalgam* easily separable by subsidence in the lighter pulp of earthy matter of which the ore consists. The amalgam thus obtained, on being subjected to moderate heat in an iron retort, gives up its mercury, which passes over in vapor, and is condensed again in another vessel, the metal being left in the retort.

In the case of pyritic ores, however, it is found that the process of amalgamation is seriously retarded by the impurities with which the gold and silver are associated. Probably the ores of Colorado do not yield, by simple amalgamation, an average of twenty per cent. of their assay value. A previous process of desulphurization is, therefore, indispensable; and how best to accomplish this is the problem which has occupied the attention of metallurgists for many years. Many methods have been advised, the majority of which, being merely empirical, have had but an ephemeral reputation.

As already intimated further details are reserved for a subsequent occasion, when an effort will be made to describe the various processes now in course of experiment.

The treatment of silver ores rests upon a far more satisfactory basis of chemical experience, and the different methods in successful use are clearly and accurately compiled in the last edition of Ure's Dictionary of Arts, Manufactures, and Mines.

TREASURE PRODUCT OF THE WORLD.

When America was discovered the gold and silver supply of Europe did not exceed \$200,000,000, of which \$60,000,000 was gold and \$140,000,000 was silver. According to the estimates of Humboldt sixty years elapsed before this aggregate of two hundred millions was doubled by the treasure product of America.

M. Chevalier estimates that the total amount of gold and silver in 1848, the epoch of the California discovery, was \$8,500,000,000, of which one-third was gold. It will require thirty-two years, or from 1848 to 1880, to duplicate this supply, even if \$250,000,000 is assumed to be the average annual production of gold and silver during that period.

We have the authority of Adam Smith that it was not until after 1570 that the increased supply from the American mines produced any appreciable effect upon prices. In 1550, or twenty years previously, the treasure stock of Europe had been doubled; and in 1570 it reached an aggregate of \$600,000,000. To this point the product of the American mines was absorbed by the new demands of commerce. It was only until 1620, or fifty years later, with a further addition of \$600,000,000 to the stock of money in circulation, that silver fell to about one-third of its former value, with a corresponding appreciation of prices. In these statements full allowance is made for the consumption of the precious metals by casualties, abrasion, and the arts.

Whatever may be said of the great social and commercial activities of the sixteenth century, the development of human industry and intelligence in the nineteenth century will prove far more effective for the absorption of the vast quantity of gold and silver now or hereafter produced.

The world in the sixteenth century received and assimilated three-fold the treasure supply of 1492 without material change of prices, which was postponed fifty years later, until a six-fold supply, or an aggregate of \$1,200,000,000, had been applied to commercial uses. Then was observed a reduction to one-third of the former value of silver. If we compare the experience of the world since 1848, the stock of specie in that year of \$8,500,000,000 will be doubled in 1880, without any other effect than to vitalize commerce; and \$400,000,000 per annum can still be absorbed by the trade and intercourse of all the continents for twenty years thereafter, or until A. D. 1900, before the monetary situation will correspond with that of Europe in 1570, when the first effect upon the exchangeable value of money is recorded.

We are assisted, by the experience of the sixteenth century, to the conclusion that an aggregate of \$25,000,000,000 in the year 1900 will hold a similar relation to the trade and intercourse of mankind that the amount of \$8,500,000,000 sustained to the population and commerce of the world in 1848. If, as early in the next century as 1920, the stock on hand should be increased six-fold, reaching a total of \$50,000,000,000, it might be attended, as in 1620, by a sensible reduction in the exchangeable value of money; but this contingency is too remote and capable of satisfactory compensation to justify much solicitude in behalf of posterity.

There are indications that the large excess in the production of gold over that of silver, which, since 1848, has reversed the former relations of these metals, may be less marked in future. The vast quantities of gold produced since 1848 are mostly from placers—from the detritus of auriferous rocks. These surface

mines are soon exhausted. In California, notwithstanding the skilful application of hydraulic power, the production of gold by gulch or placer mining has diminished from \$60,000,000 in 1853 to \$20,000,000 in 1866. Except for new discoveries, and some successful enterprises of quartz mining, the Australian supply of gold would have likewise diminished. Very few diggings hold a mining population longer than a single season. The "dust of gold" is soon gathered. It may be admitted that Australia, Siberia, perhaps the sources of the Zambesi and the Nile in Africa, and northwest British America will, when further explored, reveal a great many districts where the surface deposits are rich and accessible; but each will be in turn a scene of great excitement and of rapid exhaustion, and, perhaps, before the close of the present century alluvial gold mining will be almost a tradition. This tendency is so apparent in every gold-producing community that public attention turns constantly, and with solicitude, to the separation of gold from its native matrix of rock as the only permanent means of production. But at that stage silver mining comes into successful competition with all existing methods for the reduction of auriferous rock. It has always been more profitable to work mines of silver than of gold, of which Mexico, during two centuries of experience, and the Pacific coast, during two decades, are illustrations.

There was very little mention of silver while the discovery and conquest of America were in progress. Among the vast mineral treasures of Montezuma, the quantity of silver was small compared with gold. It was "El Dorado" which was eagerly sought for by European explorers. Each country was ransacked, with the forced labor of Indian slaves, for gold. This was the era of placer-mining in the American dominions of Spain. In consequence of the importation of gold, Isabella of Castile was obliged, as early as 1497, to modify greatly the relations of gold and silver at the mints. The Spanish sovereigns acknowledged the grant by the pontiff, Alexander VI, of their discoveries "in India" by a donation of gold from Hayti. At length, however, after the discovery of the silver mines in Peru and Mexico, and when the experience of miners had elaborated a systematic industry, gold ceased to be of much practical importance and silver became the leading metallic product of Spanish America. Of the coinage of Mexico from 1535 to 1845, \$2,465,275,954 was of silver and \$126,981,021 of gold. Except for Brazil, the proportion in South America would be fully equal to that recorded in Mexico.

In the case of California, after many unsuccessful experiments, the reduction of auriferous lodes has been established. The veinstones, when pulverized, readily release the gold; there is a remarkable absence of refractory alloys; all the conditions, especially in Grass valley, are favorable. Yet the yield of gold does not exceed \$9,000,000 per annum, while on the eastern slope of the Sierra Nevada the annual production of silver, chiefly from the Comstock lode, amounts to \$16,000,000 per annum.

As the mining territories are explored, the discoveries of argentiferous veins are reported in all directions. The interior of the vast mountain mass develops in Sonora, Chihuahua, Arizona, Nevada, Utah, New Mexico, Colorado, Idaho, and Montana, the identical formations and conditions which, in a lower latitude, characterize Durango, Zacatecas, Guanajuato, and the other well-known silver districts of Mexico. With the exhaustion of the placers (perhaps a remote contingency) it is quite possible that the production of silver, as compared to gold, will be restored to the old ratio of three of silver to one of gold.

But at present, as well as for the last eighteen years, the ratio of production is reversed—three of gold to one of silver. The following statement is submitted as an approximation, carefully avoiding exaggeration, of the quantities of the precious metals produced in 1866:

	Gold.	Silver.	Total.
United States	\$60,000,000	\$20,000,000	\$80,000,000
Mexico and South America	5,000,000	35,000,000	40,000,000
Australia	60,000,000	1,000,000	61,000,000
British America	5,000,000	500,000	5,500,000
Siberia.....	15,000,000	1,500,000	16,500,000
Elsewhere	5,000,000	2,000,000	7,000,000
	<u>150,000,000</u>	<u>60,000,000</u>	<u>210,000,000</u>

The annual production of silver since 1853 has not exceeded \$50,000,000, or £10,000,000. Yet, within the period of fourteen years—from 1853 to 1866—the sum of £11,250,000 has been annually transported from European ports (including shipments from Egypt) to Asia. The aggregates of bullion exports were as follows:

Gold	£24,773,647
Silver	157,424,757
Total	<u>182,198,404</u>

France alone, although the richest country of the world in the precious metals, has, since 1848, parted with \$165,947,253 of silver and taken gold in exchange. This has resulted from a fall in the value of gold, as compared with silver, of 2½ per cent., which, by comparison of the course of exchanges between England, using a gold standard, and Hamburg and Amsterdam, using a silver standard, is the only monetary result of the excess of gold supply since 1848. Europe and America will substitute gold for silver as money, while Asia will probably continue to absorb silver for many years to come, before the ratio of currency to population now existing in Europe shall extend over the eastern world.

A brief statement will illustrate the extent of the oriental demand for the precious metals, which, now mostly confined to silver, will hereafter, or as soon as the world shall desire it, extend to gold. India, in 1857, had a circulating medium of \$400,000,000 for the use of a population of 180,000,000, or \$2 22 per capita. France has a population of 38,000,000, with a money supply of \$910,000,000, or \$24 per capita. Suppose China, Japan, and the other industrious populations of Asia to be in the situation of India, and that the current of bullion since 1853 has supplied the Asiatics with \$3 per capita, there yet remains a difference of \$21 per capita before the monetary level of France is attained, demanding a further supply of \$21 per capita over a population of 600,000,000, or not less than \$12,600,000,000.

The railway system will soon connect Europe and Asia, and constitutes a most important agency for the transfer of capital and distribution of money among the populations of the eastern continent. Since the suppression of the Indian mutiny, an English writer estimates that more than one hundred millions sterling have been added to the currency and reproductive capacity of India, mostly from England, in the construction of railroads and canals. There were 3,186 miles of railway in operation in 1865, having cost \$86,000 per mile, and having been constructed with the aid of a guaranty of five per cent. to stockholders by the province of India. The system, for which the government indorsement is already given, will be 4,917 miles of railway, at an estimated cost of £77,500,000. These roads will relieve the government of liability when their earnings reach £25 per mile per week, a point which the leading lines have nearly reached and which all are destined to attain. Such is the success of Indian railways that their connection with Europe by the valley of the Euphrates, and their extension into China, will probably be accomplished within the next ten years. By that time Russia will have undertaken a railway from Moscow

to Peking, through southern Siberia—a great trunk line that would soon justify a series of southern lines, penetrating central Asia over those leading caravan routes which have been the avenues of Asiatic commerce for centuries.

If an investment of \$430,000,000 in 5,000 miles of railway is financially successful in Hindostan at this time, it may be anticipated that a population of 180,000,000 will warrant the enlargement of the system within the present century fully four-fold, which would be only a fifth of similar communications required and supported by an European or American community. Suppose such a ratio of railway construction extended over China, central and western Asia and Siberia, it would be only one mile for every 9,000 people; while in the United States there are 36,000 miles for 36,000,000 people, or a mile to every thousand; and yet the Asiatic ratio, moderate as it is, presents the startling result of 66,000 miles of railroad constructed by the expenditure of \$5,676,000,000. Such a disbursement of European accumulations in Asia would go far to diffuse not only the blessings of civilization, but any excess of production from the gold and silver mines of the world.

In Australia a railway has been constructed from Melbourne to the Ballarat gold fields, 380 miles, at a cost of \$175,000 per mile, which pays a net profit nearly equal to the interest on the immense investment. It is difficult to estimate the amounts destined to be absorbed for railways in all the continents, under the direction of the great powers of the world—projected, constructed, and administered by the wealth and intelligence of America, Russia, England, Germany, and France. But the railway system is but an instance, among many other causes, conducing, in the language of an eminent English writer,* “to augment the real wealth and resources of the world; to stimulate and foster trade, enterprise, and production, and, therefore, conducing, with greater and greater force, to neutralize by extension of the surface to be covered, and by multiplying indefinitely the number and magnitude of the dealings to be carried on, the *a priori* tendency of an increase of metallic money to raise prices by mere force of enlarged volume. Already the boundaries within which capital and enterprise can be applied, with the assurance and knowledge alone compatible with durable success, have been extended over limits which ten or even five years ago would have been regarded as unattainable. There have come into play influences by which it seems to be the special purpose to contribute, by the aid of the concurrent advance of knowledge, to the removal or mitigation of many chronic evils against which past generations have striven almost in vain.”

TRANSPORTATION FROM THE MISSOURI RIVER TO THE ROCKY MOUNTAINS.

While postponing a detailed consideration of the character and extent of trade and transportation from the Missouri river to the mining territories of the interior since 1848, some idea of the westward movement of merchandise and the cost of its transportation, may be obtained from the Quartermaster General's report to the Secretary of War for the year ending June 30, 1866, which exhibits the transportation on account of government, and the rates paid per hundred pounds per hundred miles. The rates from the Missouri river to northern Colorado, Nebraska, Dakota, Idaho, and Utah were \$1 45; to southern Colorado, Kansas, and New Mexico, \$1 38, with an addition from Fort Union in New Mexico to posts in that Territory, in Arizona, and western Texas of \$1 79 per hundred pounds per hundred miles. The total number of pounds transported was 81,489,321 or 40,774 6-10 tons, at a cost of \$3,314,495. Parties familiar with the course of this inland trade, estimate that the transportation on account of government is one-ninth the total amount of transportation. At this rate the whole amount paid in 1866 for freights from the Missouri river westward was \$30,330,055. According to a statement recently made by the officers

* Tooke's History of Prices, vol. vi, p. 235, published in 1857.

of the California division of the Union Pacific railroad \$13,000,000 in gold was paid in 1863 for transportation eastward from San Francisco to the State of Nevada and Territories east of the Sierra Nevada. The details of return freights and the amount paid for the movement of passengers are, as yet, too incomplete for publication. Not less than \$50,000,000 per annum is expended on or near the line of the Union Pacific railroad for the transportation of travellers and merchandise.

GENERAL OBSERVATIONS.

I beg leave to close this communication with a few observations of a general nature:

1. There are two indispensable requisites to the development of the western mines—security from Indian hostilities, and the establishment of railway communication to the Pacific coast on the parallels of 35°, 40°, and 45°. Of these, the completion of the "Union Central" on the average latitude of the fortieth parallel may be anticipated in 1870 and will unquestionably give a great impulse to the communities which it will traverse, probably in such a degree as to warrant the immediate construction of a northern line central to Minnesota, Dakota, Montana, Idaho, Washington, and Oregon, and a southern line equally indispensable to the Indian Territory, Texas, New Mexico, Arizona, and southern California.

2. Great results of a social, no less than a material character may be anticipated from the act of July 26, 1866, extending facilities for acquiring title to mineral lands. By that act, freedom of exploration, free occupation of government lands for placer mining, a right to pre-empt quartz lodes previously held and improved according to local customs or codes of mining, the right of way for aqueducts or canals, not less essential to agriculture than to mining, and the extension of the homestead and other beneficial provisions of the public land system in favor of settlers upon agricultural lands in mineral districts, have been established as most important elements for the attraction of population, and the encouragement of mining enterprises. The Commissioner of the Land Office has carefully analyzed this enactment, and greatly facilitated its execution by a circular recently issued. The spirit of the legislation under consideration is in the interest of actual settlement and occupation, and adverse to absentee ownership for merely speculative purposes, of mining properties. It will probably be necessary to supplement the act in question by some general revision of the local mining customs, which, although generally founded on the Spanish code so long in use in Mexico, are often incongruous and obscure.

3. Great loss and disappointment have resulted from the unique geological and mineralogical development of auriferous and argentiferous lodes of the Rocky mountains and the Alleghanies. Metallurgical machinery and methods which had been successful in Europe, and even in California, have proved inapplicable or met with unexpected obstacles in the reduction of ores. There is no subject of greater importance than a scientific analysis of the situation and combinations of the precious metals and the best methods for their treatment. How far Congress or any executive department can judiciously co-operate in the solution of the mechanical and chemical problem which now confronts the skill and experience of all interested in the economical reduction of the ores of gold and silver, it is not within the province of this report to determine; but the great utility of the geological survey of Lake Superior and the Upper Mississippi, in 1847, under the direction of Professor D. D. Owen, may properly be referred to as suggesting the expediency of a similar exploration under national auspices of the mineral districts of the western States and Territories, and which might be appropriately extended to include the metalliferous localities of the Alleghanies.

JAMES W. TAYLOR.

Hon. HUGH McCULLOCH, *Secretary of the Treasury.*