In addition to the stream placers above considered, there are also the auriferous deposits in the gravel plains, of which that of the Nome tundra is the most extensive, and in the high-bench deposits. The gravel plain stretching inland from the coast at Nome, usually called the tundra, is the richest of this class of deposits thus far prospected, but similar deposits, some of which are known to be auriferous, occur in other parts of the peninsula. It will remain for the future to determine what percentage of this type of placers can be profitably exploited, but in the opinion of the writer it constitutes the largest gold reserve of the peninsula. In estimating the gold contents of the gravel-plain placers values of 25 to 50 cents per cubic yard of pay streak have been adopted as being conservative. As in previous calculations the pay streak has been assumed to be 3 feet thick. The pay streaks of the coastal-plain gravels, known to contain considerable gold, have been assumed to carry 50 cents and the others 25 cents to the cubic yard.

The Future of the Mining Industry

Of the 750 linear miles of gold-bearing creeks, only 172 miles represent creeks which have produced gold in commercial quantities, but it must be remembered that many have not been carefully prospected and that there are probably other creeks not so marked on the accompanying map which will be found to carry gold. Mr. Moffit's computations indicate that those parts of the creeks which have been worked out carried values averaging probably $500,000 to the mile. Some of the richest creeks have yielded more than double this amount, but the yield of others is very much below it.

The Future of the Mining Industry

All the above facts being taken into consideration, it is believed that an estimate of $250,000,000 to $325,000,000 for the placer-gold reserves of Seward Peninsula is conservative. Although these speculations may be of interest in showing the possibilities and probable direction of future growth, the actual estimate of the gold reserve must be regarded as little more than a bold guess.

The Nome Region

General Geology

Nome Series - Structure

It has been stated that the Nome series forms a broad synclinal trough, with an approximately east-west axis, extending from the coast of Bering Sea to the Kigluaik Mountains. There is, however, abundant evidence of an earlier deformation, due to forces acting almost at right angles to those which gave rise to the broad east-west folds and producing other folds much more intense in character and with axes running north to south or from north-northwest to south-southeast. Yet, in spite of these deformations, it was found that the bedding of the sediments and the cleavage or schistosity are nearly everywhere the same, although exceptions are known.

Tertiary System

Seward Peninsula

Tertiary sediment rocks that were laid down under land conditions have also been identified at a number of points in Seward Peninsula - namely, in the valley of the Sinuk River, in the western part of the peninsula; in the valley of the Kugruk River, in the northern part; and in the valley of the Koyuk River, in the southeastern part. Most of these tracts now have only a small extent, but doubtless in the past they were much larger and have been reduced through erosion or through being covered and masked by later deposits. In all these localities the beds are dominantly composed of sandstone and shale, with some coaly layers. In the locality on the Kugruk River the coal is very thick and has long been mined as a source of local fuel. All the beds have been somewhat deformed, so that in places dips of as much as 70° are by no means unusual. The paleontologic evidence as to the age of these rocks is not adequate for basing a final conclusion but it is believed to indicate that the beds are Eocene and probably are in general correlative with the beds of similar composition and relation that are so widely distributed through other parts of Alaska and that have usually been referred to as Kenai.

Metalliferous Lodes in Southern Seward Peninsula.

Mineralization - Rock Openings

The black slate member of the series is best developed in the Solomon region. It covers a very small area but is exceptional among the rocks of the series in the way in which it has fissured. It is a dense siliceous, uniform-textured rock which has fractured along clean-cut lines. The veins of Big Hurrah Creek occur in this formation and are the best defined and most regular of the veins known in the region. The contrast between the fracturing qualities of this division of the Nome group and those of the schist affords a good explanation why most of the veins of Seward Peninsula have proved so irregular and discouraging to prospectors.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA.

Gold in Bed Rock

Distribution of Mineralization

The gold placers of Seward Peninsula fall into two broad belts, separated by the Kigluaik and Bendeleben mountains. In the southern belt, at present the largest producer of gold, are included the Nome, Solomon, and Ophir regions and some smaller mining districts. The Bluestone, Kougarok, and Fairhaven placers lie in the northern zone. The absence of placer gold in intervening regions suggests the absence of gold from the bed rock, but may also be explained by the fact that glaciation and other conditions have not been favorable to the accumulation of auriferous gravels.

Within the two belts the placers are so irregularly distributed as to make it certain that some other cause must have operated in determining their occurrence than the accidents of erosion and deposition. On some creeks there are rich placers, while at near-by localities, where the character of the alluvial deposits is identical, gold may be almost entirely absent. A natural inference is that this irregularity is due to the irregularity of the distribution of the gold in bed rock.

It has already been pointed out that there appears to be a connection between structure and the distribution of the auriferous gravel. This view is borne out by the evidence of the geologic maps, which indicate that most of the workable placers occur along or close to the contacts of limestone and schists. These contacts have in many places been exposed to erosion as a result of the domal uplifts already mentioned. This, however, is not everywhere the case, for some of the limestone-schist contacts are simply the margins of lenses of limestone included in the schist. Be the relation of the limestone to the schist what it may, it appears to be established that the bed-rock source of the gold in most deposits is traceable to a limestone-schist contact. Furthermore, these contacts appear to have been loci of the greatest mineralization, either as impregnated zones or as fissure veins.

Lode Developments on Seward Peninsula

Iron

A hot spring 2 miles below the location of the claims is said to maintain a uniform flow during summer and winter and could possibly be used to generate electric power. Another possible resource is coal. Coal-bearing rocks outcrop on Coal Creek, a tributary of Sinuk River, a short distance below the iron prospects. It is reported that a tunnel driven to prospect the coal cut 17 thin seams ranging in thickness from 3 to 16 inches. The coal is said to be of bituminous grade and of fair quality, but the extent of the coal-bearing rocks is not known.

Lode Developments of Seward Peninsula.

Types of Gold Lodes

The auriferious quartz veins have further been separated into two classes, one in which the gold is associated with the sulphides of iron, arsenic, and antimony or other minerals, and one in which the gold has no mineral association except with the quartz.

In the sulphide-bearing lodes, whether fissure veins or disseminated fracture zones, the gold either occurs free in the sulphide or inclosing quartz or is present in a state of chemical combination. A division made on this basis is the most important classification from economic considerations, as the deposits of the two kinds require entirely different plants for the treatment of the ore. Failure on the part of operators to determine the character of the ore in depth has caused considerable loss in the erection of machinery not suitable for treating the ore.

The gold-bearing lodes of Seward Peninsula have been characterized as a type of Alaskan deposit peculiar to this region, as it has never been proved that they bear a genetic relation to intrusive rocks, like most of the other gold-lode deposits of Alaska.

Lode Developments of Seward Peninsula

Types of Gold Lodes

The gold lodes of the Nome region are divided into two general classes - vein deposits and disseminated deposits. The veins include those deposits in which mineralization occurred along more or less well defined structural planes.

Metalliferous Lodes in Southern Seward Peninsula

Country Rock - Structure

The structure of the rocks of the area is complex. Faulting has occurred in all the formations. Close folding is not unusual in the limestones and is common in the schists. The details of the structure are not well known. Two periods of deformation are recognizable. The axis of one set of folds strikes in general north; that of the other set east. The easterly folds are best developed in the vicinity of Kigluaik and Bendeleben mountains, where they are the prevailing structural features. Although they can be recognized throughout the area, they are elsewhere subordinate to the northerly folds. The areas of most intense deformation are the Nome and Solomon regions, Smith has described in detail the structure of the Solomon and Casadepaga quadrangles, which may be considered as best illustrating the complicated geology that is rather characteristic of the peninsula as a whole.

Structure

The effects of igneous intrusions are more localized than the changes brought about by mountain-forming movements, and both these agencies have been active in this area.

Structure

Reference has been made in the outline of the geology to evidences of two periods of folding that have affected the rocks of the Nome group. These evidences consist in the main of two sets of folds that have axes almost at right angles to each other, the one running north and south, and the other east and west. A good example of these folds is seen in the limestone of Newton Peak east of Dry Creek. The limestone beds exposed on the south side of Newton Peak strike east and west and dip north, but when favorable exposures are examined carefully it is found that in many places the rock has been thrown into close minor folds whose axes pitch north and thus lie parallel to the principal dip of the limestone. These minor folds are subordinate, however, to the larger structural features, the principal difference between the two systems as they are seen in this region being that the folds with east-west axes are broad and open, whereas those with north-south axes are intensely compressed and in many places are so small as to be easily distinguished in a small outcrop. Such examples of the two systems of folds as that seen in the limestone of Newton Peak are found in the schists also and in places show the structure even better than at the locality mentioned. It is conceivable that the forces that produced the folds acted simultaneously, but it is believed that the east-weat folds are connected with one of the later disturbances that affected the area, probably the intrusion and uplift of the Kigluaik Mountains, and that they were superposed on the folds of an earlier movement. One of the best evidences of this is that the axes of the minor north-south folds pitch in directions parallel to the dip of the east-west folds, a fact which seems to indicate that the north-south folds were produced first. A remarkable peculiarity of the north-south folds is that they were seen only in rocks of the Nome group and were not observed in the Tigaraha schist of the Kigluaik group, in which, if they ever existed, they must have been entirely destroyed by later metamorphism.

A. H. Brooks
U.S.G.S.Bull.642.

MINERAL RESOURCES OF ALASKA, 1915

The Alaskan Mining Industry in 1915

Seward Peninsula

The cause of the decrease in production of dredge gold is not clear, as there are known to be large areas of auriferous gravels on the peninsula which appear to be suitable for profitable exploitation by dredges. One reason, however, is that most of the successful dredges appear to have worked on placers of rather high grade, and their success has been due to this fact rather than to economical mining by large operations. Little attempt has been made to work the permanently frozen placers, as has been so successfully done in the Alaska and Canadian Yukon. * * * It would seem that there is in Seward Peninsula a field for strong companies that could introduce economines in the operation of dredging and thawing.

The Nome Region

Unconsolidated Deposits - Glaciation

One of the difficult problems of the region is to discover what effect the action of glacial ice has had in modifying the former topography and in transporting loose material. That the upper valleys of nearly if not all the streams flowing south from the Kigluaik Mountains, as well as some of the tributary valleys of Grand Central River and Salmon Lake, have been occupied by ice masses in very recent time is beyond question. The morainic deposits at the head of Nome River indicate that at least the upper portion of that valley was occupied by ice, and several of the eastern tributaries of the river have well-formed cirquelike amphitheaters at their upper ends. There is no evidence available to show that the peninsula, or rather the southern portion of it, has ever been covered by an ice sheet.

Therefore it is only in exceptionally favorable places that the two structures can be made out and in many of the favorable places it is impossible to determine the direction of the oldest structure.

The second period of deformation which has been described seems in general to have been the result of compressive strains which acted in an east-west direction. These forces, therefore, produced folds and overthrusts normal to that direction. In other words, the axes of the folds were in the main north and south and the traces of the fault planes on the surface were also in that direction. It is not intended to make the assertion that the forces acted precisely in an east-west direction, but merely to point out that the trend was more nearly that way than north and south. An examination of the geologic maps brøings out the fact that most of the outcrop areas of the formations have their longest axes north and south, thus suggesting that the forces which folded and overthrust them must have been practically normal to this direction. As regards the direction of overthrusting or the direction toward which the folds are overturned, there seems to be evidence to show that in general the rocks to the west were thrust over those to the east. It should be noted, however, that in such complex structures it is not possible to prove the point as conclusively as could be desired.

The presence of this north-south structural trend has already been noted by Moffit in the northeastern part of Seward Peninsula, and seems to be more marked to the east than to the west. The fact of its being more pronounced in the eastern part of the peninsula might suggest that the thrusting or overturning was toward the west rather than toward the east, as has been suggested for the Solomon and Casadepaga quadrangles. It is impossible to consider here the question in its broad application to the whole of Seward Peninsula, but it is believed that a more thorough examination of parts of the area outside the field covered by this detailed report should be undertaken before any generalization or extension of the facts learned in the Solomon-Casadepaga region is attempted. The fact, however, stated by Moffit, that the folds are seldom overturned in the Fairhaven region might be taken as indicating that the structures seen there are not comparable with those noted in the field under discussion.

Placer Deposits
Miscellaneous Streem and Bench Placers

Beside the two main rivers, which, with their tributaries, drain the greater part of the Solomon and Casadepaga quadrangles, a few other streams occur in the area, though none of them have any importance as producers of gold from creek placers. These streams may be roughly classified as belonging to the Niukluk, the Kruzgamepa, the Klokerblok, and the Topkok river systems, and the Norton Sound drainage. Prospecting has been done on these streams, but in the main only the upper headwaters branches come within the area of the quadrangles, and most of the gravels are coarse angular fragments which have been but slightly sorted by water. As a result, although many of the streams in their lower portions, outside the quadrangles, have produced placer gold, few of them have yielded workable deposits within the area mapped. It should be noted that benches occur on many of these streams, so that they offer ample ground for prospecting for this kind of deposit. The fact that no benches are being mined is no reason for abandoning the streams as unprofitable, for the physical conditions which have produced the benches in regions where the deposits are being worked seem to have been also effective in many regions where no mining is done at present. The character of bed rock in the vicinity of the productive and of the nonprospected benches seems to be the same. It is believed therefore that there is good ground for recommending more thorough testing of the benches of many of the streams flowing in other basins than those of Solomon and Casadepaga rivers. Though such search might not be immediately successful, and though rich bonanzas may never be discovered, it is confidently believed that in places economically important deposits of this type will be located and developed.

Placer Deposits
Tributaries of Casadepaga River

The larger part of the gold that has been won from the Casadepaga Basin has come from the benches and stream gravels of the tributary creeks. Although practically all the larger side streams of Casadepaga River have marked benches along their courses, Goose, Canyon, and Willow creeks are the only ones where bench mining has proceeded to any extent. In part those benches are those of the main river, while in part they are the extension of the gradient established by the main river up the side streams. Thus, in the lower part of Goose, Dry, and Dixon creeks the streams traverse the Casadepaga bench, but farther upstream there are distinct benches formed by the streams which preceded the present streams. All the gravels, whether belonging to the benches of the main or the side streams, carry some gold. The gold is generally in fine scales and the largest pieces rarely exceed a value of 45 cents. The gold is of high degree of fineness, the banks paying $18 an ounce, although it is reported that it assays $19.50. The concentration of the values in these benches seems to have taken place mainly on thin partings of clay which occur irregularly distributed throughout the gravels. There is also some concentration on bed rock, but the clay seams are reported to run on the average higher than the bed rock.

Placer Deposits - Casadepaga River

In the Casadepaga basin benches have been somewhat more extensively prospected than in the Solomon River region, but few men are employed and the production is consequently small. The evidence from past work, however, seems to point clearly to the conclusion that the benches in many places contain gold in paying quantities and that successful mining ventures only await sufficient funds and energy to be profitable. All along the main river benches are well developed and form a prominent feature ~~of~~ in the landscape. The gravels which compose them have been but slightly prospected, yet from the meager testing done and from the relation of creek placers to the benches it is certain that some of them carry values.

The stream placers of Casadepaga River are similar in most respects to those of Solomon River, but, owing in part to the greater distance from supplies and in part to the absence of thorough prospecting, the production is less than from the Solomon River basin.

GEOLOGY AND MINERAL RESOURCES OF THE SOLOMON AND CASADEPAGA QUADRANGLES, SEWARD PENINSULA, ALASKA.

Topography of Solomon and Casadepaga Quadrangles

Effects of Structure on Drainage

A region composed of rocks of varying resistance to erosion and with structures so diverse and pronounced necessarily shows many valleys which have been determined by these features. The larger valleys, such as those of Solomon and Casadepaga rivers, when examined on a small scale, do not seem to be directly controlled by the structural or lithologic character of the rocks, as they do not flow parallel with the strike. But when looked at in a broad way the north-south trend of the belts, interrupted though they are, seems to have been the controlling influence which determined the direction of the streams. Where softer rocks occur the valleys of the main stream have often been opened out more widely than where the rocks are more resistant. Many of the local constrictions of the valley seem to have been caused by recent local uplift. There can be but little doubt that the main streams have had a long history, which is difficult to unravel.

Topography of Solomon and Casadepaga Quadrangles

Effects of Structure on Drainage

Perhaps the most striking effect of the control exercised by lithology on the shape of valleys and streams is to be found in those regions where limestone forms the country rock. Owing to the solubility and the fissured character of the limestone, much of the water is carried by underground streams, which are not effective in modifying surface forms.

Data regarding the forces that produced this latest folding are not sufficient to definitely settle their direction. It appears, however, that while the axes of the older folds were north and south, the later ones were more nearly east and west. As there are no known rocks within the region that have been affected by this period of deformation alone, it is nearly impossible to work out its areal extent or the precise effect it had upon the older structures. It, however, needs to be assumed in order to explain the areal distribution of the different formations but more particularly to account for the dislocations and distortions that certain of the structures, formed in the preceding period of mountain building, have undergone.

Structural Geology

Mountain-building movements do not appear to have affected the region since the deposition of the various gravels that cover so great an area of the two quadrangles. There is, however, a long interval between the oldest unconsolidated deposits and the youngest hard rocks, allowing abundant time for other periods of diastrophism. The fact that the Mesozoic-Tertiary coal-bearing rocks in other parts of the peninsula have been folded and are now standing at high angles indicates that relatively recent deformations have taken place.

It is believed that when such a stage is reached in the Iron Creek region placer reserves containing large amounts of low-grade ground will be found, and their exploitation will prolong mining activities for a considerable period.

From a general study of the benches that have resulted from the action of former creeks at a higher level, there seems no good reason for doubting that the gravels of the benches are identical in origin with the present creek gravels. If this is the case it necessarily follows that the bench gravels must in many places be auriferous. Although it is possible that some of the bench deposits may be as rich or even richer than the stream placers, it is safe to assume that, as a rule, they are not so well concentrated. Such an assumption is supported by the fact that in many places the gravels of the present streams are reconcentrated gravels derived from bench deposits. At such places the additional sorting of the gravels has generally resulted in the concentration of the heavier minerals.

The Iron Creek Region

Bench Placers

Practically no stream in the entire Iron Creek region, a part of whose valley lies below an elevation of 900 feet, does not show terraces on its valley slopes. Many of these terraces have been formed by streams, and it seems probable that there is a larger gold reserve in these benches than in any other part of the region.

MINERAL RESOURCES OF ALASKA, 1908

The Iron Creek Region

Undeveloped Water Resources

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As it (Kruzgamepa River) leaves Salmon Lake the river flows through a narrow outlet having a width of 150 feet at the bottom and 500 feet at the top, offering an excellent dam site and location for a hydro-electric power plant. Plans for the construction of such a plant have been perfected by the Salmon Lake Power Company (1907), which intends to develop 3,000 horsepower to be used on dredges at Nome and Council and on Solomon River.

Salmon Lake at its present level, 442 feet, covers 1,800 acres; if raised to a level of 475 feet, it would cover 3,600 acres; and at 500 feet, 4,600 acres. The reservoir thus formed could be used for the storage of the water of the floods caused by the melting snow in the spring and the occasional heavy rains in the summer. The water thus retained would give a large minimum flow not only in summer but also during the winter months, when the natural run-off becomes small.

Kruzgamepa River seldom freezes over before the first of January, and it is probable that with proper installation, power could be developed throughout the year.

The Iron Creek Region

Undeveloped Water Resources

Salmon Lake lies at the foot of the Kigluaik Mountains at an elevation of about 442 feet. It has a water-surface area of 1,800 acres and a drainage area of 81 square miles. Its principal supply comes from Grand Central River, which enters it at its west end. A number of small streams also enter the lake from both the north and the south, but with the exception of Fox Creek and Jasper Creek these are of minor importance. The outlet of the lake is through Kruzgamepa River.

This lake offers an excellent opportunity for a storage reservoir for power purposes and mining along Kruzgamepa River. The use of its water in the vicinity of Nome is practically prohibited, owing to its low elevation and the long tunnel which would be necessary to bring the water through the Nugget divide into the Nome River basin.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA.

The Kougarok Region

Quartz Creek Basin

Considerable prospecting has been done throughout Coffee Creek basin and a little gold has been mined in its upper part. The lower part of the creek is incised in the gravel terrace, and here also a little gold has been found. Prospecting on the upper part of the creek is expensive because the gravels are everywhere buried under 10 to 25 feet of muck. This is true not only of the floor of the valley, but also of the slopes and the tributary gulches. This overburden is too heavy to permit open-cut mining, and the cost of fuel has so far been to great to encourage drift mining or even prospecting. As a result much of the prospecting on Coffee Creek has been confined to cuts made by ground sluicing at favorable localities during floods, and few careful tests of claims have been made.

In the winter of 1906 some rich placer ground was found in the talus of the valley slope near the head of Coffee Creek. This peculiar auriferous deposit appeared to be almost in place. The gold occurs in 4 to 7 feet of angular schist and quartz debris and weathered schist bed rock covered by 18 to 20 feet of muck. The quartz is iron stained, but does not appear to be auriferous, and the gold probably came from the associated schist. The gold is angular, spongy, and bright colored. All these facts point to the conclusion that the material mined is a weathered part of a mineralized zone. The deposit has been traced about 1,000 feet, but is buried so deeply that its boundaries are not well known. It is indicative of the source of the gold and suggests the possibility of finding lode deposits that may x carry values.

The Kougarok Region

Northern Belt

Bench gravels have been reported at many localities, but those of proved economic importance are confined to the main Kougarok and some of its larger tributaries. These gravels are chiefly within 25 feet of the present water level, but some higher auriferous benches have also been reported.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA.

The Kougarok Region

Stream Dissection and Sedimentation in Local Basins.

While the drainage channels were being incised sediment was deposited in the Kuzitrin basin, then an arm of the sea. It has been shown that the character of this sediment is but imperfectly known. Underneath Quartz Creek valley there are nearly 200 feet of white quartz gravels, which would appear to be the result of the denudation of the old planated land surface. Such quartz gravels, many of which are not greatly rounded, are most likely to have come from an area which had been long subjected to subaerial decay. Their accumulation was probably brought about by rapid erosion and sedimentation, which would indicate rapid uplift. It has been stated that both rounded gravels and sands occur on the lower part of Quartz Creek and in a terrace along the west bank of Kougarok River, and that these are believed to be of about the same age as the white gravels described above. They probably represent a somewhat later period of deposition, when the materials had become more waterworn by stream action and more or less sorting had taken place.

The explanation of the occurrence of the clay deposit underneath the Kuzitrin lowland proper is still more difficult. Perhaps an attempt to explain this deposit is useless when so few facts regarding it are available. If, as is probable, this clay bed is extensive underneath the Kuzitrin lowland, it is probably a deposit in deeper water, laid down at the same time as the gravels described above. In other words, it is the result of sedimentation in the central part of the embayment along whose margin the gravels and sands of fluvial origin were laid down. This clay may, however, be a glacial mud, derived from the valley glaciers of the Bendeleben Mountains, which were the locus of an ice accumulation in recent time. Opposed to this genesis for the clays is the fact that the glaciation, which was confined to a very small area, occurred at a somewhat later period. One additional fact deserving mention is that the few borings made in these clays encountered several layers of vegetable matter which is in every way similar to the present tundra growth. This indicates that deposition in that part of the basin where the clay has been found has been interrupted by periods when the land stood above water long enough to permit a covering of vegetable growth.

The Kougarok Region
Geology

Bed Rock

As in other placer districts of the peninsula, the schistose rocks appear to be the source of the placer gold. Quartz seams and small veins are common in the schists, and many are iron stained. Prospectors say that some of these veins carry gold, and it is reported that a copper-bearing lode has been found near the divide between Kougarok and Serpentine rivers, but, so far as known to the writer, no lodes of proved commercial value have yet been discovered. There appear to have been two generations of quartz intrusions. The earlier preceded the extensive deformation of the schists, for its veins are crushed and sheared. The later intrusion, which cuts the first system of veins and is comparatively little deformed, appears more mineralized than the first. The presence of a massive granite intrusion near the later quartz suggests a genetic relation between this quartz and the granite, but of this there is no proof.

The Kougarok Region

Southern Belt

The auriferous gravels forming a broken fringe along the southern margin of the highlands that bound the Kuzitrin basin on the north and west have certain features in common, which justify describing them as a unit. This belt includes the placers of Quartz and Garfield creeks, as well as those of the Noxapaga basin. The bed-rock geology of the belt is obscured both by the extensive alluvial deposits and by the products of deep rock weathering. However, a belt of graphitic phyllites and schists, including some calcerous beds, appears to stretch across the upland between Kaviruk and Kuzitrin rivers. Many of these rocks carry quartz veins, locally stained with iron. Schists occur north of these graphitic rocks, and farther north are succeeded by limestone. Though these formations can not be exactly delineated, because of the deeply weathered character of the rocks and the absence of outcrops, yet most of the gold-bearing creeks appear to cross the contact of the limestone and schist.

The unconsolidated formations embrace (1) the present stream gravels, (2) the deposits flooring the Kuzitrin lowland, and (3) the bench gravels. The first group, which embraces most of the working placers of the district, is fully described on page 299. Little can be added to the description of the second group already given. The bench gravels merit closer consideration.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA

The Kougarok Region

Kougarok River

Though the general trend of the different parts of the valley is in one direction, its course in detail is tortuous. Within the valley walls the river flows in a very irregular channel, and many of the meanders are separated by well-defined benches whose flat surfaces mark former stages of water level. This is especially evident above Taylor Creek, where the river flows through a continuous series of oxbow curves, which are separated by sloping benches.

At the point where the Kougarok enters the Kuzitrin lowland both valley walls show well-marked benches. Two levels are here noticeable - one 50 feet and one 25 feet above the stream. These can be traced for several miles above Windy Creek; the walls then become steeper and the river occupies a canyon-like valley up to Left Fork. From this point to Washington Creek, 20 miles above, some evidence of benching can be observed in most places, though the benches are not continuous. The individual levels have not been traced, but in the part of the valley below Taylor Creek there are at least two high-level gravels and possibly three.

The Kougarok Region

The northwestern slope of the Bendeleben Mountains descends to a lowland basin bounded on the north by an upland and drained into Imuruk Basin by Kuzitrin River. This lowland has a width of nearly 10 miles at its upper end, but gradually narrows to the southwest as the upland and the mountains approach, becoming a well-defined valley about 3 miles wide. This valley extends about 10 miles and broadens out again to a lowland which encircles the upper end of Imuruk Basin. The margins of the lowlands are indented by the low spurs which extend from the mountains and the upland.

To the north the Kuzitrin lowland rises gently to an upland, whose flat summits stand at altitudes of 800 to 1,600 feet. Here broad, interstream areas, with flat hilltops, diversified by some higher domes reaching altitudes of 2,500 feet are separated by wide valleys. This upland level, as elsewhere in the peninsula, marks a former stage of erosion, when the entire region was planated. Subsequent uplift formed a plateau which has been greatly dissected by the present water courses.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA

The Kougarok Region

Kougarok River

The bench deposits of the Kougarok appear to afford an attractive field for the gold miner. Their position makes them easy of access and no hydraulic lifts are required to dispose of the tailings. Between Coarse Gold and Taylor creeks at least two distinct bench levels are well defined, one about 25 feet and the other 50 feet above the water. So far as observed, the gravels are from 8 to 10 feet in depth and are in most places covered with muck. No determinations of values are known to the writer, but the fact that some of the lower benches have been worked at a profit by crude means makes it seem probable that their gold content is sufficient to assure returns if handled by cheaper methods. Bench gravels have been reported at various places above Taylor Creek, and some are known to be auriferous, but they have not been developed on a commercial scale.

Descriptions of Localities

Kuzitrin Basin

Southern tributaries of the Kuzitrin - The creeks flowing into the Kuzitrin from the south side have not produced gold in commercial quantities; however, the writer was informed by a prospector that on Birch Creek some sluicing has been done. The pay gravel consisted mainly of decomposed granite, and the bed rock was also granite. The gold is probably derived from the rocks of the Kigluaik series. The mountains of the Bendeleben group are less rugged than the Kigluaik Mountains, and there has been little, if any, glacial erosion in them. If gold occurs in these rocks it is more likely to be concentrated in the gravels of the Bendeleben Range than in those of the Kigluaik Mountains.

A RECONNAISSANCE OF THE NORTHWESTERN PORTION OF SEWARD PENINSULA, ALASKA.

Physiography

Lowland Plains

The Arctic coastal plain extends from Cape Prince of Wales to Cape Espenberg. At Cape Prince of Wales it is not over 5 miles wide, but about Shishmaref Inlet it extends inland for 30 miles to the base of gently sloping hills which rise up to the Kugruk Plateau. To the eastward it appears to cover a large part of the peninsula between Shishmaref Inlet and Goodhope Bay. At its southern margin it is probably nowhere above 200 feet in elevation. The rivers and creeks which flow across it usually have entrenched their channels into the frozen deposits of the plain, sometimes exposing a face of gravel 20 feet high. In being elevated to its present position, this tract is not known to have suffered warping. All irregularities seen by the writer may be attributed to irregular deposition.

We have thus four definite periods of crustal movements, with accompanying injections, in the northern province. The first, which was probably regional, occurred in pre-Silurian times. The second was a period of intrusion, and can be provisionally assigned to the close of the Paleozoic, or the beginning of the Mesozoic. The third was a period of folding, which was rather local in its effect. The last was an epoch of extensive lavas, which, though rather widespread, was not great in the amount of material which was ejected.

Descriptions of Localities

Kuzitrin Basin

Along the Kuzitrin River below the mouth of the Kugruk the bed rock, wherever exposed, consists of the black slates and schists of the Kuzitrin series and the biotite-schists and granites of the Kigluaik series. No gold has been obtained in this part of the district.

Descriptions of Localities

Kuzitrin Basin

Near the Noxapaga, at the mouth of Turner Creek, a low, round hill, about 50 feet high, rises above the level of the lowland. This low butte is similar in form to many others scattered over the lowland, and is the remnant of an upper gravel plain which has in part been removed by erosion. The edge of the upper plain is usually marked by a sharply cut escarpment, from which partly isolated points often project, showing the phases of transition between the isolated butte and the continuous gravel plain. The butte near Noxapaga consists mainly of a dark deposit of impure peat mixed with layers of white sand. The peat contains trunks, bark, and limbs of spruce trees. The smaller branches are flattened by pressure of overlying gravels. The layers of white sand resemble sea-beach deposits, and suggest a driftwood origin for the peat. There is no spruce timber at present growing within the drainage of the Kuzitrin and Noxapaga rivers. At the time of this deposition, however, the climate here was undoubtedly milder, as is evidenced by the remains of the elephant and horse found in gravels of this period. At the base of the coal butte there is a large mineral spring from which carbonic acid escapes. The water is cold and resembles in taste that of soda springs, but no sample was taken for analysis. There is no connection between the spring and the coal butte, and their proximity is accidental. The peat has been tried with some success as fuel for steam thawers, and the butte is staked as a coal mine. It may prove of some importance in the development of the mines of the vicinity.

Igneous Rocks

Basalts

At a point on the Noxapaga River 2 miles above Noxapaga these lavas extend across the river, and their relation to the other rock was seen in a bluff above the river. Here the Pleistocene gravels filling the Noxapaga Valley rest on the upturned edges of the schists. The basalts lie upon these gravels, and near the contact the gravels are cemented by indurated clay. In the upper part of this gravel a few pebbles derived from basalt are found, mixed with quartz pebbles derived from the schist. This lava flow probably occurred in Pleistocene time, while the upper gravel plain of the Kuzitrin Basin was being formed. In the Koyuk Valley Mendenhall found evidence that the basalt is of Pleistocene or late Pliocene time. The evidence obtained in the Kuzitrin Basin indicates a similar age for the basalts found there.

Inland Basins

Kuzitrin lowland

This is an area of lowland covering approximately 200 square miles on the north side of the Bendeleben Mountains and drained by the Kuzitrin River. The lowland is tundra covered, and underlain by silts, sand, and gravels, probably of no great depth. It is dotted over with many small lakes, probably formed by oxbows of the meandering creeks and rivers. Around the lowland area on the west, north, and east sides there is a higher gravel plain, from 50 to 150 feet above the lowland. A well-marked escarpment usually separates this upper plain from the lowland. On the lowland surface, away from the margins, there are occasional gravel buttes, 50 feet or more in height, which at a distance resemble haystacks. These are regarded as remnants of the upper plain which have been left by erosion. At the edge of the upper plain transition phases between the plateau and the isolated buttes were noted in a few instances.

THE GOLD PLACERS OF PARTS OF SEWARD PENINSULA, ALASKA.

General Geology

Gravel-Plain Deposits

The Kuzitrin lowland deposit is the most extensive of the basin areas. The upper layers seem to be more gravelly than those of the Imuruk deposit. Around its western and northern borders there is a terrace from 50 to 100 feet above the general level, from which it is w separated by a marked escarpment. There are also many isolated gravel buttes from 25 to 50 feet high scattered over the lower portion. These features are regarded as residual parts of an older surface left behind in the erosion that has reduced the surface to the present level. Remains of the mammoth, horse, and other mammals, together with some large logs and accumulations of vegetable material, have been found in these buttes and terraces. Near the east end of this basin the gravels are overlain by lavas that flowed from vents near the head of Kuzitrin River.

Stratigraphic Succession

Kuzitrin Series

The type of rock of this series is a graphitic quartzite, or quartz-schist, sometimes passing into a graphitic flag, or even a slate. The Kuzitrin series forms a well-defined stratigraphic unit, which is recognized and named in the previous report. The relation of these rocks to the underlying Kigluaik series was not definitely established, but such evidence as there is indicates that they are conformable. On the south side of the Kigluaik Mountains they were found standing at a high angle and forming a belt 1 to 2 miles wide flanking the mountains. At this place the thickness of the series was estimated at approximately 2,000 feet.

Two considerable belts and a number of small areas of these rocks have been identified in the northern part of the peninsula. The southern belt, extending eastward from Port Clarence to the Kugruk River, forms a part of the northern limit of the great anticlinal uplift of the Kigluaik and Bendeleben mountains.

Physiography

Valley lowlands

The Kuzitrin lowland covers an area approximately 10 by 20 miles, its longer axis parallel with the Bendeleben Range. The portion of this plain lying along the Kuzitrin and Noxapaga rivers is subject to inundation at the time of flood. North of the Kuzitrin River a gravel terrace of about 20 feet in height marks a higher portion of the lowland. The principal settlement of this region, known as Checkers, was formerly located at the junction of the Kugruk and Kuzitrin rivers. Owing to the high water, this location was abandoned and a new town, called Kugruk, was built on the terrace near the Kugruk River, about a mile above its mouth.

Descriptions of Localities

Kuzitrin Basin

The drainage basin of the Kuzitrin River has produced placer gold in a number of widely scattered localities, and its placers have been more or less exploited since the winter of 1899.

Descriptions of Localities

Kuzitrin Basin

The Noxapaga River has a very sinuous course across the valley lowland. About 8 miles north of its junction with the Kuzitrin the Noxapaga flows near the northern edge of the valley lowland. At this point it receives a large tributary from the north, known as Turner Creek, where Noxapaga, the recording office of the district, is located. Two miles above Turner Creek the Noxapaga occupies a rather broad canyon cut to a depth of 50 feet or more in a gravel-covered plain above the valley floor. About 8 miles above Noxapaga the river forks, the branches being known as the East and West forks. Their upper waters lie in valleys incised in the higher plateau. Gold has been obtained from Garfield Creek, Boulder Creek, and Goose Creek in this region.

Descriptions of Localities

Kuzitrin Basin

Macklin Creek is a tributary of the Kugruk (Kougarok) River from the east side, about 6 miles above the mouth of Taylor Creek. It heads near the base of Midnight Mountain and flows westward about 6 miles to its junction with the Kugruk (Kougarok) River. For several miles Macklin Creek flows parallel to Schlitz Creek, tributary to the Serpentine River, and a low pass between the two creeks suggests an old waterway. The creek occupies a rather broad valley out in the upland. The bed rock, where it has been seen, consists of dark feldspathic, graphitic mica-schist, similar to that of Midnight Mountain.

Geological Problem

The andesites have a dark
between Mt. Walker and Buckland
rivers - contain - (not geological map)
several granite outcrops.

Gold placers are known in
several creeks. The _____ Co
& Caribou and are drilling ground in
Bear Creek.

It is a matter of considerable economic
importance to determine whether or
not apart or all of these outcrops
are earlier or later than the Lavas.
Should a part or all of them various
granite pegs of later age and
were intruded through the granite
a favorable field for lodes and placers.
Should all the granites have been
of an earlier age than the lavas
it would mean that ~~all~~ most of the associated gold

is contained under the lavas as placer
gravels and with the exception of the
granite intrusion presently exists at
a depth beyond the reach of economic
mining.

Again assuming the lavas were laid
down around the granite intrusion, the
eruptive conditions which preceded the
lava flows no doubt produced
fractures within the granite making
for the presence of hydrothermal
waters which caused a gold precipitate
near the surface and later erosion
may have found placer deposits in
some stream that crossed near these
granite intrusions down. Such a
condition would account for gold
discovery and the high grade placer deposits
in the lava bedrock.

Again certain intrusions may have been
prior to lava flows and some may
have been later, again placer deposits

would be found in the accumulation of the latter.

At least it is partly correct to assume that some granites particularly the monzonites & similar types - they exist there some gold as the after product of crystallization, emitted by charged heat by the Tertiary waters.

The problem of determining the kinds of contacts, ages and the regions of the contacts until lava flows and the present position of the gold at the present time ~~with the~~ ~~street~~

as (1) Work from surrounding contacts prior to lava flows. Remains mostly under the lavas. or placer deposits under lava flows

(2) Work from surrounding contacts the later later than lavas. gold contained partly a broken surrounding lavas as partly a placer or stream deposits of top of lavas.

(3) Gold as placer partly covered by latter lava & southern portions / and.

Bull 247 – Moffit

"As to the age of the Andesite, it can only be said that they, too, are younger than the metamorphic rocks, but whether earlier or later than the granite is not yet known."

MINERAL RESOURCES OF ALASKA, 1913

Placer Mining in Seward Peninsula

Fairhaven District

In the Fairhaven district four dredges were in operation in 1913, and each had a fairly successful season. One of these was on Candle Creek, one on the Kugruk, and two on Inmachuk River. The Kugruk dredge was installed in 1913 and operated for about a month and a half. Other dredges which are planned for this region may be installed in the near future. Representatives of the Dearborn Investment Co. extensively prospected the company's holdings on Kugruk River last season and expect to install a dredge in 1914. It is also reported that another company will put a dredge on Independence Creek, a tributary of the Kugruk.

THE FAIRHAVEN GOLD PLACERS OF SEWARD PENINSULA, ALASKA.

Geography

The northward projection of the peninsula is a country of very low relief, and the coastal plains bordering the Arctic Ocean and Goodhope Bay are broken only by mounds of gravel or by lava masses like that of which Devil Mountain is composed. A depression of 200 feet would put much the greater part of the area below the sea, making an island of the mountain, as it probably was at no very distant time.

Viewed as a whole, the northern part of Seward Peninsula is characterized by general low relief and monotonous appearance.

U.S.G.S.Bull. 442.

MINERAL RESOURCES OF ALASKA, 1909

Mining in Seward Peninsula

Inmachuk River

Some prospecting has been carried on for several years under the lava rims which are such noticeable features in the topography of the lower Pinnell and Inmachuk valleys, and many interesting facts have been brought to light. Two old channels have been located on both sides of Perry Creek near its junction with Pinnell River. The lower channel is at least 200 feet in elevation above the river, and the upper channel is 52 feet higher. In the lower channel there is 3 to 9 feet of gravel covered with about 20 feet of muck, and this is overlain with lava except where the lava has been eroded away. There is no muck overlying the upper channel, and the lava and gravel are mixed, a fact which seems to show that this channel was later than the lower one and was occupied by the stream at the time of the extrusion of the lava sheet. Pieces of wood were found on top of the gravels of the lower channel. A log 3 feet in diameter is said to have been encountered in one hole, but its relation to other deposits was not learned. The old channel can be traced down the Pinnell, following the left of its valley to its mouth. It then crosses the Inmachuk to its left or north side and extends for 3 or 4 miles to a point above the Homestake group of claims, where is crosses again to the right. It was not learned whether more than one channel had been located in this portion of the valley. Fair prospects were found under the lava at the mouth of Perry Creek and also just below the upper crossing of the Inmachuk and nearly opposite the mouth of Pinnell River.

Mining in the Fairhaven Precinct

Inmachuk River Above Pinnell River

Little mining has been done in the part of the river above the mouth of the Pinnell, and in 1908 the only development work was a little prospecting just above Hannum Creek. The depth of the gravel in the stream bed is here about 6 to 8 feet and the width not over 200 feet. Prospects were found, but nothing rich enough to pay to shovel. It was reported in the fall that practically all the ground from the mouth of Pinnell River to the springs on the upper Inmachuk had come under one control and that a ditch would be built to bring water from the springs for hydraulicking. It may be possible to reduce mining costs in this way, so that much of the ground can be profitably worked. The springs furnish a constant supply of water of about 8 second-feet, and a pressure of about 150 to 200 feet can be obtained on most of the ground.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

1 9 0 3

The Kotzebue Placer Gold Field, Alaska

Gold Occurrences

Inmachuk River - The Inmachuk River is between 25 and 30 miles in length. It rises in the limestone area of the western part of the field, flows toward the northeast to the flats bordering Kotzebue Sound, and then meanders slowly in the same general direction to the sound. At Record City the eastern fork, known as Pinnell River, joins the main stream from the south.

The most productive portion of the Inmachuk begins near the mouth of Pinnell River and extends down the stream for a number of miles. The valley is much broader than those of the tributaries, and in this portion is occupied by a series of broad flats, having in places a width of more than a quarter of a mile.

The gravels occasionally reach a thickness of 6 to 8 feet. They are invariably frozen, except in the channel of the river, and are often covered by an ice bed. The bench and creek claims on the Inmachuk have been more extensively prospected than on the other streams, with the result that in a number of places a well-defined pay streak is known. At two localities lines of holes, extending across the valley, have been thawed down to bed rock, and at a number of places lines of holes have been sunk part way across. This work is carried on with the aid of thawers, the boilers ordinarily furnishing steam to 4-foot points set twice each day. The consumption of fuel in work of this kind is large, and greatly increases the cost of mining.

MINERAL RESOURCES OF ALASKA, 1908

Mining in Fairhaven Precinct

Inmachuk River Below Pinnell River Page 357

The 7 miles of Inmachuk River below the mouth of the Pinnell have contributed a large share of the production in this basin, the total amount to date, as nearly as can be learned, being from $400,000 to $500,000, nearly all of which has been taken out by winter drifting. The gravel flat in this part of the river is from 800 to 1,200 feet wide and the depth to bed rock varies from 15 to 30 feet outside of the river channel. The greatest depth, 25 to 30 feet, is in the upper portion, on claim "No. 1 below Pinnell;" below the mouth of Washington Creek the ground is shallowest, being 12 to 15 feet deep. The channel thaws to bed rock in summer and as the gravel is mostly fine and loose, being called by the miners "chicken feed", there is a large underflow of water which has hindered open-cut work of any kind. In the winter the river is filled with the ice formed by the overflow of the water from the springs, and under these conditions the ground has been drifted, the ice being used as a roof. In some places enough light came through this cover to make candles unnecessary.

The bed rock is schist with interbedded limestone. The limestone seems to have served as a natural riffle and carries most of the gold. It lies in large, irregular slabs cemented together with clay, and is very hard to handle in drifting or open-cut work. Gold is sometimes found in the gravel, but only in the lower 2 or 3 feet.

MINERAL RESOURCES OF ALASKA, 1908

Mining in Fairhaven Precinct

Kugruk River Basin

Gold

The only mine that has produced any considerable amount of gold is on Discovery claim, on the Kugruk, a short distance above the mouth of Chicago Creek. At this point the river valley has a width of about a mile and the channel, which lies on the east side of the valley, is about 200 feet wide. The depth to bed rock on Discovery claim is only 12 to 14 feet, including the overburden. The pay streak is crescent shaped in outline and nearly a claim length from end to end. At the points of the crescent the gold is fine; in the middle it is coarse. The production from this claim during the winters of 1903-4 and 1904-5 is said to have amounted to $150,000. Its success led to much prospecting in the vicinity and over 100 holes were sunk to bed rock without finding any values. One hole, three-fourths of a mile from the river and a short distance above Discovery claim, is of interest in showing the great depth of ice and muck sometimes found in this part of Seward Peninsula. The following section was furnished by the prospector:

Section three-fourths mile from Kugruk River, near Discovery claim.

	Feet
Clear ice	26
Muck	60
Reddish gravel	8
Muck	3
Bluish gravel	10
Schist bed rock	

U. S. G. S. WATER-SUPPLY PAPER 314

SURFACE WATER SUPPLY

Of

SEWARD PENINSULA, ALASKA

By F. F. Henshaw and G. L. Parker

KUGRUK RIVER DRAINAGE BASIN

Description

Kugruk River rises in Imuruk Lake and flows in a northeasterly and northerly direction for about 60 miles, emptying into Kotzebue Sound near Deering. Imuruk Lake lies on top of the lava plateau that occupies a large area in the central part of Seward Peninsula, at an elevation, as near as can be determined from barometer readings, of 960 feet. I has an area of 31 square miles and a drainage basin of 102 square miles. Below the lake the river is relatively flat for 3 or 4 miles. It then breaks over an escarpment at the edge of the lava and flows through a canyon about 2 miles in length which has been cut in places 300 feet deep and 1,000 feet wide. The fall in the canyon amounts to nearly 250 feet to the mile. At its lower end the river is probably at about the level which it occupied before the extrusion of the lava flow, nearly 550 feet below the level of the lake. The canyon affords a favorable location for a plant to develop electric power, for water from the lake can be diverted through the upper end of the Fairhaven

ditch or through a water-way parallel with it for about 4½ miles and then through a pipe line to the lower end of the canyon, where a pressure of about 500 feet can be obtained.

* * * * *

Water supply available from Imuruk Lake, 1906-1908. Page 231

(Elevation, 960 feet; drainage area, 102 square miles)

		Aug.16,1906 to Aug.13,1907	Oct.1,1907 to Sept.25,190
Rise of lake surface	feet	2.17	1.53
Equivalent water supply	acre-feet	43,100	30,400
Outflow	do.	0	6,400
Total water supply	do.	43,100	36.800
Mean annual discharge	second-feet	60	51
Discharge for 100-day season . .	do.	217	186
Run-off from drainage area . . .	inches	7.9	6.8

Water-Supply Investigations in Seward Peninsula in 1909

Kugruk River Drainage Basin

Kugruk River rises in Imuruk Lake and flows northwestward for about 20 miles and thence northward for the remainder of its 60 miles of length, emptying into Kotzebue Sound near Deering. Imuruk Lake, with an area of 31 square miles and a drainage basin of 102 square miles, lies on top of the lava plateau in the central part of Seward Peninsula. About 4 miles below the lake the river has cut into the edge of the lava, forming a canyon about 300 feet deep and 1,000 feet wide at its deepest point. At the mouth of the canyon the river is about 500 feet below the level of the lake and is probably at about the elevation it had before the invasion of the lava flow. This canyon affords a favorable location for a plant to develop electric power. Water from the lake can be diverted through a ditch for about 4½ miles and then through a pipe line to the bottom of the canyon, developing a pressure of nearly 500 feet. Below the canyon the grade of the river is relatively flat.

The Kotzebue Placer Gold Field, Alaska

Character and Origin of the Gold

Candle Creek gold resembles very much that from the Inmachuk, but is usually somewhat darker and is said not to assay as well. The minerals associated with the gold are the same as those found on the Inmachuk. Many of the ironstones are nearly always present and a decrease in their amount is regarded by the prospectors as an unfavorable sign. So dark is the gold that it is not an uncommon sight to see a miner, when panning, bite a nugget in order to make sure of its being gold and not one of the ironstones. One nugget worth $62.10 and a second, $36, have been taken from the creek.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

1 9 0 3

The Kotzebue Placer Gold Field, Alaska

Character and Origin of the Gold

Bear Creek gold, assaying over $19, is flattened and much brighter in color than that from any other part of the field. With the gold is found considerable black sand, which is entirely removed by the magnet, and is undoubtedly derived largely from magnetite in the granites and andesites forming the eruptive mass in which the stream rises. The presence of black sand constitutes a second difference between this gold and that from Candle Creek or the Inmachuk district. Gold from Sherdon Creek is much coarser than the fine, flaky gold on Bear and Cub creeks, but the Cub Creek gold occurs throughout the whole thickness of the gravel, differing in this respect from Sherdon and Bear creeks, where it is found on bed rock. Cub Creek gravels also show a large amount of a heavy, red, cherty rock, which sticks in the pan or riffles and causes inconvenience in sluicing.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

1 9 0 3

The Kotzebue Placer Gold Field, Alaska

Character and Origin of the Gold

Gold from the Inmachuk district is dark and heavy, assaying about $18 to the ounce; almost no black sand is present, but considerable gray sand or pyrite is seen in the pan and the boxes always contain a large quantity of rounded hematite pebbles which the miners call "ironstones." The gold frequently contains a little quartz and is sometimes seen in the form of fine veinlets in the ironstones. Small pieces of rutile are occasionally found with the heavy concentrates and have been mistaken for cassiterite. Dr. Cabell Whitehead, of the Alaska Banking and Safe Deposit Company, has informed the writer that about 27 ounces of tin were recovered in cleaning gold brought to Nome from Old Glory Creek, so that the tin ore, cassiterite, must be present on that stream. On the upper part of Hannum Creek, a small quantity of galena is associated with the gold and ironstones. Much of the gold from the Inmachuk and its tributaries is coarse and rough. Pieces of the value of $2 or $3 are not uncommon, but no large nuggets have been found.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

1 9 0 3

The Kotzebue Placer Gold Field, Alaska

Gold Occurrences

Inmachuk River - Hannum Creek, which flows into the Inmachuk above the mouth of the Pinnel, has produced a small amount of gold during the last two years. This stream flows through a narrow canyon-like valley surrounded by a rim of lava and sheeted over with gravels, consisting mainly of schist with smaller amounts of quartz, limestone, and lava, which appear in places as broad tundra-covered flats one-fourth to one-half mile long.

The gold is irregularly distributed along the bed rock of the channel, or "spotted," as the prospectors say; with it is associated some pyrite and a very small amount of galena.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

1 9 0 3

The Kotzebue Placer Gold Field, Alaska

Gold Occurrences

Inmachuk River - Old Glory, on which the original discovery of gold in this region was made, is a short creek about 6 miles in length, rising in the limestone area north of the Asses Ears and joining Pinnell River 1¼ miles above its junction with the Inmachuk. The valley of Old Glory is cut in a series of schists with occasional interbedded limestones; it is broader than that of Hannum Creek, and is covered with a sheet of wash gravel, largely quartz, which extends well up on the slopes. Near the bottom of the valley the gravels have been much disturbed by the sliding of rock, gravel, and tundra from the sides. These gravels differ further from those above in the much larger amount of schist which they contain and the decrease in rounded quartz pebbles. No pay streak is known, the creek being "spotted," as is Hannum Creek.

U.S.G.S.Bull. 442.

MINERAL RESOURCES OF ALASKA, 1909

Water-Supply Investigations in Seward Peninsula

Fairhaven Precinct

Goodhope River Drainage Basin P. 399

Goodhope River is formed by the junction of Right Fork and Cottonwood Creek and flows in a general northwesterly course to Goodhope Bay. Right Fork, the true source of the river, rises in the lava near Imuruk Lake, the source of Kugruk River, and flows through most of its course in a rather narrow canyon, in places 600 feet deep. There are springs in the lava which contribute a large portion of the low-water flow of the river. Cottonwood and Eagle creeks enter from the east and Esperanza, Placer, and Humboldt creeks from the west and south. The larger portions of the basins of these tributaries lie outside the area of lava.

Esperanza Creek is the only tributary on which any systematic mining has been done. Gold in paying quantity was discovered in 1908 and the creek was worked in 1909 as far as the scanty supply of water permitted.

U.S.G.S. Bull. 442.

MINERAL RESOURCES OF ALASKA, 1909

Mining in Seward Peninsula

Goodhope River

P. 366

Mining was confined to Esperanza Creek, where workable placers were first found in the spring of 1908. Esperanza Creek is a small stream which drains an area of about 20 square miles. It has a flat grade, especially in the lower portion, where the fall is only 5 to 7 feet to the claim, or about 25 feet to the mile. The stream has a narrow channel winding between muck banks and its general appearance is similar to that of Candle Creek. The pay streak, so far as developed, lies in a narrow, shallow strip in the creek bed. When the creek was visited, on June 24, preparations had been made to mine on six claims near the lower end of the creek. Ditches had been dug to convey water for sluicing and diversion dams had been put in. These ditches were for the most part about a claim in length and were built with very light grade, but even then they gave hardly enough head to raise the water into the sluice boxes. * * * *

Placer Creek, a tributary of Goodhope River, below Esperanza Creek, was prospected by shafts during the winter, but no values were found. A hole was sunk about 6 miles above the mouth, through muck and angular material, to a depth of about 45 feet, where heavy lava bowlders were encountered.

Some prospecting was done on Humboldt Creek, which rises near the hot springs north of Taylor Creek and enters the Goodhope about 10 miles from its mouth. Values were found, but nothing rich enough to pay to shovel.

The Gold and Platinum Placers of the Kiwalik-Koyuk Region

Tertiary Rocks

It is not known how long sedimentation continued after the close of the Cretaceous. In near-by regions there is reason to believe that it was uninterrupted until well into the Eocene. By that time a considerable thickness of Cretaceous beds had accumulated, a large portion of which has since been eroded. At or near the close of the Eocene, however, earth movements of considerable magnitude took place in different parts of Alaska, and this region was affected by them. Igneous intrusions along the axes of the folds accompanied this diastrophism. Some of the rocks of the Granite Mountain area, already described, and the accompanying dikes, which are found on Bear and Candle creeks, may be ~~xxx~~ of this character.

U. S. G. S.

WATER-SUPPLY PAPER 314

SURFACE WATER SUPPLY OF SEWARD PENINSULA, ALASKA.

by

F. F. Henshaw and G. L. Parker

Summary of Placer Mining

Pp. 302-303

Cheaper transportation and fuel would decrease the expense of dredging and to a lesser extent the cost of other forms of mining. Mining engineers who have studied the question hold that mining costs can be reduced by the increased use of mechanical devices other than dredges.

The data presented go to show that the cost of placer mining in Seward Peninsula is much greater than in the States. It is also true, however, that the peninsula is far more easy of access than the Yukon region and, except for the absence of fuel, its physical conditions are more favorable to mining. Mining operations should therefore cost much less at Nome than at Fairbanks or in the Klondike. The Klondike has an advantage in its water supply, but in stream gradients there is little to choose between Fairbanks and Seward Peninsula.

The future of the placer-mining industry of the peninsula depends of course, on the amount of placer ground remining that can be profitably exploited. This, in turn, is a function of the cost of mining. No one can doubt that there are enormous deposits of gravel which carry 25 cents in gold to the yard, in such position that they can be mined only by mechanical means, particularly by dredges. What percentage of this gravel is unfrozen and therefore available for recovery under the present dredging practice can be determined only by careful prospecting. The most important problem for duture dredge mining is to devise means to thaw the frozen auriferous alluvium at a cost sufficiently low to permit profitable extraction by dredges. Extensive creek placers, too shallow to work by dredges, probably carry higher values than the deposits mentioned above. Some of these deposits are so located with reference to water supply that they can be profitably hydraulicked, though elevating the tailings will in most localities be necessary. Lack of water, however, will always prevent any very large expansion of the hydraulic-mining industry. Underground mining is on the wane and the outlook for its expansion is not encouraging, although some extensive deposits of deep gravels at several localities have not yet been carefully prospected.

AREAL GEOLOGY OF ALASKA

Tertiary to Recent volcanic Rocks

Seward Peninsula

Throughout Seward Peninsula are many small areas in which Tertiary to Recent volcanic rocks have been reported, and in the vicinity of Imuruk Lake, in the north-central part of the peninsula, an area of considerably more than 1,000 square miles is covered by these rocks. So recent are some of these lavas that the ropy surface of the original flow is still preserved, and in places they have flowed out over gravel of late Tertiary or Pleistocene age.

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In those places the lavas are old, though from such evidence as is available they are not so old that they antedate the Tertiary. Furthermore, some of the gravel deposits over which the younger lavas flowed contain pebbles derived from earlier lavas. These flows must have had very significant effects on the drainage lines of the region by filling up some of the stream channels and causing the streams to take up new courses elsewhere. As many of the old stream courses elsewhere were the sites of placer concentration, the determination of the location of those that have been buried under the lava might have considerable economic value and well repay a search to discover them.

Suggestions to Prospectors for Placer Deposits

Gravel-Plain Placers

In the gravel-plain deposits that form the broad flat between Kruzgamepa and Niukluk rivers, the evidence as to the existence of placers is not clear. Much of the material of which this plain is formed has been brought from the Kigluaik and Bendeleben mountains, which are regions in which no gold veins have yet been found. This would suggest that economically important placers will be wanting. On the other hand, some of the material has come from the south and in that region gold-bearing veins and workable placers are known. The material from the north and south is more or less intimately ~~mixed~~ intermixed. From this/conclusion is reached that the placer gold will be so scattered through a large amount of barren material that it could be extracted only by large companies capable of handling an immense amount of gravel at a low cost.

On the other hand, the areas where placers have been most extensively worked have been downstream from the outcrop of the massive Sowik limestone or along the contact of this formation with the Solomon schist.

Suggestions to Prospectors for Placer Deposits

Stream and Bench Placers

The intimate relation between many of the rich placer districts and the limestone-schist contact is being more and more strongly emphasized the more Seward Peninsula is studied.

Suggestions to Prospectors for Placer Deposits.

Stream and Bench Placers

It has previously been pointed out that the Hurrah slate is a much mineralized rock, everywhere intersected by quartz strings, some of which are known to be auriferous. In areas where this formation is the country rock placers are usually found. The best example of this condition is shown by the creek and bench placers along Big Hurrah Creek. There are, however, some places where this rock is found but where placers are wanting. It therefore remains to be proved whether the absence of placers is real or is only due to lack of prospecting. On the whole, however, the Hurrah slate does not seem to be as important a placer producer as the limestone-schist contact.

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METHODS AND COSTS OF GRAVEL AND PLACER MINING IN ALASKA

Methods of Mining, and Conditions.

The remarkable ancient gravel channel which cuts the southern portion of the peninsula from east to west, extending from Fish River along Casadepaga and Kuzitrin rivers to Port Clarence, lies at so low a level that the present streams have not cut through it to bed rock. Except where subordinate pay streaks exist in it above the present stream, therefore, the physiographic conditions will forbid its gravels being hydraulicked, while any other form of open cutting is manifestly impossible. It has been little explored, and portions of it may be found rich enough to drift.