seen flanking the northwest side of the trap range of Keewenaw Point, southwest of township 57 N., R. 33 W., or between this and the Lake coast, until they were found on the northwest side of the Porcupine mountains. They are supposed to be wanting between these points, or they have diverged from the trap range, and occupy the bed of Lake Superior, which latter condition is deemed the most probable, as this direction best conforms to the strike of these rocks at both places.

VEINS AND VEINSTONE.

Between the east end of Keewenaw Point, and Portage Lake, the trap and conglomerate rocks are traversed by many well defined veins, at nearly right angles with the general course of the trap range, and at the surface of the rocks, these veins are from a mere line, to several feet in width.

The veins above alluded to, are generally nearly vertical in the rocks they traverse, and in some instances, they appear to have been fissures in the rock, and subsequently filled with veinstones, differing much in their character in different rocks.

In the greenstone and amygdaloid, these veins are usually made up of trap, more or less associated with quartz, and on their sides firmly blended with the rock which they traverse; but, in the conglomerate rocks, the veins are almost uniformly of calcareous matter.

Besides the well defined veins, above alluded to, there are others imperfectly formed, having a more diffusive character; also, at several points on the Lake coast, along the line of conglomerate rocks, veins of calcareous matter were seen, apparently embraced between

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their strata. These veins have a course nearly at right angles to the veins before alluded to, and are supposed to be of no very great extent.

Some of these veins at least are metalliferous through some portions of their course in the rocks which they traverse, and contain native copper and some of the ores of copper. Green and blue carbonate, and the black oxide, are thought to be the most abundant of the ores; and so far as I have been able to observe these veins, their metalliferous character is best developed along the line of junction of the the trap and sedimentary rocks on *both sides* of the trap range.

The metalliferous character of these veins above described, have been most explored on the northwest side of Keewenaw Point, where some of them are now being worked, and much interest is felt by the enterprising proprietors of these works.

Thus far, several of these veins offer increased inducements to prosecute the work, and a few years of labor will develope, in some *good* degree their true character.

That portion of the trap range of Keewenaw Point, extending southwest of Portage Lake, to the south boundary of the survey, has generally less width than that which has already been described, and the trap rocks do not so frequently crop out, consequently, its junction with the sedimentary rocks, could not often be seen. But the aberrations of the magnetic needle, (determined by the Solar Compass,) has always been found to be very great on or near the trap hills, by which means, it is believed, that its boundary on the township lines, where no out crop could be seen, has been very nearly

defined. (See map.) But few veins are seen traversing the rocks on this part of the trap range, and no one observed to be metalliferous. Creditable reports, however, say, that copper veins have been found near the head waters of Elm river.

ARGILLACEOUS SLATES.

Argillaceous slate of a dark brown color, and slaty sandstone, are developed on a large scale in the bed and banks of Iron river, through township 51 north, range 42 west three or four miles east of the Porcupine mountains. These slates are very variable in their direction and amount of their dip in different places. They vary from N. E. to S. E., and dip from 15 to 45 degrees in that direction.

These slates were also seen 50 or 60 chains east of Iron river, near corner of sections 25 and 36, and dipping E. N. E. about eleven degrees. From these facts it is reasonable to infer, that the slates dip under the sandstone, to the east of them, and that they extend west, to the base of the Porcupine mountains. But these slates, except in the streams before mentioned, are generally overlaid with a considerable depth of earth, and, therefore, their boundary could not be correctly defined.

Argillaceous slaty sandstone, somewhat similar to those already described, are found on the northwest side of the trap range of Keewenaw Point, on the east and south boundaries of township 53 north, range 36 west, (sections 25 and 33.) These slaty sandstone seldom crop out, consequently their limit was not ascertained. These rocks dip considerably to the northwest.

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RED SANDSTONE.

Between the slates of Iron river and the trap range of Keewenaw Point, (except as above mentioned,) and south of the north half of T. 57 N., R. 33 W. and the Lake coast, to the south boundary of the survey, so far as known, the country is underlaid with red sandstone.

This rock frequently appears along the Lake coast, and in the beds and banks of streams and ravines.—The sandstone here is supposed to belong to the same formation of the red sandstone already described, east of the trap range of Keewenaw Point. Its general character is the same, except that in some places it contains more mica. This sandstone was observed to dip most near the trap range, in a N. N. W. direction, which dip diminishes to the coast of Lake Superior. A nicely stratified and jointed form of this rock, may be seen on the Lake coast at the south boundary of T. 55 N., R. 36 W.

TRAP AND CONGLOMERATE ROCKS OF THE PORCUPINE MOUNTAINS.

The remaining part of the survey embraces the northerly portion of the Porcupine Mountains, the boundaries of which have already been described. (See map.) These mountains are made up of a somewhat broken range of trap and conglomerate hills, having an estimated height from three to nine hundred and fifty feet above Lake Superior.

South of Carp river, (which runs nearly parallel to the Lake coast,) and the south boundary of the survey, also the west half of T. 51 N., R. 42 W., embraces

the trap rock within this part of the survey, which occupies an area of less than one township.

A large proportion of this trap is very compact, but in some places it is an amygdaloid, the cells of which are generally filled with calcareous matter or epidote. This trap, also, varies in color from a dark green or gray, to nearly a brick red.

To the northwest of the trap rock hills, and separated from them by the valley of Carp river, are two conglomerate hills, having a course nearly parallel to the Lake coast, from six to eight miles, the highest parts of which are estimated at 400 feet above Lake Superior.

These conglomerate rocks appear to belong to the same formation with the upper conglomerate of Keewenaw Point, having, like the latter, alternating strata of sandstone and conglomerate rocks, which dip to the N. N. W., at an angle from 25 to 45 degrees. A few veins of calcareous spar, were seen in these rocks at the Lake coast, on east boundary of T. 51 N., R. 43 W.; also, near the *lone* rock (so called.) in T. 51 N., R. 44 W., but no one observed to be metalliferous.

It is, however, creditably reported, that copper veins have been found on this part of the survey.

DRIFT.

Numerous erratic boulders and other finer materials, are found spread over this region of country, apparently derived from the rocks which abound here, and from the region north of Lake Superior. Therefore, it is not uncommon to find transported blocks along the Lake coast, or in valleys of streams which contain copper or other interesting minerals. The relative position of the

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land and water of Lake Superior, at some remote period of time, appears to have been quite different from their present state, as is evidenced by the effect of the Lake on the rock, and the form of the Lake bluffs, in many places some two hundred feet above its present level.

Thus far, a brief view of the geological condition of the various rock formations has been taken, leaving to the reader the pleasure of drawing his own conclusions as to the causes which have produced these geological effects, and also as to what may be deemed to be more or less valuable or interesting in this region of country.

In executing this part of the work, I have been much assisted by valuable instructions from our late and respected State Geologist, Dr. Douglass Houghton, who had this survey in charge, and from whom a critical geological report was expected.

In conclusion, it may be proper to remark, that in consequence of township lines being confined to distances of six miles apart, and to north and south and east and west courses, they frequently pass, for a long distance, over ground not the most favorable for geological examinations; also, supplies have to be furnished with packmen, instead of pack horses, in this region of country, and each man of a party on township lines, is under the necessity of performing his duties with a pack upon his back. But, notwithstanding these difficulties, it is believed that when experience shall have perfected this system of linear and geological surveys, it will be found the cheapest and the best yet devised for the public interest.

WILLIAM A. BURT.
Deputy Surveyor.

GENERAL OBSERVATIONS.

UPON THE

GEOLOGY AND TOPOGRAPHY

OF THE DISTRICT

SOUTH OF LAKE SUPERIOR,

SUBDIVIDED IN 1845, UNDER THE DIRECTION OF

DOUGLASS HOUGHTON, DEPUTY SURVEYOR.

THE subdivisions embrace the following townships which are fully completed, and the notes and maps thereof, are herewith returned.

Town 46 North,	Ranges	24, 25 and 26		West.
" 47 "	"	24, 25 and 26		"
" 48 "	"	25 and 26		"
" 51 "	"	32 and 33		"
" 52 "	"	32		"
" 53 "	"	32 and 33		"
" 54 "	"	32 and 33		"
" 55 "	"	31, 32 33 and 34		"
" 56 "	"	30, 31, 32, 33 and 34		"
" 57 "	"	29, 30, 31, 32 and 33		"
" 58 "	"	26, 27, 28, 30 and 31		"
" 59 "	"	27, 28 and 30		"

The notes and maps of town 58 north, ranges 29 and 32 west, and town 59 north, range 29 west, were in possession of Dr. Houghton, and were lost with him.

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For our present purpose, the above named towns may be arranged in two divisions, which, from their different geological features, will be separately considered.

In the first, will be included towns 46, 47 and 48 north, ranges 24, 25 and 26 west. In the second division, the towns upon the Keewenaw Peninsula. Towns 48, in ranges 25 and 26, and all those of our second division, are within the *town line survey* of the past season, and the general features of their topography and geology, are exhibited with great perspicuity and accuracy, in the report of WM. A BURT, Esq. accompanying the returns of his surveys. I shall therefore, as far as possible, avoid repetition of facts which appear sufficiently detailed by him.

PRIMARY AND METAMORPHIC REGION.

Granite Rocks.

The portion of country included in our first division, which is occupiod by these rocks, embraces towns 46 north, ranges 24, 25 and 26 west, together with most of the lower tier of sections in the towns adjoining on the north.

Throughout this region, the granite rocks make their appearance in a succession of rounded knobs, elevated from 20 to 100 feet above the surrounding country, and from 300 to 800 feet above the level of Lake Superior, and having a general range a little south of west, and north of east.

These rocks vary much in character and composition, being sometimes hornblendic, and approaching a perfect syenite, but more commonly feldspathic, or

composed of quartz and feldspar, in which the latter mineral predominates. In the more southerly portion of the district, the feldspar is red, and gives a predominant color to the rock. Occasionally, the granite is traversed by quartz in irregular veins. Some portions are massively stratified, the masses dipping to the north, or being nearly vertical. The knobs are rounded in outline; and are sometimes bare rock; but, in general, they, in common with the surrounding country, are well timbered with spruce, hemlock, fir, birch, sugar maple, white pine and aspen. The soil is, in general, sandy, and second or third rate.

Plains of spruce pine occupy the more elevated portions of the district, embracing about one half or the central part of town 46, range 25, and, stretching northerly, include the southwesterly one fourth of town 47, range 25. This tract is destitute of streams, and the soil is very poor and sandy. The timber is chiefly an inferior spruce pine. These plains divide the waters flowing into Lake Superior on the N. and E., and Lake Michigan on the S.

This granite district is intercepted on the east by a belt of the red sandrock, hereafter alluded to, which occupies the tract between it and the Lake coast.

A little south of Presque Isle, granitic rocks make their appearance on the coast of the Lake, and westerly from Presque Isle, continue to occupy the projecting points for several miles, the red sandrock occupying the intervening bays. Knobs also of this rock, occupy the portion of town 48 north, range 25 west, lying north of Riviere du Mort.

The granite of this portion of the country is traversed

by large and irregular dykes of greenstone trap, and the granite itself puts on a trappose character, the two rocks being sometimes with difficulty distinguishable from each other. This is the commencement of an apparently very large extent of granite country, extending westerly into the region not yet surveyed by section lines.

These granites are important in an economical point of view, being so situated as to be easily quarried, and affording a great variety of very durable, as well as ornamental building stones. When we consider that the whole vast valley of the Mississippi to the south, is made up of secondary rocks, it seems probable that these granites will furnish a valuable article of commerce so soon as a more easy communication shall have been afforded between Lake Superior and the Lower Lakes.

METAMORPHIC GROUP.

The rocks thus designated, occupy the country lying between the two granite regions above mentioned.—The several portions of this district vary so much in the character of the prevailing rocks, as to call for separate descriptions.

The more southerly, which I shall here denominate the *quartzite* portion, is composed of white and brown quartz rocks, talcose, augitic and clay slates, slaty hornblende, and specular and micaceous oxides of iron, and embrace the tract between the granite on the south, and a line bearing north of west from the mouth of Carp river, to the centre of the west line of T. 48 N., R. 26 W. This tract is rolling, with frequent ridges, having

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a direction nearly east and west, or bearing south of west, and elevated above the surrounding country from 40 to 150 feet. The greatest elevation above Lake Superior, as determined by the barometer, is 1001 feet. The timber is chiefly sugar maple, with some scattering pines, and other evergreens and birch.

The central portions of these ridges would seem to be trap, which is here capped, as well as flanked, by the metamorphosed rocks. Though no well-characterized trap makes an outcrop, throughout this portion of the metamorphic region, the altered nature of the rocks plainly indicates the near approach of an igneous rock to the surface, and the dip of the rocks, though mainly north, at a high angle, exhibits a tendency in all directions from a central axis.

These rocks are throughout pervaded by the argillaceous red and micaceous oxides of iron, sometimes intimately disseminated, and sometimes in beds or veins. These are frequently of so great extent as almost to entitle them to be considered as *rocks*. The largest extent of iron ore noticed, is in town 47 north, range 26 west, near the corner of sections 29, 30, 31, 32. There are here two large beds or hills of ore, made up almost entirely of granulated, magnetic and specular iron, with small quantities of spathose and micaceous iron. The more northerly of these hills extend, in a direction nearly east and west, for at least one-fourth of a mile, and has a breadth little less than 1000 feet, the whole of which forms a single mass of ore, with occasional thin strata of imperfect chert and jasper, and dips north 10 degrees east, about 30 degrees. At its southerly outcrop the ore is exposed in a low cliff, above which the

hill rises to the height of 20 to 30 feet above the country, on the south. The ore here exhibits a stratified or laminated structure, and breaks readily into sub-rhomboidal fragments, in such a manner as will greatly facilitate the operation of quarrying or mining the ore.

This bed of iron will compare, favorably, both for extent and quality, with any known in our country.—The largest of the large ore beds of the state of New York, is estimated to be but 700 feet in breadth, by 1000 in length.

A more extended and minute examination will probably determine this portion of the metamorphic group to contain other ores, less in amount, but which are generally esteemed more valuable.

The northerly portion of the metamorphic group of rocks, and which may here be denominated the *trappose* portion, embraces the whole remainder of the group north of the portion last described, except a small tract of country occupied exclusively by clay slate rock, and whose extent will be hereafter noticed.

This division of the metamorphic region is characterized by the frequent occurrence of knobs or uplifts of greenstone and augitic trap, making their appearance rather irregularly over the country, and surrounded by altered sandstones and slates. These uplifts are doubtless disconnected from any common centre or focus of eruption; but it is evident that rocks of igneous origin, form the base of all the rocky elevations of the region, and the surrounding altered and slaty rocks flank their sides and dip in all directions from them, the trap being protruded into a series of low knobs. Around the bases of these are the metamorphic rocks, consisting mostly of

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talcose, chlorite and clay slates. Quartz forms comparitively a small proportion of these rocks. The prevailing dip is northerly, about 80 degrees. Several of these knobs, in T. 48 N., R. 26 W., attain an elevation of 1053 feet above Lake Superior.

A hill of tolerably well defined granite makes an outcrop near the centre of this region, and in a low ridge, bearing in an easterly and westerly direction about two miles, but the granite is evidently of a trappose character. The hills of this region are generally timbered to their summits, and in many of them the rock does not come to the surface. The country is, in general, moderately rolling and beautiful. The timber is chiefly sugar maple, yellow birch, fir, hemlock and spruce, and the soil will, without doubt, prove fertile.

CLAY SLATE.

The rocks of the metamorphic group frequently graduate into clay slate, and it will be perceived, by reference to the map, that a well defined clay slate occupies a distinct tract in the region under consideration. This tract is almost wholly in T. 48 N., R. 26 W., and occupies an area of about five sections. The slate appears generally in low knobs, dipping northwesterly, and is highly argillaceous. The tract is timbered with a large growth of sugar maple and hemlock.

RED SANDROCK.

It will be perceived that this rock occupies a small portion of the country embraced in our first division.—

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It is found skirting the primary and metamorphic rocks on all sides, and almost excluding them from the Lake coast.

As this rock occupies a larger area in the district of country, hereafter to be considered, no description of it will here be given. It may, however, simply be observed, that this rock is frequently found surrounding, and in contact with, the uplifted masses of igneous rocks, and is then invariably much altered both in appearance and texture, and may, under such circumstances, fairly be considered as metamorphic.

KEEWENAW POINT.

The subdivisions of the past season upon this part of the survey, include all that portion of Keewenaw Point lying north and east of Portage Lake, and this portion of the work will be separately considered.

Keewenaw Point may be said to be made up of three rock formations, trap, trap conglomerate, and red sand rock. Of these, the first mainly gives its peculiar character to the country, giving to it its mountainous aspect and general configuration, having been protruded by the operation of igneous forces into its present position; while the other rocks are sedimentary in their origin, and are found surrounding and resting against the other.

The accompanying map will exhibit, with much accuracy, the positions and extent of these rocks, in reference to each other, and to the town and section lines.

TRAP ROCKS.

It will be seen that throughout nearly the whole of

the portion occupied by these rocks, may be traced two distinct ranges of hills, which, commencing near the easterly extremity of the Point, run nearly parallel to the boundary of the trap. The summits of the more northerly range, preserve an almost uniform distance from the northerly boundary of trap, of about one and a quarter miles, while those of the southerly range average little more than a half mile from the southerly extension of the trap formation. These ranges, which are quite continuous from T. 57 N., R. 28 W., westerly as far as T. 57 N., R. 32 W., begin here to fall away, becoming also more irregular and broken as they approach the basin of Portage Lake. In fact, from the latter town, southwesterly, their character, as distinct ranges, is almost entirely lost, until they reappear at about an equal distance from the Portage Lake, on the other side of the basin. The continuity of the trap rocks, however is not destroyed, though its bounds are much narrowed.

The barometer work having been carried no further west from the extremity of the Point, than range 29, does not enable me to give the elevations of these ranges with completeness; but it may be stated that the highest point found is in the southerly range, in T. 58 N., R. 29 W., where the trap rises into a knob having an elevation above Lake Superior of 876 feet. To this knob has been given the name of Mt. Houghton. The general elevation of the northerly range of hills is, however, somewhat the greatest, the knobs rising to from 400 to 600 feet.

These ranges present their steepest escarpments on their southerly sides, where they rise frequently into

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cliffs of 100 feet nearly perpendicular, and, in one instance, in the southerly range, to nearly 460 feet. In general, they slope much more gently to the north, thus following the general inclination, or dip, which is common to all the rocks of the Point.

The portion of the trap district included between these two ranges, as far westerly as range 30, has a gradual descent in the valley of the Little Montreal river. Beyond this, westerly, it is more rolling and sometimes broken by knobs and ridges of trap, with some intervening swamps. The whole is, in general, covered by a sandy loam, and is clothed with an abundant growth of sugar maple, birch, fir, oak and white pine; the maple greatly predominating, wherever the soil is of sufficient depth. Where this soil is barely sufficient to conceal the underlying rock, cedar is the prevailing timber.

It will be observed that the Little Montreal river, above alluded to, has its course wholly between these two trap ranges, pursuing its course nearly across ranges 30, 29 and 28. This is the most considerable stream in the district under consideration. Though somewhat sluggish through the first half of its course, which may be said to occupy the most elevated part, or plateau, of the trap region, it becomes more rapid through ranges 29 and 28, and its course to the Lake shows a very considerable descent, probably of a about 300 feet, through the latter range.

The more northerly of these ranges of trap is very uniform in character, and while the rock of both the northerly and southerly ranges may be denominated greenstone, that of the latter is much the most compact. The rocks of the former range, have a very distinct-

ly chrystaline structure, passing from a very gradulated greenstone to a rock composed of chrystals of augite, or hornblende, and feldspar, with considerable intermixture of quartz, sometimes nearly forming an imperfect syenitic granite, and showing the identity of origin of the trap and granite rocks. These portions of the trap are extremely hard, and break with difficulty under the hammer.

The central portion of the more elevated knobs of the southerly range are frequently composed of a very hard and compact trap of a reddish color, which sometimes takes on the character of a trap breccia, or aggregate of small cemented angular pieces of rock, and may perhaps be denominated a trap porphyry.

Intermediate between these two ranges, the trap is sometimes compact, at others amygdaloidal, and occasionally granular; while, on the outer slopes of both ranges, it is almost uniformly amygdaloidal, and is frequently what may be denominated a true amygdaloid, having its cells filled with spar, quartz, epidote and other minerals.

In an economical point of view, the greenstone of the trap range is worthy of consideration, being well fitted for use as a building material, from its durability, and the ease with which, in consequence of its jointed structure, it may be quarried.

CONGLOMERATE ROCK.

Resting against the trap on its northerly slope, and extending from the extremity of Keewenaw Point westerly in T. 57 N., R. 33 W., will be found a rock formation which is evidently of sedimentary origin, being composed of water worn masses, generally of the harder portions of the trap rock, held together by an exceedingly hard calcareous and argillaceous cement. It is evident that this rock was deposited around the base of the trap hills, beneath the waters, and has been subsequently elevated, for the whole mass dips northerly, or from the trap hills, at an angle of about 45 degrees.

At or near its junction with the trap, this rock rises into a very distinct and generally continuous hilly range; which may, in fact, be considered as the outcropping edge of the formation, rising on its northerly side in a steep escarpment, but sloping more gradually down towards the Lake, on the north. This ridge varies in elevation, the highest ascertained point being in T. 58 N., R. 27 W., and is 680 feet above Lake Superior. But this is much above the average elevation which will not be found probably to exceed 350 feet.

A marked difference is observable in the character of the country occupied by the trap and conglomerate rocks; for while the former exhibits a series of elevated knobs of a rugged and broken character, the latter presents a more uniform and rounded outline, and cedar, fir, and other evergreens, constitute a larger proportion of its timber.

MIXED CONGLOMERATE AND SANDROCK.

At a short distance northerly from the range last mentioned, may be observed another, but less elevated and continuous ridge, which is the southerly outcrop of the mixed conglomerate and sandstone formation. This

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rock may, in fact, be considered as an upper member merely of the conglomerate, and differs from it only in being composed of alternating strata of coarse or fine materials, derived from the same origin. As the finer strata of this rock has been mistaken by some for the red sandrock, hereafter described, it is important to observe that a very marked difference exists between the two rocks; for, while the latter is made up of materials derived from the several rock formations of the country, and into which quartzose grains enter most largely, the former is wholly derived from the trap rocks.

This conglomerate and sandrock range probably nowhere exceeds 350 feet above the level of the Lake. It occupies the northern coast of Keewenaw Point, with some exceptions occasioned by trap dykes, within the limits alluded to as the extent, easterly and westerly, of the conglomerate rock formation.

In the hollow between these two ridges of conglomerate, and conglomerate and sandrock, lie several long and narrow lakes, and lines of swampy ground are not an uncommon feature.

The barometer work having been carried over a comparatively small portion of the Point, I have not been able to form any new estimate of the thickness of the conglomerate and mixed rocks. Those contained in the report of Dr. Houghton, made to the Legislature of Michigan in 1841, may be considered as sufficiently precise, which fix the maximum of the latter at 4200 feet, the former having probably a less thickness on the Point, though attaining near the Montreal river a thickness of 5260 feet.

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TRAP DYKES.

I have already alluded to the fact that the granites of the more northerly portion of the primary district are traversed by dykes of trap, which have produced great changes in the rocks of that district, as also to the fact that the conglomerate and sandrocks are found traversed by similar dykes. On approaching Keewenaw Point, from the eastward, trap is seen apparently interstratified with the conglomerate and mixed rocks which constitute the coast, the whole dipping together to the north at an angle varying from 30 to 45 degrees.

A trap dyke of very unusual size makes its appearance on the eastern extremity of the Point, in section 10, and may be traced westerly, following the general curvature of the coast, into range 31 west. It has an average breadth of half a mile. In its westerly prolongation, this dyke first approaches the coast at Copper Harbor. It has here been broken across by the waters of the Lake; so that, while the conglomerate rocks are found composing the outer points, as well as the south side of the harbor, the trap is seen at its two ends and at the projecting points and island, and it forms the bar across the entrance.

Continuing westerly, this dyke cuts entirely across the conglomerate and sandrocks, at Agate Harbor, and from thence the coast is constituted of this rock, westerly as far as section 3, in T. 58 N., R. 31 W. Along this portion of its course it is found gradually thinning out, having at Grand Marais and Eagle Harbors a width of a few rods only, and thinning out entirely, or passing off into the deep water of the Lake, at the point above named.

The trap composing this dyke is partly compact and partly of amygdaloidal structure. At Agate Harbor, the trap is of this latter character, and the cells are filled with chalcedony, cornelian, jasper, quartz, &c. often forming agates of great size and beauty. This part of the coast is lined with islands at a few rods distance from the main shore, most of which appear to be portions of trap of a more hard and compact character, and which have resisted the action of the waters that have washed away the intermediate portions, thus forming a series of narrow and deep channels.

This dyke dips regularly with the conglomerate and sandrock in which it is included, to the north and northwest, at an angle of about 45 degrees.

RED SANDROCK.

This rock, the equivalent of the Potsdam red sandrock of the New York reports, it will be seen by the map, occupies the whole remainder of the portion of Keewenaw Point under consideration, skirting a large part of the trap range, on both sides, but having by far its broadest extension on the south side. It here lies in nearly horizontal strata, though at the coast a slight dip inland is observable, becoming more apparent as it approaches the basin of Portage Lake. In its approach to the trap, however, it is found more or less tilted from its original horizontal position, and is also very much altered by its contact with that igneous rock. The evidences both of the deposition of this extensive formation, in calm and shallow waters, and of the subsequent change induced in it by the trap rocks, when in a fused or heated state, are very apparent.

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Receding from the trap ranges southward, the surface of the country underlaid by this rock is, in general, rolling, and timbered with sugar maple, hemlock, birch, spruce, fir and occasional large pines. The soil is a sandy loam, and in general of good quality. Approaching the Lake coast, the land falls gradually to a level, where the evergreens predominate over the maple, and the country is much cut up by marshes.

MINERAL VEINS.

In regard to this subject, I have deemed it unnecessary to enter into details, for the reason that the returns of the surveys, so far as the geology is concerned, relate rather to the general character of the region, and that the observations of the past season, so far as can now be determined, tend to confirm the facts which have been stated in considerable minuteness of detail, in the report made by Dr. Houghton, in 1841, to the Legislature of the state of Michigan.

It may, however, be observed, that the courses of many veins have been fixed with accuracy, and the veins themselves traced, in some instances, for several miles across the conglomerate and sandrocks, and into and across some portions of the trap. The observations thus made, are confirmatory of the fact first noted by Dr. Houghton, that the true veins of the district referred to, pursue a course nearly at right angles to the line of bearing of the trap range.

In concluding these brief descriptions, it may be proper to state, that the personal observations of the writer have been confined almost entirely to a somewhat

cursory exploration, made several years ago, while acting as assistant to Dr. Houghton, in his arduous labors in the geological commission of Michigan, and that he has been enabled to devote but a very limited time to the examination of the specimens collected, and of the notes returned. It is very probable that he may have omitted many facts of importance. It is only by special solicitation, and the apparent necessity of the case, that he has undertaken to prepare such general observations as seemed called for under present circumstances.

In attempting this duty, the undersigned cannot be unmindful of the very meagre and imperfect sketch here presented, when compared with whatever proceeded from that master mind, whose genius first developed, and whose indomitable energy tracked through all its difficulties, a system not only intricate in itself, but novel to science; and in a region at that time destitute of all the ordinary facilities for scientific investigation. To the same active and philosophic mind, we owe the system of the union of geological with the lineal surveys of lands of the United States, the first experimental results of which are now returned to this department.

In presenting these, it may not be deemed inappropriate to allude to to the general advantages resulting from the new system, as devised, and thus far successfully prosecuted, by Dr. Houghton.

The advantages of thorough geological and topographical surveys, are now so well appreciated, that they have been prosecuted to a considerable extent by foreign governments. Great Britian has already appropriated immense sums towards the accomplishment of a complete survey of that kingdom, which has as yet advanced but a comparatively little way. And the geological surveys made by the United States, have made very fully and generally known the advantages of these undertakings. Fortunately, the system of rectangular surveying, adopted by the United States government, affords the best possible opportunity to accomplish, with little additional expense, what, under other circumstances, could be effected only at a much more considerable cost. The maps, both geological and topographical, herewith returned, will afford some evidence of the extreme accuracy, as well as the extent and minuteness of the results thus obtained.

In noticing some of the scientific results of the survey of the past season, the duty would be imperfectly performed, were I to omit calling attention to the unwonted accuracy with which the lines have been run. This accuracy has been attained by the exclusive use, by all the parties, of "Burt's Solar Compass;" an instrument to well known to need more than a bare allusion, but the great value of which has been more than fully confirmed during the surveys of the past season. This remark will seem justified, when it is considered that nearly the whole region of country traversed by these surveys, abounds with mineral attractive to the magnet; that the needle has been almost constantly acted upon by causes which produced deviations from the true meridian of the earth's magnetism, and often so powerfully as to completely reverse the direction of its poles. A variation fluctuating from 6° to 20° on either side of the true meridian, was not uncommon, through the length of an entire township; and it seems difficult to imagine how the lines could have been run with the ordinary

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surveyor's compass. Other important advantages have been arrived at, from the use of this compass, of both a scientific and practical character; one of which only, will be here alluded to, viz: the means afforded by it of detecting the presence of certain rocks, over large areas, where no rocks are visible at the surface. This was particularly observable in the region of the great trap ranges, where it was almost uniformly found that the needle became deflected towards the mass of the trap hills, even though distant, and was more or less fluctuating, when passing over a country whose underlying rock was trap. The same phenomena were exhibited among the iron ore rocks of the metamorphic region.

Allusion may here be made to the increased importance given to the work of the past season, by the introduction of the barometer upon the lines, by means of which the elevations of the country are exhibited with a great degree of accuracy; a complete section being obtained on every line, and thus furnishing all that was needed to make a true, complete, and minute exhibit of the topography of the country. In another and more scientific point of view, the use of this instrument becomes highly important, from the means it affords of ascertaining the true dip and thickness of rocks; data, the importance of which are appreciated not merely by the man of science, but, as is well known, in the practical operations, more especially of the miner and engineer.

It may be allowed me, further, to allude to that commendable zeal and fidelity which has been exhibited by all those who have been associated with Dr. Houghton, as his aids, during these surveys, in furthering the plans

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marked out by him, and by their numerous and close observations, assisting to perfect the knowledge of the geology of that interesting region.

BELA HUBBARD.

STANARD'S ROCK,

Was discovered by Capt. Charles C. Stanard, at four o'clock, P. M. August 26, 1835.

"The course to this rock from the east end or point of Manitou Island, is twenty-seven miles S. E. half E., and from Point Abbaye, forty-five miles E. by N. 3-4 N., lat. 47° 8′ north, long. 87° 24′ west from Greenwich.

"On both of my visits to the rock, the sea was too rough to allow me to land on it, but from the mast head of the vessel, it appeared to be about twelve or thirteen feet long, by five or six feet broad, and rising above the surface about three feet. On the south, southeast, east and northeast sides, the water is deep. On the west, southwest, and northwest sides, the water is quite shoal for some distance out; and from the rock about N. N. W. runs a reef to the distance of about eighty or ninety rods.

"The composition of the rock is the same as the trap of Point Keewenaw, This I learned from Mr. Mendenhall. I also saw a piece of the rock brought away by one of the sailors of the Algonquin.—*Capt. B. A. Stanard.*

GLOSSARY.

INCLUDING THE TECHNICAL TERMS USED IN THIS WORK.

Alluvion or Alluvium. Recent deposites of earth, sand, gravel, mud, stones, peat, shell banks, shell marl, drift sand, &c., resulting from causes now in action.—This term is generally applied to those deposites in which water is the principal agent.

Amorphous. Bodies devoid of regular form.

Amygdaloid. A trap rock which is porous and spongy, with rounded cavities scattered throughout its mass. Agates and simple minerals are often contained in these cavities.

Anticlinal. An anticlinal ridge or axis is where the strata along a line dip contrariwise, like the sides of the roof of a house.

Arenaceous. Sandy.

Argillaceous. Clayey.

Augite. A simple mineral of variable color, from black through green and gray to white. It is a constituent of many volcanic and trappean rocks, and is also found in some of the granitic rocks.

Basalt. One of the common trap rocks. It is composed of augite and feldspar, is hard, compact, and dark green or black, and has often a regular columnar form. The Palisades of the Hudson show the columnar aspect of trap rocks. The giant's causeway is cited as an example of basaltic rocks, and the columnar structure is there very strikingly displayed.

Blende. Sulphate of zinc. A common shining zinc ore.

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Bluffs. High banks of earth or rock with a steep front. The term is generally applied to high banks forming the boundaries of a river or river alluvions.

Bog Iron Ore, or Ochre. A variety of ore of iron which has been deposited by water. Chiefly in low, wet ground.

Botryoidal. Resembling a bunch of grapes in form.

Boulders. Erractic group. Lost rocks. Rocks which have been transported from a distance, and more or less rounded by the attrition or the action of the weather. They lie upon the surface or loose in the soil, and generally differ from the underlaying rock in the neighborhood.

Breccia. A rock composed of angular fragments cemented together by lime and other substances.

Calcareous rocks. A term synonymous with limestone.

Calcareous spar. Crystalized carbonate of lime.

Carbonates. Chemical compounds containing carbonic acid, which is composed of oxygen and carbon.

Chert. A siliceous mineral, approaching to chalcedony, flint and hornstone. It is usually found in limestone.

Chlorite. A soft green scaly mineral, slightly unctious.

Chlorite slate. Slate containing chlorite

Clinkstone. A slaty feldspathic or basaltic rock, which is sonorous when struck.

Cleavage. The separation of the laminæ of rocks and minerals in certain constant directions. They are not always parallel to the planes of stratification, but are often mistaken for them.

Conformable. When strata are arranged parallel with each other, like the leaves of a book, they are said to be conformable. Other strata lying across the edges of these may be conformable among themselves, but *unconformable* to the first set of strata.

Conglomerate, Crag or Puddingstone. Rocks composed of rounded masses, pebbles and gravel cemented together by a siliceous, calcareous, or argillaceous cement.

Cross course. A lode intersecting a vein at any angle, and generally throwing the vein out of its course.

Cress. The best ore.

Chrushing. Grinding ores without water.

Cuniform. Wedge shaped.

Cross-cut. A method of discovering lodes by sinking pits in their vicinity, and driving transversely to their supposed direction.

Crop out and out crop. Terms employed by geologists and mining engineers, to express the emergence of rock, in place, on the surface of the earth at the locality where it is said to crop out.

Crystaline. An assemblage of imperfectly defined crystals, like loaf sugar and common white marble.

Dykes. A kind of vein intersecting the strata, and usually filled with some unstratified igneous rock, such as granite, trap or lava. These materials are supposed to have been injected in a melted state into great rents or fissures in the rocks.

Diluvium or Diluvion. Deposites of boulders, pebbles and gravel, which many geologists have supposed were produced by a diluvial wave or deluge sweeping over the surface of the earth.

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Dip. Where strata are not horizontal, the direction in which their planes sink or plunge, is called the direction of the dip, and the angle of inclination, the angle of dip.

Dolomite. A magnesian limestone belonging to the primary class. It is usually granular in its structure, and of a friable texture.

Drift. A horizontal excavation in any direction under ground, for ore, ventilation &c.

Dead ground. The portion of lode in which the ore is dead or valueless.

Deen. The end of a level or cross cut.

Dropper. A branch where it leaves the main lode.

Driving. Digging horizontally.

Embouchure. From the French, signifying mouth or entrance, (of a river.)

Estuaries. Inlets of sea into the land. The tides and fresh water streams mingle and flow into them.—They include not only the portion of the sea adjacent to the mouths of rivers, but extend to the limit of tide water on these streams.

Fang. A niche in the side of an adit or shaft for an air course.

Feeder. A branch where it falls into a lode.

Fault. A dislocation of strata, at which the layers on one side of a dyke or fissure have slid past the corresponding ones on the other. These dislocations are often accompanied by a dyke. They vary from a few lines to several hundred feet.

Feldspar. One of the simple minerals, and next to quartz, one of the most abundant in nature.

Ferruginous. Containing iron.

Galena. An ore of lead composed of lead and sulphur.

Garnet. A simple mineral which is usually red and crystalized. It is abundant in most primitive rocks.

Gneiss. A stratified primary rock, composed of the same materials as granite, but the mica is distributed in parallel layers, which will give it a striped aspect.

Geode. Geodiferous. Geodes are small cavities in rocks generally lined with quartzose or calcareous crystals.

Economical Geology refers to the applications of Geological facts and observations to the useful purposes of civilized life.

Granite. An unstratified rock, composed generally of quartz, felspar and mica, and it is usually associated with the oldest of the stratified rocks.

Graywacke, Grauwacke. A group of strata in the transition rocks; but the term has been so indefinitely applied, that other names will probably be substituted.

Greenstone. A trap rock composed of hornblende and feldspar.

Grit. A coarse-grained sandstone.

Gad. A small, pointed wedge, used in the mine for wedging off splits.

Gossan. Oxid of iron and quartz, generally occuring in lodes at shallow depths.

Gulph of ore. A very large deposite of ore in a lode.

Gummics. Sands or workings.

Hornblende. A mineral of a dark green or black color, and which is a constituent part of greenstone.

Hornstone. A siliceous mineral approaching to flint in its character.

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Horse. Is where a hard formation or the wall rock intercepts a vein.

In situ, In place. In their original position where they were formed.

Laminæ. The thin layers into which strata are divided, but to which they are not always parallel.

Line of bearing, is the direction of the intersection of the planes of the strata with the plane of the horizon.

Linear survey. A plan of surveying adopted by the United States government, by which the public lands are divided into rectangles, by straight lines.

Loam. A mixture of sand and clay.

Lodes. Cracks or fissures containing ore.

Leap. Is when a vein disappears suddenly by diminishing in quality or quantity.

Magnetic Meridian. A great circle passing through or by the magnetic poles of the earth; to which the *compass needle*, if not otherwise hindered, conforms itself. This "line of no variation," is not stationary, but shifts eastward or westward of the true meridian, during a term of years.

Mural Escarpment. A rocky cliff with a face nearly vertical like a wall.

Mammillary. A surface studded with smooth small segments of spheres like the swell of the breasts.

Matrix. The mineral mass in which a simple mineral is imbeded, is called its *matrix* or *gangue.*

Mechanical origin, Rocks of. Rocks composed of sand, pebbles or fragments, are so called, to distinguish them from those of a uniform crystaline texture, which are of chemical origin.

Metamorphic rocks. Stratified division of primary rocks, such as gneiss, mica slate, hornblende slate, quartz rock, &c., and which may probably be regarded as altered sedimentary rocks.

Metalliferous. Containing metals or metallic ores.

Mica. A simple mineral, having a shining silvery surface, and capable of being split into very thin elastic leaves or scales. The brilliant scales in granite and gneiss are mica.

Micaceous. In part composed of scales of mica.

Mica Slate. One of the stratified rocks belonging to the primary class. It is generally fissile, and is characterized by being composed of mica and quartz, of which the former either predominates, or is deposited in layers, so that its flat surface gives it the appearance of predominating.

Native Metals. Those portions of metal found in nature in a metallic, or uncombined state, are called native.

New Red Sandstone. "A series of sandy and argillaceous, and often calcareous strata, the prevailing color of which is brick-red, but containing portions which are greenish grey. These occur often in spots and stripes, so that the series has sometimes been called the variegated sandstone. The European, so called, lies in a geological position immediately above the coal measures."

Nodule. A rounded, irregular shaped lump or mass.

Ochre. See bog iron.

Old Red Sandstone. "A stratified rock, belonging to the carboniferous group of Europe."

Out-crop. See Crop out.

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Oxid. A combination of oxygen with another body. The term is usually limited to such combinations as do not present active acid or alkaline properties.

Porphyry. A term applied to every species of unstratified rock, in which detached crystals of feldspar are diffused through a compact base of other mineral composition.

Primary rocks. Those rocks which lie below all the stratified rocks and exhibit no marks of sedimentary origin. They contain no fossils, and are the oldest rocks known. Granite, hornblende, quartz and some slates belong to this division.

Prospecting. Examining for and partially opening veins when discovered.

Pudding Stone. See Conglomerate.

Pyrites. A mineral composed of sulphur and iron. It is usually of a brass yellow, brilliant, often crystalized, and frequently mistaken for gold.

Quartz. A simple mineral, composed of silex.—Rock crystal is an example of this mineral.

Rock. All mineral beds, whether of sand, clay, or firmly aggregated masses, are called rocks.

Sandstone. A rock composed of aggregated grains of sand.

Schist. Slate.

Seams. "Thin layers which separare strata of greater magnitude."

Sedimentary rocks. All those which have been formed by their materials having been thrown down from a state of suspension or solution in water.

Septaria. Flattened balls of stone, which have been more or less cracked in different directions, and cemented together by mineral matter which fill the fissures.

Serpentine. A rock composed principally of hydrated silicate of magnesia. It is generally an unstratified rock.

Shale. An indurated clay, which is very fissile.

Shingle. The loose water-worn gravel and pebbles on shores and coast.

Silex. The name of one of the pure earths which is the base of flint quartz, and most sands and sandstones.

Silicious. Containing silex.

Simple Minerals—Are composed of a single mineral substance. Rocks are generally aggregates of several simple minerals cemented together.

Shaft. Is what is usually called a well. After drifting has progressed, shafts are required as ventilators, to free them from the smoke of blasts.

Slate. A rock divided into thin layers.

Stratification. An arrangement of rocks in strata.

Strata. Layers of rock parallel to each other.

Stratum. A layer of rocks; one of the strata.

Strike. The direction in which the edges of strata crop out. It is synonymous with *line of bearing.*

Syenite and *Sienite.* A granite rock, in which hornblende replaces the mica.

Synclinal line, and *Synclinal axis.* When the strata dip downwards, in opposite directions, like the sides of a gutter.

Transition Rocks. A series of rocks which lie below the secondary and next above the primary, and are so called because they seem to have been formed at a period when the earth was passing from an uninhabited to a habitable condition. They contain numbers of characteristic fossils.

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Trap—Trappean Rocks. Ancient volcanic rocks, composed of feldspar, hornblende and augite. Basalt, greenstone, amygdaloid and dolomite, are trap rocks.

Tuff or *Tufa.* "An Italian name for a volcanic rock of an earthy texture."

Unconformable. See conformable.

Veins. Cracks and fissures in rocks filled with stony or metallic matter. Most of the ores are obtained from metallic veins.

Veinstone. That mineral matter with which the ores or metallic contents of the veins are associated.

Wall rock. The hard rock which is almost universally found on each side of a vein.

LIST OF

NATIVE METALS AND ORES.

ABRIDGED FROM DANA'S MINERALOGY.

Native copper. Color. Copper-red. Ductile and malleable. Fracture, hackly. It consists purely of copper. Before the blow pipe it fuses readily; on cooling it is covered with a coating of black oxid. It dissolves readily in nitric acid.

Copper occurs in beds and veins accompanying its various ores, and sometimes associated with iron. It is frequently found in loose masses imbedded in the soil. This metal has been found native, throughout the red sandstone region of the United States.

The largest mass of native copper ever known, is the one they are now taking out of the vein worked by the Copper Falls Company, for which see notice of that company.

Blue Copper. Lustre—resinous, faint. *Streak*—lead-gray, shining. Color—indigo blue or darker.—Opaque. Sectile. Before the blowpipe it burns, before becoming red hot, with a blue flame, and fuses to a globule, which is strongly agitated and emits sparks; finally it yields a button of copper.

Argentiferous copper. Massive; impalpable. *Lustre;* metallic. *Streak;* shining. *Color;* steel-gray. *Fracture;* subconchoidal. Sectile. This species is of rare occurrence.

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Copper Black. Disseminated, or coating other copper ores, in shining, botryoidal masses. *Color;* black or brownish black. Before the blowpipe it is infusible. With borax it affords a greenish slag.

Green Malachite or Green carbonate of copper. Lustre; adamantine, inclining to vitreous; fibrous varieties have often a silky lustre, and others are dull and earthy. *Streak;* green, paler than the color. Translucent—subtranslucent—opaque. *Fracture;* subconchoidal, uneven. Seldom observed in crystals. Before the blowpipe, it decrepitates, becomes black, and is partly converted into a black scoria. With borax, it fuses easily to a deep green globule, and ultimately affords a bead of copper. Dissolves with effervescence in nitric acid. It usually accompanies the other ores of copper. It is the principal ore that is worked for copper in the Wisconsin mines.

Vitreous copper or copper glance. Lustre; metallic. *Streak* and *color;* blackish, leadgray; often tarnished blue or green. *Streak;* sometimes shining. *Fracture;* concheidal. Sectile. In the oxidizing flame of the blowpipe it melts, gives out fumes of sulphur, and emits glowing drops with a noise, coloring the flame at the same time blue. In the reducing flame it becomes covered with a coating and does not melt. If the sulphur is driven off, a globule of copper remains. In heated nitric acid the copper is dissolved, and the solution assumes a green color; the sulphur is precipitated.

Red copper ore or *Tile ore. Lustre;* adamantine, or sub-metallic—earthy. *Streak;* several shades of brownish red. *Color;* red, of various shades, particu-

larly cochineal red, occasionally crimson-red by transmitted light. Subtransparent—subtranslucent. *Fracture*: conchoidal, uneven. Brittle. Before the blowpipe in the reducing flame, or charcoal, affords a globule of copper. Dissolves with effervescence in nitric acid. *Tile ore* formerly included the earthy varieties. These usually present a brick-red or reddish-brown color, and are frequently mixed with oxide of iron.

Copper Pyrites. Lustre; metallic. *Streak*; greenish black—a little shining. *Color*; brass-yellow—subject to tarnish. Opaque. *Fracture*: conchoidal uneven. Rather Sectile. Before the blowpipe, on charcoal, it blackens, but becomes red on cooling. After a continued heat, it fuses to a globule which is magnetic. With borax it affords pure copper. Dissolves in nitric acid, excepting the sulphur, forming a green solution. A drop of liquid ammonia changes it to a deep blue. Its richness may in general be judged of by the color; if of a fine yellow hue, and yielding readily to the hammer, it may be considered a good ore, but if hard and pale-yellow, it is assuredly a poor one, being mixed with iron pyrites. Copper pyrites is readily distinguished from iron pyrites, which it somewhat resembles, by its inferior hardness; it may be cut by the knife, while iron pyrites will strike fire with the steel. The effects of nitric acid are also different. It differs from gold in being brittle, on account of which it cannot be cut off in slices, like the latter metal.

Sulphate of copper or *Blue vitriol. Lustre*; vitreous. *Color*: deep sky-blue, of different shades. Sub-transparent—translucent. *Taste*; metallic and nauseous. Somewhat brittle. It is soluble in water. A polished plate of iron introduced into the solution becomes covered with copper. Blue vitriol is found in waters issuing from mines, and in connection with rocks containing copper pyrites, by the decomposition of which it is formed.

Sulphurate of copper See "*Vitreous copper.*"

Variegated copper. Lustre; metallic. *Streak*; pale greyish black, and slightly shining. *Color*; between copper-red and pinchbeck brown. *Fracture*; small conchoidal, uneven. Brittle. It speedily tarnishes when exposed. Before the blowpipe it blackens, and becomes red on cooling; at a higher temperature it fuses to a globule, attractable by the magnet. It is mostly dissolved by nitric acid. It occurs with other copper ores in primitive and secondary rocks, This species is a valuable ore of copper.

Crysocolla or *Copper green.* Botryoidal and massive. *Lustre*; vitreous, shining, earthy. *Streak*; white. *Color*; emerald and pistachio green, passing into sky-blue; often brown when impure. Translucent—opaque. *Fracture*; conchoidal. Rather sectile, translucent varieties brittle. Blackens in the interior flame of the blowpipe on charcoal, without melting.—With borax it melts to a green glassy globule, and is partly reduced. The same specimen of this mineral often presents very different appearances at its opposite parts; being sometimes of an earthy appearance, like decomposed feldspar, in one part, and translucent and brittle on the opposite. The differences of the several varieties are owing, more or less to impurities.

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Emerald copper ore or *Dioptase.* *Lustre*; vitreous, inclining to resinous. *Streak*; green. *Color*; emerald-green; also blackish-green and verdigris-green. Transparent—sub-translucent. *Fracture*; conchoidal, uneven. Brittle. Decrepitates in the blowpipe flame, tinging it yellowish-green; in the exterior flame it becomes black, and in the interior, red, but does not melt. It fuses with borax, giving it a green color, and finally is reduced. Insoluble in nitric, but soluble without effervescence in muriatic acid. It acquires negative electricity by friction when insulated.

Gray copper ore. *Lustre*; metallic. *Streak*; sometimes inclined to brown, but generally the same as the color. *Color*; between steel-grey and iron-black. Opaque. *Fracture*; sub-conchoidal, uneven. Rather brittle. The comportment of the different varieties before the blowpipe is somewhat various. They all give off fumes of antimony and arsenic, finally melt, and after roasting, afford a globule of copper. When pulverized, they dissolve with a little residue in nitric acid. The solution has a brownish-green color. Fuses very easily before the blowpipe.

Gold. *Lustre;* metallic. *Streak* and *color* various shades of gold-yellow, sometimes inclining to silver white. Opaque. Is the most ductile and malleable of all metals. The ores of gold in nature usually contain silver in different proportions. Copper is occasionally alloyed with gold. Native gold occurs in veins and in interspersed grains and lamina, and occasionally crystallized in quartz, and is usually associated with talcose rocks. It is often found in the sands of rivers and valleys where it has been carried from disintegrated

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auriferous rocks. It is also disseminated in grains or thin leaves in various metallic minerals, particularly iron pyrites.

Spathic iron. *Lustre*; vitreous—pearly. *Streak*; white. *Color;* ash-grey, yellowish-grey, greenish-grey, also brown and brownish-red; sometimes white.—Translucent, sub-translucent. *Fracture*; uneven.—Brittle. In the blowpipe flame it blackens, giving off carbonic acid, and ultimately an oxyd of iron is obtained, which is attractable by the magnet. Alone, it is infusible. It colors borax green. It dissolves with difficulty in nitric acid, and scarcely effervesces, unless previously pulverized. Exposure to the atmosphere darkens its color, rendering it often of a blackish-brown or brownish-red color. It occurs in many of the rock strata, in gneiss, mica-slate, greywacke, and in connection with coal formations. It is often associated with metallic ores.

Magnetic iron ore. *Lustre*; metallic—sub-metallic. *Streak*; black. *Color*; iron black. Opaque. *Fracture;* sub-conchoidal, shining. Brittle. Strongly attracted by the magnet and sometime possessing polarity. Before the blowpipe it becomes brown, and loses its influence on the magnet, but does not fuse. With borax in the oxydizing flame, it fuses to a dull-red glass, which becomes clear on cooling, and often assumes a yellow tint; in the reducing flame it becomes bottle-green.—Dissolves in heated muriatic acid, but not in nitric acid. Magnetic iron ore occurs in beds in primitive rocks, generally in gneiss or syenite, also in beds and isolated crystals in clayslate, hornblende and chlorite slates, greenstone and occasionally in limestone. No ore of iron is more

generally diffused than the magnetic, and none superior for the manufacture of iron. It is easily distinguished by its being attracted readily by the magnet. and also by means of the black color of its streak, or powder, which is some shade of red or brown in specular iron and brown iron ore. The ore when pulverized may be separated from earthy impurities by means of a magnet, and machines are in use in many parts of northern New York for cleaning the ore on a large scale.

Specular iron. Lustre; metallic and occasionally Splendent—massive varieties sometimes earthy. *Streak:* cherry-red or reddish-brown. *Color;* dark steel-gray or iron-black; impure varieties red and unmetallic. Opaque, except when in very thin laminæ, which are faintly translucent and of a blood-red tinge. *Fracture:* sub-conchoidal, uneven. Sometimes it is slightly attractable by the magnet; the volcanic varieties occasionally exhibit polarity. Infusible, alone, before the blowpipe; with borax it forms a green or yellowish glass. Dissolves in heated muriatic acid. This species includes the old species, specular iron and red iron ore, which are identical in chemical composition, and differ only in the state of aggregation of the particles. *Specular iron* includes specimens of a perfect metallic lustre; if the structure is micaceous, it is called *micaceous iron.* The varieties of a sub-metallic or non-metallic lustre, were included under the name of *red hematite, fibrous red iron;* or if soft and earthy, *red ochre,* and when consisting of slightly coherent scales, *scaly red iron* or *red iron froth.* Under this species must also be included the different clay or argillaceous-iron ores, many of which contain but small portions of iron; *reddle* or *red*

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chalk, the common drawing material, which has an earthy appearance and a flat conchoidal fracture; *columnar* and *lenticular argillaceous iron,* distinguished by a columnar or flat granular structure. Specular iron occurs commonly in primitive rocks. The argillaceous ores form beds in secondary rocks. These varieties especially the specular, require a greater degree of heat to smelt than other ores, but the iron obtained is of a good quality.

Iron Pyrites. Lustre; metallic—splendent—glistening. *Streak;* brownish-black. *Color.;* a characteristic bronze-yellow, nearly uniform. Opaque. *Fracture;* conchoidal, uneven. Brittle. Strikes fire with steel. It becomes red in the oxydating flame of the blowpipe, and gives off fumes of sulphur; ultimately, there is obtained a globule of oxyd of iron which is attractable by the magnet. It is soluble in nitric acid, except a white residue. Some varieties are very liable to decomposition on exposure to the atmosphere. Iron pyrites occurs abundantly in rocks of all ages, from the oldest primitive to the most recent alluvial deposites. This species is of the highest importance in the arts, as it affords the greater part of the sulphate of iron and sulphuric acid of commerce, and also a considerable portion of sulphur and alum.

Manganite. Lustre; sub-metallic. *Streak;* reddish-brown, sometimes nearly black. *Color;* dark steel-black, iron-black. Opaque; minute splinters cleared off sometimes exhibit a brown color by transmitted light, when exposed to the direct light of the sun. *Fracture;* uneven. Before the blowpipe alone it is infusible; with borax it yields a violet-blue globule. In-

soluble in nitric acid; in muriatic acid it gives off chlorine and dissolves without a residue. It occurs in veins traversing porphyry, associated with calcareous spar and heavy spar.

Black manganese. Lustre; sub-metallic. *Streak;* chesnut-brown. *Color;* brownish-black. Opaque. *Fracture;* uneven. In the oxydating flame of the blowpipe it affords an amethystine globule. Dissolves in heated muriatic acid, with the odor of chlorine.

Cuprous manganese. Massive in small reniform and botryoidal groups. *Lustre;* resinous. *Streak* and *color;* bluish-black. Opaque. Before the blowpipe it becomes brown, but does not fuse; to borax and salt of phosphorus it communicates amethystine and green colors, and the other characteristic indications of copper andmanganese.

Antimonial sulphuret of silver. Lustre; metallic. *Color* and *streak;* light steel-grey, inclining to silver white, also blackish lead-grey. Yields easily to the knife, and is rather brittle. *Fracture;* conchoidal—uneven. Before the blowpipe it emits copious white vapors and a slight sulphureous odor, after which, a white metallic globule remains. This species occurs at several localities on Lake Superior.

Native silver. Lustre; metallic. *Streak;* shining metallic. *Color;* silver-white; subject to tarnish, by which the color becomes greyish-black. Ductile. It fuses readily in the blowpipe flame, and affords on cooling, a globule, having an angular crystaline form Dissolves in nitric acid and heated sulphuric acid. Native silver occurs principally in aborescences and filiform shapes, in veins of calcareous spar or quartz, traversing the primitive rocks.

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Dark red silver ore. Lustre; metallic-adamantine. *Streak;* cochineal-red. *Color;* black, sometimes approaching cochineal-red. Translucent—opaque. *Fracture;* conchoidal. Sectile, yielding readily to the knife. Before the blowpipe it fuses and gives out fumes of antimony; ultimately a globule of silver is obtained.—Partially dissolves in heated nitric acid. The *dark red silver ore* occurs principally with calcareous spar, native arsenic, and galena. It is highly valuable as an ore of silver.

Light red silver ore. Lustre; adamantine. *Streak;* cochineal-red, sometimes inclining to aurora-red. *Color;* cochineal-red. Sub-transparent — sub-translucent.—*Fracture;* conchoidal—uneven. Before the blowpipe its behavior is like the preceding species, except that fumes of arsenic are emitted. It occurs with other ores of silver, galena, blende, pyrites and arsenic. It is an important ore of silver. Red orpiment, which it sometimes resembles, differs from it in having a yellow streak.

Carbonate of Zinc. Lustre; vitreous, inclining to pearly. *Streak;* white. *Color;* white, often greyish, greenish brownish-white, sometimes green and brown. Subtransparent—translucent. *Fracture;* uneven—imperfectly conchoidal. Brittle .Loses its transparency in the blowpipe flames, but does not melt; carbonic acid is driven off, and oxyd of zinc is obtained or passes off in white flakes. Dissolves with effervescence in nitric acid. It becomes negatively electrified by friction.—It is found both in veins and in beds, especially in company with galena and blende; also with copper and iron.

Siliceous oxyd of Zinc. Lustre; vitreous, sub-

pearly, sometimes adamantine. *Streak;* white. *Color;* white ; sometime blue, green, yellow or brown. Transparent—translucent. *Fracture;* uneven. Brittle.—Assumes electric polarity by friction or heat. When pulverized, it dissolves in heated sulphuric or muriatic acid, and the solution gelatinizes on cooling. In the blowpipe flame, it decrepitates, loses its transparency, intumesces, and emits a green phosphorescent light. It is infusible alone ; but with borax melts to a clear glass, which becomes opaque on cooling.

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COASTING DISTANCES AROUND LAKE SUPERIOR.

View looking westward from a point a few miles west of Presque Isle.

	Miles.	Miles from Sault.	Course.	REMARKS.
From Sault de Ste Marie				
To Point Aux Pins,	8		west	Good Landing.
Parisean Island,	15	23	n w	N and W sides of island rocky, dangerous landing. E and S sides good landing.
White Fish Point,	15	38	n w by w	Good landing.
From Sault de Ste Marie				
To Point Iroquois,	14		west	
Tompamenon River,	10	33	w by n	Boat Harbor.
White Fish Point,	15	48	n by e	Good landing.
Two Hearted River,	22	70	w by s	Boat Harbor.
Grand Marais Harbor,	26	96	west	Vessel Harbor.
Hurricane River,	13	109	w by s	Sand beach—shoal water.
Miners' River,	17	126	s w by w	Pictured Rocks.
Williams' Landing on Grand Island,	11	137	s w by w	Vessel Harbor.
Riviere Aux Train,	10	147	w by s	Boat Harbor,
Laughing Fish River,	16	163	w n w	" "
Chocolate River,	11	174	west	" "
Riviere Du Mort,	6	180	n n w	Harbor for large boats.
Presque Isle River,	8	188	n w	Good Landing.
Garlic River,	8	196	n w by n	" "
Little Iron River,	9	205	n n w	" "
Yellow Dog River,	7	212	n w by w	" "
Pine River,	6	218	w n w	" "
Huron River,	8	226	w 1-2 n	Boat Harbor.
Point Abbaye,	7	233	n w by w	Good landing.
Methodist Mission,	15	248	s w by w	" "
Catholic Mission,	5	253	s w by w	" "
From Point Abbaye,				
To Portage River,	14	247	west	Five feet on the bar,
South end of Portage,	22	269	n n w	Vessels can come within 1 1-2 miles of this.