forms in the ground mass. The grain becomes slightly coarser towards the bottom and almost all the constituent minerals are to be recognized.

337 to 348. The upper portion of this horizon consists of a light colored, brownish trap with a few large irregular amygdules filled with calcite. This portion is also considerably cut up by calcite and there has been some enrichment of the ground mass from the vein. The rock has a distinctly open texture. Small segregations of chlorite are rather abundant throughout specimen. The iron appears to have been much decomposed and their remains appear as reddish blotches on the mass. This gives a somewhat speckled appearance to the upper portion of the member. Below this the rock becomes very coarse grained and shows a considerable amount of characteristic diabase minerals. The core from this portion becomes much more compact and less broken up. Some luster mottling is also present. Towards the central portion, however, the luster mottling is not nearly so marked. The speckled character of the rock is largely lost; the grain, however, remains relatively coarse. Chlorite is abundant throughout the specimen, but veins of calcite are not of such common occurrence. At about 346 there is an amygdaloidal portion, the amygdules of rather small size, in a dark, decomposed matrix. This rock is so badly altered that only a small portion of it is preserved in the drill record. Presumably the amygdules are filled with calcite or its alteration product, laumontite. As represented by the core this member only consists of a band of about an inch in thickness. This member is immediately succeeded by a dark greenish, fine grained trap, but this soon gives place to rock the same as that which lay above it. Very near the bottom of this hole, this greenish trap showing a large amount of chlorite and serpentine, is cut by a small band only poorly represented on the core of a reddish, sandy looking rock, much the same as the matrix of the breccia which occurred in the earlier part of the series. The contact between the two is somewhat irregular, portions of a greenish trap projecting rather irregularly into this sandy portion. This light greenish, brown colored rock is very similar to the felsite already noted from near the United States mine. The extreme bottom of this member shows another band similar to the one just described, but separated from it by a dark, very much decomposed trap of moderately fine grain in which the individual members are not separable. This is cut practically parallel to the longer axis by calcite veins.

348 to 357. A dark trap cut by veins with laumontite on surface is the top of this member, but it is soon succeeded by a greenish gray amygdaloidal rock, the amygdules in this instance being filled with quartz. Veins of calcite with some quartz filling also intersect the core. The amygdules are of rather small size. A large amount of chlorite is present and in the bottom of this portion the amygdaloid has an outer envelope of epidote which is earlier than the quartz filling. The thickness of this band, however, is rather slight and is immediately succeeded by a rock represented in the drill core as a very reddish brown, earthy colored sand. The determination of the original character of this sand is very indefinite. The first fragments which are large enough for determination in this amygdaloidal part occur at 351 feet and consist of a dark greenish, rather fine grained trap, with numerous, rather large bunches of chlorite. Veins of calcite frequently intersect the mass. The bands of chlorite have given a somewhat greenish color to this portion. There is then a very much decomposed, much iron rusted portion of a reddish brown trap. This shows great decomposition and affords a poor basis for the determination of original characters. There is a small band of greenish epidotic rock represented in the core by about an inch of material which is of very fine grained, even textured rock, showing practically no other constituents than epidote, but this is followed by a dark, much decomposed amygdaloid, the amygdules being filled with

calcite or its alteration product, laumontite. Underlying this at about 354 feet and extending to the bottom of the member is a brownish sandstone with the stratification poorly shown. The sandstone contains, in part, more or less epidote, which has given it locally a very greenish color. The texture of the mass is very fine grained and remarkably even. Veins of calcite intersect the mass nearly parallel with the cross-section of the core. The lowest portion of this member shows the contact of this brownish sandstone with a greenish amygdaloidal rock. The contact between the two is rather even, although apophyses of the green amygdaloid extend into the sandstone. The amygdules are for the most part rather regular in outline and are filled with quartz.

357 to 367. This brecciated appearance still exists in the upper portion of this member but the sandy portion is much less, and the rock has distinctly a greenish amygdaloid with amygdules of small size. Most of the amygdules are filled with calcite and quartz. The rock has a very greenish color owing to the large amount of epidote present. The thickness of this band as represented in the drill record is not over a foot at most and is succeeded by a dark greenish gray, luster mottled trap. This trap contains a large amount of chlorite scattered in rather regular bunches, irregularly throughout the mass. A few very small scattered amygdules filled with calcite are also to be noted in the upper portion but the amygdular member of the portion rapidly fades into a dark, fine grained trap with few of the constituent minerals recognizable. Chlorite is abundantly present throughout this upper portion. The luster mottled phase is, as usually occurs in rather localized bands, separated by portions not so conspicuously luster mottled. This phase extends to about 364 feet, where the rock passes into a reddish brown amygdaloid much iron stained on weathered surface. On fresh fracture this rock is seen to be a dark brown one, with the amygdules filled both with calcite and quartz, but the calcite has in large part been altered towards laumontite. Later than the calcite filling of the amygdules, some chlorite has been introduced. Veins of calcite intersect the mass and radiating out from these veins are numerous small fragmentary veins which seem to lead to the various amygdules and connect one amygdule with another. This upper layer shows numerous brecciated faces with the same characteristic brownish sandy rock, cutting diagonally through the core. Near the contact between these two members the amygdaloid is seen to have its amygdules more abundantly dispersed near the contact of the two formations. A reddish brown, iron stained horizon also makes the line of contact more prominent. The sandstone is very fine grained and compact. As represented in the drill core this phase does not extend more than a few inches. The best example of this may be seen in cores 363 to 367, No. 12. Also down in this amygdaloid the color changes from the brownish iron stained character of the upper portion to a more dark colored ground mass. The amygdules here are for the most part filled with quartz. At the very base of this series the amygdaloid gradually dies out and is present in a dark brownish, slightly amygdaloidal trap, the amygdules in this trappean portion being very small in size and of not great abundance.

367 to 380. The upper portion is a dark reddish brown, slightly amygdaloidal trap about the same as at the bottom of the last portion described. Abundant irregular masses of chlorite, the irons somewhat weathered, giving the rock a rusty speckled appearance. This is succeeded at 370 by a much coarser variety of the same rock, showing also slight luster mottling. At 371 this grades into a dark greenish, fine grained trap with scattering amygdules filled with quartz, much cut up and intersected by calcite veins. In the thin faces there has been a considerable development of chlorite. A few scattered amygdules of rather regular outline are also noted throughout this portion. At about 375 this fine grained rock gives

place to a somewhat coarser, dark greenish trap, with a considerable amount of chlorite in this portion; however, amygdules are sometimes found filled with calcite and some chlorite. A much decomposed band has passed through, presumably of the same character, and then to the bottom of this member the rock remains a dark grayish, somewhat greenish trap with a slight tendency towards luster mottling.

380 to 392. Upper portion of this member consists of a greenish amygdaloid, the amygdules filled with quartz. Laumontite is also present as an alteration of the calcite which also sparingly occurs. There is a large amount of chlorite present which is seen both in the amygdules and also evenly disseminated throughout the rock, giving it a somewhat banded greenish character. Some of these amygdules still have open cavities in the central portion. The amygdaloidal portion of this rock shows considerable variation between the amygdaloid and trap, the more amygdular horizons, being separated from each other by bands of trap in which amygdules are relatively rare. At about 385 feet the rock becomes much more reddish brown than preceding portion, the amygdules are much more scattered and those amygdules filled with calcite and quartz are of large size. The lowest portion of this amygdaloid ends at about 386 feet and is a greenish, fine grained amygdaloid with some rounded bullet shaped particles of chlorite, which on fracture leave the rock and stand out in nodular projection. The central portion of this member shows a few much scattered amygdules filled with calcite and quartz, but the most abundant mineral throughout it is a chlorite which occurs in small local segregations throughout the whole mass. At 389 feet this amygdaloidal portion entirely vanishes and to the bottom of this member the rock remains a dark greenish, moderately coarse grained trap showing in portions a somewhat luster mottled character. The chlorite is still abundantly present, both sparsely disseminated throughout the ground mass in irregular bunches and also as a coating upon the joint faces which intersect generally nearly horizontally these cores.

Label on Box No. 1, 393 to 470 feet. Stencil number on box, No. 5.

392 to 393. A dark greenish trap with considerable amount of alteration towards a chloritic material.

393 to 401. A dark luster mottled trap yielding a good core. This rock is a moderately coarse grained diabase with many of the constituent minerals recognizable in the hand specimen; contains a few bands of chlorite scattered irregularly throughout core. Towards the base of this member the trap is seen to be intersected by a few seams of calcite and laumontite, after which the mottled character of the rock becomes somewhat less distinct and the fragments of core are considerably broken up. At the very end of the series the chloritic bands seem to be somewhat more numerous and the core is only represented by small fragmentary chips.

401 to 410. This is a very massive trap of moderately fine grain, showing a considerable amount of chlorite throughout the ground mass. This member shows slight luster mottling in part which increases with depth. The cores are represented especially well by fragments, the shortest of which is nearly eight to ten inches in length, showing the massive character of the rock. On fresh fracture the rock is seen to have a dark, greenish gray color with augites slightly noticeable in cross-section. At the base of this member the trap is seen to be somewhat intersected by calcite veins with some laumontite also on surface. The extreme base of this series is marked by much smaller, broken-up cores.

410 to 416. The trap has almost entirely lost its mottled character and is a very compact, dense, dark rock showing such a moderately fine grained structure that the individual minerals are not distinguishable in the hand specimen.

This member is very much the same as the last, except that it has no luster mottled character. The amount of chlorite distributed through these cores is somewhat greater than any before noted in this section and there are also bunches of calcite. On fragment No. 7 of this same series we come into an amygdaloidal belt, with amygdules of rather irregular shape filled with calcite. The amygdaloid has a general purplish gray color. In specimen under examination a large bunch of epidote altered to a chlorite is seen. There is a somewhat greenish cast given to the rock on account of the presence of epidote. Drusy cavities are also seen in which small epidote needles appear crystallized out into the cavity. A vein of calcite is also seen intersecting the amygdules as though of later origin. Towards the base the purplish color becomes less marked, the amygdaloid becoming considerably more brown and the amygdaloid seems to be fairly well consolidated and to hold its own under the action of the drill, but not nearly so well as the trap cores represented by fragments an inch or so in length. At the very base the core is considerably more broken up and the amygdules become less and less scarce, the very lowest portion consisting mainly of trap. A small amount of laumontite is seen near the very base of this member.

416 to 421. A moderately coarse grained trap on exposed surface having a brownish color. On fresh fracture showing distinctly a greenish tinge on account of amount of chlorite present. The core from this member is exceedingly good and in long fragments. Bunches of chloritic material with a decided envelope of calcite are seen at certain very rare intervals throughout the length of this column. Veins of calcite and laumontite also intersect this member, some of them occurring at about right angles with the long axis of the core. At the bottom of this member beds become very fragmentary.

421 to 426. Rock very similar to preceding with the exception that the texture is rather less coarse grained than in the one previously described. A few large, irregular amygdules of calcite are seen in this member but they are relatively coarse. Near the base of this member the rock becomes more amygdaloidal and has a much more reddish color, the amygdules are scattered sparingly throughout the mass and have a rather regular outline. Amygdules are filled in part with calcite and also some chlorite. On fresh fracture this rock is seen to have a very reddish color. Some of the amygdules are of extremely irregular shape. Towards the very base of this member the amygdaloidal character becomes less and less prominent until very near the bottom the rock is represented by No. 15 of this series simply as irregular masses and blotches of green chlorite, and wherever amygdules do occur, they are in very large irregular shapes. There is a large bunch of prehnite occurring here which carries some copper in small fragments scattered throughout it. It appears as though the copper occurred in certain druses throughout this vein material. The rock then passes on in very small fragments, much broken up, of the same kind of reddish trap with chloritic bunches and a few irregular amygdules to 426, which is very similar to the preceding, then comes a reddish gouge of clay which seems to afford no evidence of its original character. From 426 to 432, the rock is a dark brownish trap with very few chloritic bunches sparingly scattered throughout the core. This member is somewhat broken up by veins of calcite and laumontite. Then comes another mass or gouge which has a more or less reddish color. This latter is succeeded by a somewhat greenish amygdaloid as is shown by No. 5 of this series. There is then at the very base of this member a greenish sand probably derived from the sand pump and not to be considered as a gouge, which is apparently principally composed of epidote or chloritic material.

432 to 434. The top member consists of a dark trap somewhat intersected by calcite veins, followed by somewhat brownish green sand, which is very similar to the sand described in the preceding member, but the greenish cast is not so pronounced. This sandy member is then followed by a more compact, brownish trap, with a few irregular bunches of chlorite much the same as the preceding. On fresh fracture this trap is seen to have a distinctly reddish tinge. The bunches of chlorite are generally of small size, but distributed rather evenly throughout the mass, but in some instances there has been a local accumulation and the chlorite is preserved as quite a considerable bunch. This member is also considerably intersected by veins (which cut the core longitudinally) of calcite with some laumontite. The base of this member is very well consolidated as is shown by the length of the core which is about one and a half feet.

434 to 443. This member is very similar to the preceding with the exception that it shows a somewhat fine grained luster mottled appearance. Bunches of chlorite enclosed by calcite occur at rare intervals throughout the mass. The rock on the whole is moderately coarse grained. The cores preserved are of good length, sometimes running up as much as a foot or more. On fresh fracture the rock is seen to be moderately coarse grained, but of a reddish brown color.

443 to 445. A brownish red, moderately coarse grained trap, very similar to the preceding member. Bunches of calcite and chlorite are practically wanting throughout this member and the rock is only slightly intersected by calcite veins. The luster mottled character of the rock is fairly well seen.

445 to 453. This member is very similar to the preceding, the luster mottling being somewhat coarser towards the top but gradually decreasing in amount as we descend the series. In the central portion of this member the bunches of chlorite become of considerably greater size, but as we still descend the series, this chlorite does not become so apparent and is scattered more sparsely throughout the core. The luster mottled character which the rock loses in large part near the central portion of this member, becomes somewhat more pronounced as we near the base. On fresh fracture the rock is seen to have a moderately coarse grained structure. Examining under the glass there seem to be certain metallic bands throughout this trap as is shown in core No. 39, which from their color and general appearance would seem to be copper. They are so minute, however, that it is impossible to state positively their character. At the very base of this member the luster mottling again disappears to a considerable extent as is shown by No. 36 of this series. There is a small band of calcite intersecting this member. Thickness seems to be one-eighth of an inch.

453 to 456. A brownish red trap with a considerable number of bunches of chlorite throughout the core, the cross-section of these bunches showing them to be approximately spheroidal. This member is intersected by a number of veins of calcite which would allow the mass to be broken up to a great extent. There is some evidence of slickensiding, but it is very slight.

456 to 459. A brownish amygdaloidal trap of the upper portion which grades downward into a more typical amygdaloid. The thickness of the amygdaloidal portion as represented by the core is, however, rather unsatisfactory, not being much over a foot, and then grading downward again into an amygdaloidal trap, followed by an ordinary trap. The amygdules are rather irregular in outline and of moderately small size. The filling seems to be for the most part of calcite which is of a reddish color. Amygdules filled with chlorite are also seen but they are of relatively small size and of slight importance. As noted above this member grades down into a trap at the base of the series which is of a dark, very compact character. The individual minerals are not recognizable to the unaided eye. On fresh fracture the rock is seen to have a very dark greenish color due to the presence of a considerable amount of small particles of chlorite. This rock is intersected by numerous veins. Scattering amygdules occur often through this trap but are relatively scarce.

459 to 461. Is a dark brownish trap with small bunches of chlorite. Epidote is also abundantly present and No. 5 of this series is represented by a purely greenish epidotic sand. This is very much more epidotic than the sand described above in the portion 426 to 432. To all appearances, this sand is principally composed of epidote. The fragments of cores succeeding this sand are seen to consist entirely of epidote (with numerous drusy cavities in which epidotic needles project) and also some quartz. The epidote seems to be very much broken up through drilling but this is principally due to the open character of the rock on account of the numerous drusy cavities. These cavities are of relatively small size and of extreme number throughout the specimen.

461 to 466. The very top of this member consists of an epidotic rock exactly similar to that previously described, merging gradually into a reddish brown trap of moderately fine grain, with a considerable amount of epidote present in the trap. This epidote is easily recognized throughout the member on account of its color, and the needle-like forms in which it is crystallized. Many of the druses in the upper portion of this member contain numerous well crystallized needles of this mineral. Passing downward the rock becomes more reddish brown and somewhat coarser grained. Veins of calcite intersect the mass and show a peculiar pressure twinning. Bunches of chlorite are here and there abundant and are of sparse dissemination throughout the cores.

466 to 470. Is a more coarsely grained trap showing in the upper portion a rather small luster mottled appearance, which in the central portion is not so well pronounced, and gradually decreases in extent as the base is approached. This member is also considerably intersected by veins of calcite with laumontite on the faces. On fresh fracture the rock has a distinctly reddish color but the constituent minerals are not easily determinable, although feldspars of a long vesicular type seem to be present.

Label on box, Hole No. 1, 470 to 555 feet. Stencil number, No. 6.

470 to 476. A reddish brown trap with a considerable amount of chloritic material scattered in irregular masses throughout the core which has given the rock a distinctly greenish cast. The texture is moderately coarse grained near the top; as greater depth is approached the rock becomes more luster mottled and in some instances is a distinctly coarse grained, poikilitic trap with a greenish cast. The greenish character seen in the luster mottled portion is not due to the large bunches of chlorite that are seen in the upper portion, for here the chlorite is more finely disseminated throughout the whole ground mass and is not collected into separate large sized bunches. This luster mottled portion is much more dark colored and has lost the reddish cast that was present in the upper portion of the bed. Veins of calcite and laumontite do intersect the mass but are relatively coarse. A few very sparsely disseminated amygdules filled with calcite are seen throughout this member; at the basal portion the luster mottling is much less pronounced and is of smaller size where present.

476 to 486. Rock is a dark, moderately coarse grained diabase showing rather large luster mottling. Veins of calcite are particularly wanting throughout this member. This luster mottled diabase is very compact and hard as is shown by the length and character of the drill cores; some of these are at least two feet in length

and retain perfect symmetry showing very slight wearing away. This member also has a distinctly greenish cast due to the amount of finely disseminated chlorite which is present throughout it. The lower portion does not furnish as long cores and the rock does not seem to be as thoroughly massive as the upper member. The character, however, of both portions is very much the same, only the lower portion is more often cut by calcite veins. Chlorite is seen to be present on many of the vein faces and it is considerably gouged and polished as though the result of slickensiding action. The luster mottling in the central portion is not as pronounced as in the upper but it gradually merges from the upper with quite a sharp line of demarcation. By this it is not to be understood that the lower portion is not luster mottled for it is distinctly so.

486 to 496. A rock of practically the same character as the preceding, in some instances the core being cut by veins of calcite horizontally. The luster mottling is rather pronounced showing an increase over the base of the preceding member. This rock has a dark greenish color and is moderately coarse grained. Not only is this rock intersected by horizontal veins but also vertical veins cut the core. These veins are, however, relatively rare and the core furnished by this member is of good quality, sometimes a foot and a half in length. Chloritic bunches are found throughout the member but there are no distinctly large separate accumulations of this mineral. Towards the lower portion the rock ceases to show such a coarsely luster mottled character as in the upper portion and merges more into an non-poikilitic trap.

496 to 500. A reddish, moderately fine grained trap with a large amount of irregular disseminated chlorite. The chlorite also occurs in rather regular shaped amygdules of a rounded outline. This trap is very much iron stained, calcite is also present and some large bunches of amygdules of irregular form filled with calcite with an outer envelope of laumontite. This member has a distinctly decomposed appearance even in the cores here represented. Near the very bottom of this member occurs a considerable amount of epidote associated with calcite, the epidote and calcite both occurring in irregular masses throughout the core. Leading out of these various amygdules are various little bunches or veins of small extent both laterally and vertically.

503 to 506. A greenish, somewhat epidotic, amygdaloidal trap with amygdules filled with calcite and epidote. In some instances drusy cavities are filled with epidote in long projecting needle-like forms. The outline or form of these amygdules is very regular, and from the evidence presented by the core, the epidote is later than the calcite. This rock is a reddish brown in its general color and this has been changed to something of a greenish tinge by the presence of epidote. Slightly below the upper portion of this member, occurs a very dark, moderately fine grained trap, which is represented by No. 3 of this series. In this trap there are bunches of a reddish hematitic color which are probably derived from the decomposition of some of the constituent minerals. This dark trap member is represented by the cores as only a couple of inches in length and is succeeded by another portion very similar to the top of this member, namely, a reddish brown, moderately fine grained trap with numerous large irregular amygdules filled with calcite and epidote. This epidotic portion appears to be in the form of an irregular vein which cuts across the core at nearly right angles. This vein of epidote is represented by a band not exceeding three-quarters of an inch in its greatest dimension, and extremely irregular in shape so that in portions it is not over one-sixteenth of an inch in width. This epidotic portion is filled by a reddish, fine grained trap with bunches of somewhat regular outline of chlorite. The constituent minerals are not to be determined in this specimen on account of the fine grained character of the rock.

The chlorite bunches seem to be somewhat spherical in their general outline. This member also shows certain reddish iron stains throughout the mass, which are probably due to the decomposition of the iron minerals, possibly the chlorite.

506 to 511. This member starts in a somewhat reddish brown, amygdaloidal trap. The amygdules are of moderately small size, and some of them are filled with quartz. Calcite is also present, but the main part of the amygdule filling is quartz. This rock has a distinctly greenish color owing to the amount of epidote present and the core is intersected by numerous veins of calcite which intersect the core at an angle of about 45°. The amygdules grow smaller and smaller in size as we go down the series but finally we come in the central portion of this member to a greenish sand with which there is a considerable brownish material mixed. Subsequent to this sand occurs an amygdaloidal trap very rich in epidote which is disseminated throughout the ground mass, and also occurs in small drusy cavities in vesicular form. The presence of the epidote has given a distinctly greenish color to this amygdaloidal trap. In No. 7 of this series a vein of chlorite and epidote about an inch in thickness is seen to be filled with a quartz. In this connection it is interesting to note that strings of quartz proceeding from the amygdules intersect an epidote band and continue through it, thus showing that the quartz is younger than the epidote. This is well seen in fragment No. 7 of this series. The very bottom of this core is represented by an extremely rotten and much decomposed trap of a brownish iron stained color.

511 to 515. A moderately fine grained trap with considerable amount of chlorite present in irregular bunches disseminated throughout the ground mass. In some instances this chlorite has been decomposed, leaving the irons present as a reddish hematitic stain on the core. On fresh fracture it is seen that this rock is of a dark brownish gray color. Calcite is present in the form of veins cutting the core horizontally. In one vein of calcite a little prehnite is also present. The lower portion of this member consists of an amygdaloid or amygdaloidal trap in which there is a considerable amount of epidote present. The form of these amygdules is somewhat irregular but they are of relatively small size. Several of these portions are represented only by sand from the sand pump. In portions epidote is abundantly present, but in sparsely disseminated amounts.

515 to 524. A reddish brown amygdaloid with amygdules of very large size, the amygdules being filled for the most part with calcite. In some instances, however, there is a considerable amount of crystallized epidote in small cavities and in one instance at least, in No. 7 of this series there is a large quartz crystal finely crystallized in one of these drusy cavities. There is a large amount of quartz filling in some of these large irregular druses. One of these portions is represented in fragment No. 12 which has for the major part of the core a mass of quartz which is filled with irregular fragments of greenish chlorite. Irregular fragments of a reddish green amygdaloidal trap are also seen surrounded by this quartz and the whole has very much the appearance of a brecciated vein. In this quartz there are a few small crystals of copper. The contact between the quartz and the adjacent rock shows that there has been some slight alteration. The greenish trap near the quartz is seen to become more reddish and this reddish stain has somewhat permeated the quartz. Towards the lower portion of this member the rock becomes considerably more epidotic or chloritic but this gives it a much greener character. The vein material stops at about 522 and is followed by this greenish, fine grained trap with a few bands of chlorite and a few irregular disseminated amygdules filled with epidote and calcite, the calcite in this instance being older than the epidote. The very lowest member of this portion is represented by a much decomposed brownish green, much altered trap. This trap shows its extreme decomposition in the very

small comminuted fragments which are preserved in the drill record. The very end of this member is represented by a brownish sand with a few of the constituent minerals recognizable. This sand has a somewhat greenish cast due to the amount of epidote present in the rock.

524 to 526. A dark greenish trap with numerous bunches of chlorite. The whole core shows that this chlorite is present throughout the mass and in some instances it looks as though it had been dragged out and rolled by slickensiding motion into greenish striated plates.

526 to 530. The upper portion of this member consists of an amygdaloidal trap of a somewhat open textured character with considerable quartz, calcite and epidote present as filling for these irregular cavities. Veins filled with laumontite and calcite also intersect the rock horizontally; the filling of the amygdules is in very large part quartz. Below the upper portion of this member the rock becomes more of a typical trap, of a dark, nearly black color of such a relatively fine grain that none of the constituent minerals can be recognized by the naked eye. The cores from this member are sometimes cut by horizontal veins filled with calcite. Bunches of chloritic material are present throughout the mass and appear to have a general, rather irregular outline. Near the lower portion of this member the rock becomes considerably more amygdaloidal. The upper portion of this amygdaloidal member is marked in the core by a band at least an inch thick of greenish chloritic material which is probably derived from epidote. The amygdaloid is of a greenish brown color. The filling of the amygdules is in large part quartz. Near the contact of this amygdaloid with the greenish epidotic portion the amygdaloid has a much more reddish color and along the contact between these two parts has rather irregular apophyses of the trap, including epidote. This amygdaloid has a distinctly green color due to the amount of epidote which is present in small disseminated particles throughout it. In the drusy cavities which have remained open, epidote is seen to have crystallized out into needles.

530 to 533. Much broken up drill core of a greenish brown character with some irregular amygdules of considerable size filled with quartz, much the same as the preceding, but the whole rock with a much more brownish cast than the preceding. The amygdules are scattered so widely that few appear in the drill core. The lowest portion of this member is represented by a brownish sand in which the various members can not be determined. From about 496 up to this point the cores have all been very much broken up and the fragments rarely exceed an inch in length showing the generally decomposed fractured character of the beds which this series represents.

533 to 542. The upper portion of this member consists of a dark brownish, moderately fine grained trap with a considerable amount of chlorite in moderately large sized bunches scattered throughout the core. This chlorite is in rather disseminated, irregular bunches but further down it appears in rather greater quantities in rather spheroidal forms. Calcite is sometimes present also as a filling in these chloritic bunches and in all such cases it appears as though the calcite were formed previous to the chlorite. In many instances the chlorite has been decomposed and altered into a reddish iron material and a few seams of calcite cut the core at an angle of about 45° and in some instances the original filling of calcite has been apparently largely replaced by chlorite. In certain instances the chlorite of this trap appears to have suffered slickensiding. At the very bottom of this member the color of the trap is somewhat darker and there is a slight tendency towards rather small luster mottling.

542 to 552. The upper portion of this member consists of a dark, very fine grained trap, much the same as the preceding, the luster mottling, however, not being as

evident and bunches of chlorite are somewhat less frequent also. The core is intersected by veins filled with calcite and laumontite which intersect it both horizontally and vertically. The core preserved from this series is of good quality and of moderate length. Towards the central portion of this member the fine luster mottling again appears to some extent, and a few bunches filled with calcite are also evident through the core. The luster mottling here represented seems rather to be a localized feature, but it does not extend throughout very much of the core. Slightly below the central portion of this section the rock becomes distinctly more greenish and begins to lose the luster mottling which characterized it in the central portion. Together with this change the trap becomes somewhat more amygdaloidal, the amygdules being of rather regular outline. The filling of the amygdules has been, for the most part, of calcite but in some instances chlorite is also found as a filling. It is highly probable that this chlorite was derived from the epidote which is sparingly represented in these cores. The amygdules are of very small size and rather widely disseminated throughout the specimen. This amygdaloidal portion is rather localized but it does not extend much more than six or seven inches as represented by the core. Below it comes a more fine grained, homogeneous trap of a reddish brown color which is filled by a more reddish colored amygdaloid. The filling for this amygdaloid is calcite and epidote. The epidote has been altered to chlorite. This phase is well represented by No. 20. Following this portion of the member the rock becomes more greenish as represented by No. 23 and owes its character to the amount of epidote present. This portion lies near the base of this member. Epidote is present in considerable amounts, apparently as a vein. This epidote is rather drusy and contains numerous cavities in which crystals of great beauty project. The width of this vein, judging by the core is perhaps eight inches. This is followed by a much decomposed and broken up, dark greenish, amygdaloidal trap. The amygdules in this case are filled with quartz which has a somewhat pinkish color. The amygdules are rather irregular in outline. This portion of the core is retained in only small comminuted fragments.

525 to 555. This portion consists of an amygdaloidal trap, the amygdules being sparingly preserved in the core. The amygdules are. for the most part, filled with quartz which has a more pinkish color as before noted in the preceding member. The ground mass in which these amygdules occur is a dark, moderately fine grained trap in which few of the constituent minerals are to be recognized.

Central drill hole 2. 488 feet deep, dip 60°, elevation 61 feet above datum and horizontally 6472 feet, to which may be added (cot 24° x 123) for the difference in elevation, in a direction S. 18°E., from an outcrop of the Allouez conglomerate at an elevation of 184 feet,—840 feet from Hole 1. Hubbard makes the strike of the Kearsarge conglomerate N. 80° 11′ E. in the Central mine and its dip 21° to 27°. The uncertainty of the strike may make 1% difference in horizontal distance. The Kearsarge is about 2599′ below the Allouez in the Central mine. The top of the hole is about 6747 x sin 24°=2740 feet below the Allouez.

Central drill hole 8. (Cend. 8). A vertical hole 727 feet deep should be comparable with Cend. 1, faults apart, for it is distant from it 170 feet along the strike line S. 72° W. and 13 feet N. 18° W. from the strike line. Accordingly it should be 827 across the strike below, and 26′ vertically below 2. Its elevation is probably about 35′ above datum and 11 feet below No. 1. By barometer from Keweenaw Central

R. R. 1175 A. T. Its top should have struck the horizon of Cend. 1, had they neither had any overburden, if the strike is correctly assumed and there are no faults. But as Hole 8 is vertical, to get the equivalent thickness of strata one must multiply the vertical distance by the cosine of the dip making them between 8/10 and 9/10 of the present value. If we take the average dip of sediments and contacts in connection in the drill hole, the dip indicated is 29°, which is in very fair harmony with dips otherwise assumed. The next drill hole south No. 5,[1] seems to have dips of about 35°. On the other hand there is nothing in Cend. 1 to correspond to Cend. 8. 42-319 which can not well be less than 277 x cos 29°+20=260 feet deep by direct measurements, confirmed by the coarseness of grain. This same big ophite should also appear in the bottom of Cend. 2. The only chance for it is to suppose that it is the Bed 58, just entered (Cend. 2 442-498) and correlate Cend. 2. 457 with Cend. 8 42 implying a dip of 31°⅓ which we shall do.

Overburden 42, then bed rock. This is right in the swamp.

(58 bis) Ophite. (250)

Trap 8.42-314′9″=273+ (235+15)

The amygdaloid top is not present. The mottling is well marked as follows:

mm.	2–3,	7?,	5–7?,	12?,	9,	5,	3,	2–3,
depths in hole	42,	44,	60,	172,	202,	218,	239,	273,
or distances of	240,	238,	223,	124,	98,	84,	66,	36,
mm.	2,	1–2,	1					
depths in hole	279,	295,	305,	314′9″				
or distances of	31,	17,	8,	0ft.				

from the bottom if the dip is 29° or so. This is a well-marked ophite and has a nearly normal increase in grain and does not appear extra feldspathic. At 60 there seems to be dark resinous grains of porphyritic augite; at 66-8 feet there is a vein of prehnite and copper making an angle of about 34° with the drill core, perhaps therefore nearly at right angles to the bedding and thereafter it is very chloritic, as if near a big slip. The feldspars are small and the general effect dark. Another chlorite seam at 282.

This would appear to belong close under the Wolverine sandstone. At the Wolverine the second belt below, from 87-307 feet in the 11th level cross-cut, is a heavy belt of trap, say 145 feet thick.

Base below base of Wolverine sandstone (281)

59. Melaphyre (30) (311)

Scoriaceous amygdaloid d 8. 314-331=17 (15)

This amygdaloid is badly broken up and mixed with red clasolite and epidotic sandstone, and may represent a sedimentary belt as well as the top of the ophite below, dip apparently 35°

Trap d 8. 331-348=17 (15)

A fine grained melaphyre with epidote and amygdaloid inclusion at 337-338, broken up from 344 down. It is noticeable also that scoriaceous amygdaloids, and an abundance of epidote, and red sediments are associated with the beds beneath the Wolverine sandstone, also at the Wolverine (amygdaloid and epidote) and at the Arcadian (bottom of Hole 2 and Hole 19), and on the Calumet and Hecla property A, 2-21, 1-21, B. Cf. also Franklin Junior 1, 2, 3, and the

[1]Holes 1 and 2 were sent to the Geological Survey office to examine. Then where drilling was recommenced the numbering of the boxes seem to have begun with 1 again, 1, 2, 3, 4, A, 5, and then the last hole was numbered 8 as may be easily verified by comparing depths.

more massive parts of the flows are more feldspathic, sometimes doleritic, sometimes glomeroporphyritic, when ophitic faintly so, the mottling not showing until it is quite coarse.

60. Chocolate sandstone. Dip 26. 5°, clasolite? at d 8. 348 (311)

Cf. C. & H. B. 463.

61. Amygdaloid d 8. 348-350=2 (2) (12)

Trap reddish, fine grained with a few chloritic amygdules-360=12

(323)

62. Felspathic melaphyre (35) (358)

Amygdaloid d 8. 360-371=11 (11)

Marked red, granular with white amygdules; perhaps only a band in the flow above to 369, then coarser feldspathic with a few large amygdules and at 371 epidote.

Trap growing coarser then finer d 8.-400 29 (25)

Dip of bottom contact 17°

63. Melaphyre (8) (364)

Amygdaloid d 8. 400-404=4 (3)

Trap growing finer d 8. 404-410=(5)

64. Feldspathic melaphyre (40) (404)

Amygdaloid d 8. 410-8.420=10 (8)

Epidote seam, amygdaloid with chlorite and calcite, and amygdaloid with a little red clasolite matter and prehnite.

Trap d 8. 420-459=39 (32)

Coarsest, somewhat mottled about 447.

65. Amygdaloid (10) d 8. 459-462=3 (2) (414)

Poor, coarse.

Trap somewhat amygdaloidal d 8. 462-471 (9)

66. Ophite, feldspathic. (12)

Amygdaloid d 8. 471-477=6 (5) (426)

Red with white amygdules, and epidote and calcite seams.

Trap d 8. 477-485=8 (7)

Faintly mottled.

67. Ophite, feldspathic. (23) (449)

Amygdaloid d 8. 485-491=6 (5)

Red, marked with small amygdules of epidote, chlorite and some calcite.

Trap d 8. 491-512=21 (17)

There are seams making an angle with the hole, (the vertical), of 29° and perhaps about at right angles to the dip. There is a faint 2-3 mm. mottling at 501, growing finer below. The dip of the bottom contact is between 26° and 45°.

68. Amygdaloid d 8. 512-514=4 (42) (2) (452)

Marked with pink amygdules.

Trap d 8. 514-516=2 (2)

69. Ophite, feldspathic. (11) (463)

Amygdaloid d 8. 516-518=2 (2)

Marked like the one above.
Trap d 8. 518-528=10 (9)
70. (9) (472)

Amygdaloid d 8. 528-532=4 (3½)
Poor.
Trap (with chloritic amygdules) d 8. 532-538=6 (5)
71. Feldspathic ophite (13) (485)

Amygdaloid d 8. 538-544=6 (5)
Red, fine grained chlorite-540, then 1 inch of epidote, and feldspathic, chloritic, somewhat amygdaloid-544.
Trap d 8. 544-553=9 (8) (13)
72. Ophite (122) (607)
Amygdaloid d 8. 553-556+=3 (3)
Red marked to 556, coarse a few feet farther and fine grained to 565.
Trap d 8. 556-693=137 (189) (122)
Grows coarser to about 644, as follows:

mottles	2 mm.,	3 mm.,	3-5 mm.,	5 mm.,	3 mm.,	2 mm., at
depths	576,	583,	599,	627,	666,	675,
distances	103,	96,	82,	58,	23,	7, from the foot.

At 583 there are chloritic seams and from 682-685 one of epidote.
(73 and 74 see Hole 5) (25) (632)

Amygdaloid d 8. 693-702=9 (8)
Red, fine grained with chlorite and epidote, from 695-702 very epidotic.
Trap d 8. 702-722=20 (17) 25
Coarse, feldspathic, growing finer to 722, the top of the contact being about 26°,—an epidote seam at 712
75. Amygdaloid d 8. 722-726=4=Cend. 5.8 8 (637)
Trap, feldspathic d 8. 726-727+1

Central drill hole 5. 950 feet from No. 8 in a direction S. 18°E. Elevation by barometer 195 A. T. Vertical depth 818 feet. The boxes at the mine are labelled 3. Dip about 35°. At this dip the bottom of 8 should be equivalent to 92 feet down in No. 5, and in turn its bottom should be equivalent to 185 feet down in No. 3. The correlation of 8 d 5. 807-816 with d 5. 182-186 is a fair one, and we may also compare d 8. 722-727 with d 5. 88-92.

The sediment d 5. 98 to 100 does not appear in 8, nor does the ophite which appears in 8 down to 693 appear in 5. This gives us a 33 foot range of correlation and the 34 feet beds between are small amygdaloids upon which we cannot depend.

Overburden sand 65 feet.

(73) Amygdaloid with white amygdules d 5. 565-68 3 (2)
Feldspathic melaphyre d 5. 568-84 10 (12) 14
With chloritic amygdules.
Contact at the base dips at angle of 7 or 8:10 (about 36°⅔)

(74) Amygdaloid
White with epidote seams d 5. 584-86 2 (2)
Trap d 5. 86-88 2 (2) (3)
Probably a gush of the underlying flow

Below the base of the Wolverine sandstone (631)
Glomeroporphyritic.
(75) Amygdaloid
White with epidote seams d 5. 88-92=4 (3+)=[8.722] 639
Trap d 5. 92-98 (6) (4-½) (8)
A feldspathic melaphyre with chlorite amygdules.

76. Sediment d 5. 98-100 2 (2) (641)
Aphanitic, mottled pink and green like castile soap, epidotic, dip 35°.
Base of this sediment below the Wolverine sandstone No. 9.
77. Amygdaloid d 5. 100-102=2 (2) (31) (672)
Feldspathic melaphyre d 5. 102-138=36 (29)
78. Inclusion bed, feldspathic melaphyre (820)
Amygdaloid d 5. 138-141=3 (2)
Trap d 5. 141-320=179 (146) (149)

Faintly mottled with amygdaloid inclusions, and slightly doleritic at 169, 175, 183, 189. At 201.6 the feldspar is 4 mm. long. At 223 there is a vein of porcelainic datolite. At 267, 277, 285, 289, there are marked inclusions of epidote amygdaloid. From 313 to 318 are marked clay veins dipping from 31° to 38° with brecciation.
Cf. Arc. Belt 74.
79. Feldspathic ophite. (999)
Amygdaloid d 5. 320-335=15 (19)
Calcite poor.
Trap d 5. 335-540=205 (167)
Feldspathic, fine grained, faintly mottled to 367, quartz calcite seams to 366 and at 419, mottled 4 mm. across at 450, 3-5 mm. at 499, at 501 laumontite seams.
80. Feldspathic melaphyre. (1035)
Amygdaloid d 5. 540-544=4 (3)
At first small amygdules and then coarser structure.
Trap feldspathic d 5. 544-585=41 (33)
There is an amygdaloid inclusion at 564.

81. Conglomerate and sandstone d 5. 585-593=8 (7) (1042)
A red sandstone at the base basic, giving a number of good chances to measure the dip, which average (8 measurements) 70 per 100.
Cf. Arc. bed 76.
82. Melaphyre d 5. 593-632=39 (32) (1074)

Amygdaloidal somewhat throughout, fine grained.
83. Feldspathic malaphyre (20) (1094)

Amygdaloid d 5. 632-640=8 (6)
Trap d 5. 640-657=17 (14)
84. Feldspathic melaphyre (14) (1108)

Amygdaloid d 5. 657-662=5 (4)
Trap d 5. 662-674=12 (10)
Seamed at 668.

85. Feldspathic melaphyre (15) (1123)

Amygdaloid d 5. 674-685=11 (9)
Trap d 5. 685-692=7 (6)

86. Feldspathic melaphyre (29) (1152)

Amygdaloid d 5. 692-708=16 (13)
Epidotic with white amygdules on gray ground.
Trap d 5. 708-728=20 (16)
Amygdaloid inclusion d 5. 713-715
Cf. d 3. 61-128? which is also a feldspathic melaphyre. The three flows ? above appear in d 3. 61-128 as one?

87. Feldspathic melaphyre with inclusions. 64 (1216)

Amygdaloid d 5. 728-743=15 (12)
Trap d 5. 743-807=64 (52)
Faint mottling, at 758 and 767 amygdaloid inclusions, at 778 faint 1-2 mm. mottles growing finer.
In Cd. 3 we have from d 3. 128-182=54 (45) a feldspathic melaphyre, with a red and white, then greenish gray, and gray and white, with pink prehnite, amygdaloid, with an amygdaloid streak d 3. 142, then a feldspathic melaphyre with large amygdules of pink prehnite and a little copper to d 3. 182.
Amygdaloid d 5. 807-816 is we assume = d 3. 182-192

Central mine drill hole 3. 940 feet from No. 5 in a direction S. 18° E. About 922 feet across the strike. Elevation by barometer 1223 A. T. Vertical depth 708 feet. Dip by correlation with drill hole 4 33° $\frac{2}{3}$ leading to a reduction of .83 for thickness. This is making d 3. 608-612 equivalent to d 4. 67-68, a sedimentary belt characterized by an unusually fine grained, not augitic set of flows beneath. The only indication of dip in the hole itself is an amygdaloid flow contact at about 371 feet which seems to dip about 31°.

Surface d 3. 0-12.

(82. bis) Feldspathic melaphyre d 3. 12-37=24+ (20)

(83. bis) Feldspathic amygdaloidal melaphyre.
Amygdaloid d 3. 37-54=17 (14)
The feldspars are 1 to 2 mm. broad, larger than usual, but uniform, not glomeroporphyritic, more doleritic in type, a coarse laumontitic amygdaloid.
Trap d 3. 54-61=7 (6) (20)
Finer grained.

(84-86. bis) Feldspathic melaphyre.
Amygdaloid d 3. 61-70?=9 (7)
At first amygdaloid, then fine grained, marbled, epidotic.
Trap d 3.70-3.128=58 (47) (54)

Dark, dense, epidotic at 75, grows coarser at least to d 3. 100, a feldspathic melaphyre.

87. Feldspathic melaphyre.
Amygdaloid d 3. 128-138 10 (8)
Trap d 3. 138-182 44 (36) (44)

Amygdaloid streak also at 142, pink prehnite and copper are characteristic
Below the base of the Wolverine sandstone according to the correlation used (1216)

88. Feldspathic melaphyre (1263)
Amygdaloid d 3. 182-192=10 (8+)
Trap d 3. 192-239=47 (38+) (47)
Greenish, hard to 186, poor to 192, at 194′ 9″ crystals in cavities, apophyllite, stilbite, etc., doleritic at 198, at 234 green epidote inclusion.

89. Melaphyre (9) (1272)
Amygdaloid d 3. 239-244=5 (4)
Trap d 3. 244-250=6 (5)

90. Feldspathic melaphyre (5) (1277)
Amygdaloid d 3. 250-252=2 (2)
With prehnite quartz and copper at 251′ 3″
Trap d 3. 252-256=4 (5)

91. Melaphyre (9) (1286)
Amygdaloid d 3. 256-258=2 (2)
Gray, rather coarse
Trap d 3. 258-267=9 (7)

92. Melaphyre amygdaloidal (11) (1297)
Amygdaloid d 3. 267-278=11 (9)
Greenish gray
Trap d 3. 278-280=2 (2)

93. Feldspathic melaphyre (74) (1372)
Amygdaloid d 3. 280-285=5 (4)
Trap d 3. 285-371=86 (70)
Marked contact at top and a red amygdaloid passing into a coarse gray one and then a feldspathic trap, with 3 mm. mottles at 344?, and epidote at 369-370.
The dip of contact is 31°.

94. Feldspathic ophite. (182) (1554)
Amygdaloid d 3. 371-374=3 (2)
Brown with numerous amygdules of pink prehnite.
Trap d 3. 374-595=221 (179)
Generally massive feldspathic, with occasional coarse amygdules of chlorite or prehnite, doleritic at 405. Faintly ophitic, 7 mm. across at 440-464; from 511-521 a seam nearly parallel to the drill of prehnite, quartz, chlorite; at 528 an epidotic inclusion.

95. Feldspathic melaphyre (19) (1573)
d 3. 595-608=d 4. 40-67? 23
From d 3. 595-599 is an ophitic bed, mottled pink and green like castile soap, passing into a plain glomeroporphyrite; from 599 to 604 is plainly a glomeroporphyrite; at 604-6 is like 595-9; then it relapses into glomeroporphyrite once more-608.

96. Conglomerate. Cf. Old Colony sandstone
d 3. 608-612=d 4. 67-68=5 or (4) (1577)

Fine grained, basic, but quite distinctly a sediment. This would be somewhere about 1600 feet below 9. Cf. Arcadian Belt 76 which is 968 below the Wolverine sandstone, and only 12 belts. The association with feldspathic doleritic ophites, often slightly and coarsely amygdaloid with prehnite is similar.

Central mine drill hole 4. 850 feet from No. 3 in a direction S. 10° E. About 840 feet across the strike. Elevation by barometer 1245 A. T. Vertical depth 675 feet. Dip by correlation with drill hole 3, 33° ⅔. According to this dip the top of 6 should be = d 4. 540 and d 6. 39 should be d 4. 579. As a matter of fact the glomeroporphyritic character and fine grain of the flows are notable points of resemblance, but the nearest comparison of their tops must be d 6. 39=d 4. 501 to 517 or 648 or 675+ which gives dips respectively of 30° to 30° ⅔ or 37°. From a comparison of 6 and 6A we get (as we shall see) a dip of about 36° which indicates that the correlation d 6. 39=d 4. 648 is the more likely, in which case the factor to reduce to true thickness would be .81 instead of .83 for 33° ⅔.

Overburden to ledge 40 feet.
Feldspathic faulted ophite 40-67
Sandstone and brecciated amygdaloid 67-68′ 3″.
Base below Wolverine sandstone (1577)

97. Porphyrite? (80) (1657)

Amygdaloid d 4. 68-69=1 (1)
Trap d 4. 69-167=98 (79)

The amygdaloid is poor and the trap uniform and fine grained.

98. Porphyrite? (115) (1772)

Amygdaloid d 4. 167-170=3 (3)
Trap d 4. 170-309=139 (113)

The amygdaloid is greenish, poor, but with a little copper, a hard white amygdaloid with prehnite and datolite. The feldspar is fine grained and feldspathic, a little darker and coarser toward 221. There is a chloritic seam crossing at an angle of 11° ⅓ with the drill core, i. e., perhaps dipping 79° from the horizontal about 4.267′.

99. Glomeroporphyrite feldspathic (87) (1859)

Amygdaloid d 4. 309-314=5 (4)
Trap d 4. 314-417=103 (83)

A glomeroporphyritic amygdaloid with calcite, prehnite and a trace of copper, then fine grained and porphyritic, at d 4. 354 amygdaloid bomb with speck of copper.

100. Glomeroporphyrite (68) (1927)

Amygdaloid d 4. 417-428=11 (9)
Trap d 4. 428-501=73 (59)

A red glomeroporphyritic amygdaloid, somewhat brecciated, epidotic, with an epidote seam directly under from d 4. 431 to 433, then at 447 a faint 2 mm. mottling, yet not plainly ophitic or due to the augite, of the same type as above and below.

101. Glomeroporphyrite (145)? (2072)

Amygdaloid d 4. 501-508 or 514?=13 (11)
Trap d 4. 514-675+161?=132+

Begins as a characteristic red glomeroporphyrite, amygdaloid in streaks, a coarse, more pronounced glomeroporphyrite (2 mm.) from d 4. 508 to 511, then finer to 514, then a solid, light colored feldspathic melaphyre, with chlorite amygdules the rest of the way; at 585 there is a prehnite chlorite seam, and another at 536 with a little copper, and at 648 an amygdaloidal streak and yet it is neither ophitic nor doleritic in spite of its thickness, but of a well-marked type, toward which the beds at the bottom of 3 also tend and those in 6 and 6A.

Central mine drill hole 6. 845 feet from No. 4 in a direction S 10° E. or about 835 feet across the strike? Elevation by barometer 1260 feet. Vertical depth 801 feet. Dip by correlation with 6A which starts from the same point at a dip of 64° .5 calling d 6A. 290=d 6. 352 is 35°⅓. The reduction factor to get thickness will accordingly be .81. Correlating with Hole 7, the top of it should be equivalent to d 6. 610. The nearest correlation we can get to this is d 6. 650-801, a coarse feldspathic and ophitic doleritic flow, with d 7. 37-257. The grain at the bottom of 6, 10 mm., would indicate that the bottom would be at d 6. 950 or some such point, but the grain at d 7. 37 indicates that the top of the flow is not much above, perhaps corresponding to d 7. 0. It seems likely that this rather unusually large flow is correctly correlated and comparing d 7. 0 with d 6. 650 and d 7. 257 with d 6. 950 we get a dip of 36° ⅔ to 38° ⅓, which agrees well enough with a progressively increasing dip to the South.

Overburden 33 feet
We probably make no large error in assuming d 6. 39=Cend.
d 4. 675+ or below the Wolverine (2072)

Begins in a fine grained trap with small chloritic dots.

102. Glomeroporphyrite (37) (2109)

Amygdaloid d 6. 39
Trap d 6. -85

Begins with small pink feldspar phenocrysts 1 mm. long, appears coarse at 44, then at 54 finer and from 60-73 a fine dense trap, then glomeroporphyritic from 73-85, but the flow boundary is very doubtful.

103. Glomeroporphyrite. (44) (2153)

Amygdaloid d 6. 85-87=2 (2)
Trap d 6. 87-140=53 (43)

The general habit along here is that of the porphyrites and Ashbed group. From d 6. 85-87 is amygdaloid with empty or chloritic amygdules, then light greenish gray and from 101 on very faintly mottled. At 113 it is typically feldspathic with chloritic spots, and then grows finer.

d 6. 39-140 (82 feet) correspond to 6A. 36-112 (75) feet.

104 & 105. Glomeroporphyrite (62) (2215)

Amygdaloid d 6. 140-145=5 (4)
Amygdaloidal trap d 6. 145-217=72 (58)

This begins red glomeroporphyritic with chloritic amygdules, becomes coarsely amygdaloid and feldspathic to 160. A calcite seam at an angle of 42° with the core (perhaps nearly perpendicular to the dip) crosses at 171. Toward the bottom it becomes a little darker and faintly mottled, but the feldspar laths remain conspicuous, being 2-3 mm. long at 205. This belt d 6. 140-217 (64) corresponds to 6A. 112-171? (58). The heavy bottom belt of trap is well marked and characteristic, the top is amygdaloidal and we see in comparing the two holes the irregularities of flow in the amygdaloids.

106. Glomeroporphyrite (110) (2325)

Amygdaloid d 6. 217-220=3 (3)
Trap d 6. 220-352=132 (107)

The amygdaloid is red, glomeroporphyritic with chlorite and some calcite amygdules, then remains fine grained down to 273 when a faint mottling begins. At 278, 304, 315 there is a somewhat doleritic texture. From 2 mm. at 339 the mottling gets finer (at 341 1 to 2 mm.) to the bottom.

This d 6. 217-352 (122) agrees with d 6A. 171-290 (117) both in the thickness and the general glomeroporphyritic character and fine grain with an ophitic tendency toward the base only about 20 feet above it. This is not so pronounced a glomeroporphyrite as the beds above it.

107. Glomeroporphyritic feldspathic ophite. (157) (2482)

Amygdaloid d 6. 352-357=5 (4)
Trap d 6. 357-544=187 (153)

In this flow although it begins with a glomeroporphyritic amygdaloid and remains fine grained and feldspathic to 367, there is a much plainer ophitic mottling, beginning from 390-304; at 406, 451, 454, 496? feet we appear to have mottles

(116), (78), (76), (40)
4-5, 4, 5-7, 3

mm. across, being plainer than anything above in Hole 6 or 5. From 376.9-379.9 there is a well-marked vein of prehnite with copper; at 397-400 it is doleritic with feldspar laths 5 x 1 mm; at 406′ 5″ there is a vein with datolite crystals; at 413 it is doleritic; at 415 there is a speck of copper, at 425 there is datolite. The base is uniform. Correlating d 6. 413 with 6A. 339 we have a dip of about 36° ⅙.

108. Glomeroporphyrite? (9) (2491)

Amygdaloid d 6. 544-552=8 (6)
Trap d 6. 552-555=3 (3)

This is a poor red amygdaloid and the belt probably belongs with the one above or below.

109. Glomeroporphyrite. (4) (2495)

Amygdaloid d 6. 555-558=3 (3)
Trap d 6. 558-560=2 (2)

The amygdaloid is red glomeroporphyritic, the trap coarse, feldspathic, with chloritic dots.

110. Glomeroporphyrite (8) (2503)

Amygdaloid d 6. 560-563 (or 6?)=3 (3)
Trap d 6. 563-570=7 (6)

The amygdaloid is a brecciated glomeroporphyrite with chlorite amygdules to 563, and remains fine grained and somewhat amygdaloid to 566, then feldspathic, with the feldspar 1 to 2 mm. long.

111. Glomeroporphyrite (65) (2567)

Amygdaloid d 6. 570-572=2 (2)
Trap d 6. 572-650=78 (63)

Amygdaloids like these above, then a feldspathic melaphyre, coarsest (one feldspar 3 to 4 mm. x 1 mm.) from 614 to 641, at times red, toward the base finer and glomeroporphyritic.

112. Glomeroporphyritic ophite (205)+? (2772)

Amygdaloid d 6. 650-665=15 (12)
Trap d 6. 665-801′ 3″=136+ (110) 122+

Amygdaloid glomeroporphyritic-653 passing into coarse chloritic; the trap beginning grayish green feldspathic gradually becoming mottled and ophitic, at

677, 685, 700, 731, 801′ 3. the mottles are
2, 3, 4, 5+, 10 mm. across; doleritic at 687-9.

The grain being as coarse at the bottom as elsewhere we should infer at least as much more, were it not that in these feldspathic and glomeroporphyritic ophites the coarsest mottling is generally much nearer the base. The thickness according to the usual formula for augite mottling would be still more than 140-+16 from the bottom of the hole (180′ below it), so that the total thickness would be more than 262-+16 feet in all.

Now Hole 7 is 900 feet, or 890 feet perhaps at right angles to the strike from No. 6, and 20 feet higher so that the bottom of d 6. 801 at a dip of 36° 10″ would correspond to d 7. 171. It is therefore to be expected that this heavy ophite should appear at the top of it, and we do indeed find that it begins under the drift at 37 feet with a doleritic streak and a coarseness of 2-3 mm. and that the same belt continues to d 7. 257′ 6″, being coarsest near 155 feet. Taking grain and all into account it seems as though the doleritic streak d 6. 687 might be at the same level as that at d 7. 37 which would imply a dip of 37°. In such case the top of the flow should have come at 70, and the bottom at d 6. 907. It is possible that my estimate of the grain at 801 feet was somewhat exaggerated.

Central mine drill hole 6A. From the same station as 6 but only 414 feet deep and at an angle of 64.5° so as to cut the beds more nearly at right angles, really at about 80°, so that the reduction factor is about .985.

Overburden 36 feet.

(102. bis) Glomeroporphyrite. (20)
Amygdaloid d 6 A. 36-41=5 (5)
Trap d 6 A. 41-56?=15 (15)

(103. bis) Glomeroporphyrite (51)
Amygdaloid d 6 A.? 56-62=6 (6)
Amygdaloidal trap d 6 A. 62-112=50 (49)

From 56-62 prehnite, calcite, epidote, etc., and a little *copper*, and, I suspect, a contact. Thence to 70 is a marked glomeroporphyrite with chlorite amygdules; these occasional coarse hard amygdules of prehnite and *copper* continue to 87 and beyond. The top of the flow is very uncertain, and very probably the two are really one, the finer part being merely a flowage streak.

(104. bis) Amygdaloid d 6 A. 112-117=5 (5)
Amygdaloidal trap d 6 A. 117-127=10 (10)

White amygdaloid with radiated greenish prehnite on a red ground and *copper* (at 114) passing gradually into chloritic amygdaloid forms into which the feldspar laths may be seen to project. At 117′ 6″ the general color tone is light gray-green with white feldspar laths on a reddish ground and radiated chlorite. One fine grained amygdule of radiant chlorite fibres has an epidote center. At 122 rock becomes seamed, red, hard.

(105. bis) Glomeroporphyrite
Amygdaloid d 6 A. 127-130=3 (3)
Amygdaloidal trap d 6 A. 130-171?=41 (40)

The amygdaloid at 127 contains some copper, and also flesh colored crystals of a greasy luster, and coarse chloritic amygdules continue at least to a seam at 138 of calcite and pink feldspar (?) making an angle of 17°.5 with the hole. Comparing this with the fissure crossed at 171 in 6 making an angle of 42° we find that they cannot be made to agree closely at all and that if the seam is at all the same it is irregular so that the angle at which it cuts the hole has not much meaning. Still it must be in a general way not far from normal to the dip.

Below is a fine grained trap.

(106. bis) Amygdaloid d 6 A. 171-179 (8)
Trap d 6 A. 179-215-220 Fault?-290 (109)

The amygdaloid is brecciated, i. e., shattered, with quartz, epidote, etc., and below it is seamed but plainly getting coarser. At 195 it is somewhat amygdaloid and chloritic,- a bomb-like inclusion. At 200 there is a red streak. At 210 it is rather dark, and a mottling appears (2 mm?)

From 215-220 it is seamed and of a different appearance but not amygdaloid and seems to get coarser to 268, remaining dark, fine grained, faintly ophitic, then gets finer so that at 276 the mottling is 1 to 2 mm.

(107. bis) Glomeroporphyritic ophite. (122+)
Amygdaloid d 6 A. 290-298 (8)
Trap d 6 A. 293-414+(114)+

The amygdaloid is red and white, the trap cut with seams of datolite nearly parallel to the hole. At 310 feet the mottling appears (2-3 mm.); at 387 it is 5 mm.? and the rock continues coarse to the end; at 339 it is doleritic, the same streak as d 6. 413? (implying a dip of 36° 10′).

Central mine drill hole 7. 900 feet from No. 6 in a direction S 10° E or about 890 feet across the strike? Elevation by barometer 1280 feet, and the land is a little higher 1285 feet A. T. between this and No. 6. Dip by correlation with No. 6, 37°. Reduction factor to get the thickness will accordingly be .795.

"Overburden to ledge" d 7. 0-36.

112. Feldspathic ophite d 6. 650-801′3″+=d 7. 36-257.6

36-37 is doleritic with feldspar 2-3 mm. long and chloritic interstices very plain; at 43, 1 to 2 mm; at 41, epidote; from 46 to 48, 51′ 6″-55 and 79-81 are streaks of chloritic amygdaloid, probably inclusions; at 62 it is very light colored, and on the whole it is faintly mottled and feldspathic. The mottling is:

43,	70,	75,	94,	127,	155,	233
(168),	(147),	(143),	(128),	(109),	(41),	(11)
1–2,	3,	4–5,	5,	6,	7,	1–2

Comparing this grain as a whole with that at the bottom of 6 would indicate that the top of the flow was really near d 7. 30 and diminish its thickness to 190 feet, while at the same time they would indicate that the base in 6 was only 60 feet or more below 801, the rate of decrease being exceptionally fast, making it only 180 feet.

Base assumed below Wolverine sandstone (2772)

113. Ophite (203) (2975)

Amygdaloid d 7. 257′ 6″-267 or 276=19 (15)
Trap d 7. 276-514=238 (187)

Begins with a well-marked red amygdaloid with small white and epidotic amygdules to 267, then but slightly amygdaloid fine grained and porphyritic with occasional small feldspar crystals, to 273.

Then a poor amygdaloid (possibly having a definite contact, but probably a mere streak) to 276. Then feldspathic, chloritic and somewhat amygdaloidal nearly to 290, when the ophitic mottling begins in a dark resinous trap as follows:

at 310,	327,	343,	410,	427,	465,	483,	498,	514
(160),	(147),	(135),	(82),	(68),	(38),	(24),	(12)	feet
2,	4–5,	5–7,	7,	10,	5–7,	3–5,	2,	mm. contact

The increase from the bottom seems to be unusually rapid 1 mm. in 7 feet.

The trap is very dense and fine just above this contact which is well marked with a dip of 6 or 7 to 10, i. e., 31° to 35°, while some chlorite seams at 399 with some interesting red amygdules dip 28 to 10, 19° ⅔ from the vertical.

114. Glomeroporphyrite? melaphyre (29) (3003)

Amygdaloid d 7. 514-520= 6 (5)
Amygdaloidal trap d 7. 520-549=29 (23)

Begins with a red amygdaloid with small calcite and epidote amyg-

dules, then at 520 becomes feldspathic almost glomeroporphyritic (cf. these glomeroporphyritic flows with those up Isle Royale and Huron streets south of Houghton) with occasional epidote calcite amygdule spots, and at 549 quite epidotic amygdaloid.

115. Amygdaloid d 7. 549-550=1 (1) (11) (3014)

Amygdaloidal trap d 7. 550-563=13 (10)

Red with chlorite amygdules (base of previous flow?) changes to yellowish green with large coarse amygdules of epidote, calcite and quartz -554 then begins to get red again and brecciated and slightly amygdaloid, then light yellow to 563. We have along here apparently a number of gushes.

116. Doleritic ophite (270)+ (3284+)

Amygdaloid d 7. 563-567=4 (4)

Trap d 7. 567-818+ (at least 100 feet probably)=251+

Begins with a well-marked red amygdaloid with quartz and epidote amygdules to 567, then massive yellowish, fine grained to 570, then reddish, fine grained to 604 where it begins to be faintly mottled; the red bed above seems quite characteristic. Dolerite streaks are numerous below and characteristic, at 648-652 (feldspar 6-8 mm. long) at 658, 660, 662, 668, 674-677, 691, 703, 710-776, and 804-818 (feldspar 10 mm. long and 2 or 3 broad, and augite 10 mm. across.)

The augite mottling is as follows:

at 604,	615,	623,	635,	645,	679,	804-818
begins 1-2,	2-3,	4-5,	5,	10,	10?	mm.

The end of the section then appears to be about 3174 feet below the Wolverine sandstone in a series of large heavy ophites, which remind one of ophites at the lower part of the Arcadian section, but without the scoriaceous brecciated amygdaloid tops which there appear.

This Copper Falls-Central section gives as good a chance as any to get the thicknesses of some of the important groups rigorously.

The Lake Shore traps are (200)

The Great (Copper Harbor) conglomerate, 4700 feet broad is perhaps (2200)

The Eagle River group, Marvine's (c) to 45 through 44 (1150)

(some cut out by a fault?) Marvine gives 1417

The Ashbed group b. from 66 through 44 (Marvine 618) (560)

a. from the "diorite" (Marvine 925) or the Mesnard epidote to the Ashbed (1020) (1580)

The Central group from the Mesnard epidote to the Allouez slide (nearly equivalent to the Diorite group, Marvine) (1193+ 87+)? (1324)

from Allouez 15 to Wolverine sandstone No. 9 (3442)

Balance in Central section (3284)

Estimate to Bohemia conglomerate 8 (200)

Total Central group (8250)

There is something like a mile of Bohemia Range group below at a steep angle (5000)

Total Lower Keweenawan (18,380)

My impression is that this is an under-estimate and that several hundred feet have been cut out by slide faults.

§7. EAGLE RIVER-CLIFF (FIGS. 34 AND 35.)

This is historically an important section, since the Eagle River gives the best and most continuous natural section and was thus used by Marvine in Volume I as his type section. We therefore continually refer to it and do not hestitate to refigure it with some slight modifications. Eagle River gap is on the Phoenix property and is now being explored by the Keweenaw Copper Company.

On the way we pass in Section 28 the Natick Gap leading over to the Humboldt property (Sections 16 and 21) probably marking a considerable vein or throw. Close to the Eagle River Gap is the Phoenix property. Then we come to the Eagle River section described in Volume I, Part II, pages 117 to 140, so that we need only reproduce it in Figure 34 and give a condensation here.

-2, and -1, Ss. 16872 and 16871 are the Great Copper Harbor conglomerate. Then we have in the EAGLE RIVER series:

(1) A[1] and M, (2) Ss. and conglomerate, (3) M, (4) Ss., (5) M, (6) Ss., (7) M, (8) Sp. 16869 Ss., (9) M Ss. 16864-16868, (10) A and M, (11) AM, (12) A and M, (13) ophitic melaphyre with prehnite, copper and datolite, (14) (15) and (16) melaphyre (709)

(17) Ss. and conglomerate, (18) M with pink prehnite (Sps. 16863 to 16860) (19) Ss., (20) AM. (21) Ss., (22), (23), (24) and (25) AM, (26) Ss., (27) AM, (ophite), (28) Ss. (1159)

(29) AM, (30) AM, (31) AM, (32) (13) A and M, (33) (10) A and M, (34) (14) A and M, (35) (28) Ss. (fault) (1272)

(36) (21) A and M, (37) (16+10) A and M and covered, (38) (14) M (Sp. 16859) (39) (80) M (Sp. 16858 and 16857, ophite), (40 and 41) (54) covered, (42 and 43) (50) M largely covered, (44) sandstone top, to scoriaceous amygdaloid (1417)

This is the end of the Eagle River series structurally as Bed 45 is one of the Ashbed diabases or melaphyre porphyrites in type, and Marvine draws the line here. The bed above No. 44 is, however, an amygdaloid conglomerate of the type of those below rather than those above, the last typical sandstone being 35

ASHBED GROUP (45) brittle fine grained M, Sps. 16856-16854, (86 feet) (1503) (46), (47) Sps. 16853-16850, (48), (49), (50), (51), (52), (53), (54), (55) Thin AM's with altered olivine, laumontite, prehnite and copper in foot of amygdaloid zones (1630)

(56), (57)? (58) M, (59) and (60) AM and M (61) and (62) AM and M (Sp. 16848) (63) seam of sandstone (I think Beds 64 and 65 may be the same bed, Sps. 16847 and 16846B), (1810)

(64) A, AM and M fault, (65) A, AM and M (16847-16846) (1990)?

I have examined one of the Wisconsin sections of this bed as follows:

Bed 65, Eagle River section,[2] February 24, 1909. A. C. Lane. Section 4607 U. of Wis. See Journal of Geol., 1908, p. 772 analysis. Is too thick. Augite color up to .000948÷.029=.033mm+. Ashbed diabase. Bed 65 Eagle River section, sample No. 7 of Rohns collection.

[1]A stands for amygdaloid.
M stands for melaphyre.
Ss stands for sandstone.
[2]See Fig. 34 in envelope.

Augite is in granules generally, here and there in patches beginning to be poikilophitic. The granules are .10 to .05 mm. in size and smaller. A few large pieces apparently left from an early coarser crystallization run up to .2-3 mm.

Feldspar is quite varied in size, glomeroporphyritic, the largest aggregate is 3.5 mm. x 2; composed of laths each about 1.5 x 0.3. Albite twins parallel M (010) 21°.5 ex with 25°.5 and 14°. 2. The largest grain is Ab75 An25. The small feldspar laths probably nearly at right angles to P, and to M are about 15 x .03 mm; ex 4, 3-6, 4-5, 0-0, 1, 3 ave. 3°, and supposing them perpendicular to M and parallel to P indicate between Ab3 An and Ab5 An3. Olivine pseudomorphs into green serpentine and red iron oxides are generally irregular and not very common. 0.5 mm. is the largest. They are probably corroded remnants.

Iron oxides (magnetite) are in triangular octahedral sections up to about .35 mm. It is quite abundant original. There is some secondary.

Green substances replace olivine and feldspar phenocrysts and possibly fill miarolitic interstices.

This is an (oligoclase) melaphyre porphyrite of the ashbed type. As A. N. W. says it is related to Irving's bed 87. Cf. in the Isle Royale section, Volume VI, Pt. 1, pp. 173, 174, 213 foot of page. See 15515 (a) of Pl. V, 15438; Fig. 4, Pl. VI, p. 67, 15437-15441 Hole IX 328-385, which is, as I made, the equivalent flow on Isle Royale. It is a lucky coincidence that I figured just this flow. (See also pp. 159, 67, 170.)

This is probably near the center of the flow, at any rate quite augitic and not near the top.

The analysis made for Winchell is also given in Chapter II.

(67) A, AM and M, and (68) A, AM and M (I think one bed) (69) A, AM and M (Sp. 16843), (70) A and AM (2211)

(71) A and M, (72) M part covered (2288)

(73), (76) and (78) AM and M [porphyrites] part covered, (79)- (81) covered, 64 feet? First sandstone south of Ashbed (2496)

(82) AM and M, (83) Sandstone 3 inches and Am. conglomerate, (84) A and M porphyrite, (85) sandstone, (86) A and M, (87) A, A and M and M, Ss. 16840-16842 (154) (2840)

(This is the glomeroporphyrite to ophite analyzed by Pumpelly, (Ch. II) the phenocrysts sometimes red and sometimes green

Covered (position of the Mesnard) ———

CENTRAL GROUP

(90) M (part of 91?) Sp. 16839 (2927)

(91) Aphanitic diorite, Sp. 16838 (94) (3021)

(Upper bed like the Greenstone and ophite and as no distinct amygdaloids were recognized perhaps a part of it)

(91 to 108) Marvine classes as diorites (sometimes separating the light, what we call doleritic, type and the dark more poikilitic type, as separate beds. (92), (93), (94), (97), (98), (100), (102), (104), (106) are dark; (107) is alternating light and dark, the coarsest "hornblende" [augite] being 4 inches in diameter, 108 is the bottom (412) feet)

Total thickness 87 to 108 (1280) (4120)

Ss. 16839, 38, 36, 35, 34 and 33 are from Beds 90, 91, 92, 93 and 94 respectively.

Wis. Coll. No. 4605. Sec. 4605 is from the "Greenstone" ophite. Eagle River section Bed 108, (See Journal of Geology, 1908, p. 772 and A. N. Winchell's description. See also Geol. Sur. Mich., Vol. I, Pt. II, p. 136) is the lower 412 feet of the flow.

Section is thick since birefraction for feldspar is up to 650 mm.—^{6} for augite is up to 1350 mm.—^{6} i. e. 0.06 mm.?

Augite is in polysomatic grains and patches up to 3.7 mm; the largest seen is 4.2 mm. With this coarseness one can not be sure of the grain. It is much cut up by the feldspar. The larger iron oxides and olivine are crowded away from the center of the augite patches.

	Ex.	Ex.	Ex.	Ex.	
Feldspar (M)	18.7	21.4	26	39.9	
retardation	430			430	
Cf. Ab_1, An_1+					
		292.6	318.2	264.2	w K 271?
biref			270	400	
Near M		293	300	282	
biref			200	200	

Its composition is near Michel Levy's Ab_3 An_4 or (fig. 194 in Rosenbusch) Ab_2An_3

Iron oxides, also occur in poikilitic patches enclosing the feldspar 1 to .5 mm. in diameter. The feldspar is older. Patches tend to be equant with traces of triangular section.

Olivine, (owing to the thickness it is not easy always to tell it from the augite), is in about .2 mm. rounded granules, one grain .5 mm?

Green substances, chlorite mainly, in interstices, probably miarolitic.

This is a typical luster mottled melaphyre or "ophite" as I have called them. (See Vol. VI, I, pp. 156 and 158) The feldspar checks well. (See also pp. 74, 125-127, 136-137, 167, 175). The specimen was probably 35 to 60 feet from the base of the flow.

The analysis given in the Journal of Geology (and also in Ch. II) should be compared with Volume VI, Part I, pages 147, 215, VII, X,[3] XIV[4] and Ovitz's analysis. Notable are the close checks in Al, Ca, Na_2. The variation in SiO_2+TiO_2 may be analytical. That from Fe to Fe_2 is important. I cannot understand the absolute absence of K_2O in the analysis by the U. S. Geological Survey.

(The Allouez conglomerate is omitted, being cut out by the slide. The remaining beds are ophites, with amygdaloid tops, cut in the workings of the Phoenix mine.

(109) AM and M	(42)
(110) AM and M	(24)
(111) AM and M	(82)
(112) AM and M	(31)
(113) AM and M	(24)
(114) AM and M	(15)
(115) AM and M	(9)
(116) AM and M	(12)
(117) AM and M	(28)
(118) AM and M	(20)
(119) AM and M	(57) 115 feet wide
(120) AM and M	(18)
(121) AM and M	(103) (7 mm. ophite, probably the Mandan ophite mottles "0.3 inch").
	———
(122) AM and M	465
(123) AM and M	

[3]There are misprints, Fe_2O_3 should be 2.86 and CaO 10.28.
[4]An old and hence inaccurate analysis of the same flow.

Cliff Mine Section.

This Cliff mine section (Fig. 35)[5] by Mr. Klepetko, dates from before my time. I have not thought it desirable to have it redrawn. One may see in the older reports of commissioners of Mineral Statistics a map which shows the impression the amygdaloid bands give in mining near a cross-vein where the alteration and pseud-amygdaloid effect is so great that without careful study it is impossible to make out the belts. Were I making up the section anew no doubt I should use a trifle different language. But the main horizons, the Calumet and Kearsarge conglomerates and the Kearsarge amygdaloid, are correctly determined, I think. The mottled gray trap at the bottom of Hole A may be Manitou 3 bed 66 (Fig. 29) a 10 mm. ophite. Drill hole E and Manitou 3 d 2 S. agree in their well-defined ophites. The heavy bed of trap second above the Calumet conglomerate persists (Manitou 3. Bed 42).

The Houghton conglomerate is not shown but it is very often an amygdaloid conglomerate in the Manitou 3 section. It is the eleventh soft belt about 600 feet below the Allouez conglomerate and here we found amygdaloid flow, No. 2, at just the same number of belts and distance from the "slide."

There has been much recent drilling on this section.

§8. KEARSARGE LODE.

After leaving the Cliff there has been but little done in the way of systematic sectioning until we cross Allouez Gap and come to Calumet. The attention of mining men has of late been focused on the Kearsarge lode. This has been followed almost continuously, not merely in the sections here given, but in numerous other holes, pits and explorations. It is clearly identifiable in the Mandan (Fig. 25) and has been repeatedly struck in drill holes and a shaft has been sunk upon it, though in the Empire and Clark-Montreal sections it is not so clearly identifiable and may be cut out. In the Manitou it was well-defined and specimens have been obtained showing copper well. It is located on the Central property, and was identified by Hubbard on the Miskwabik, Section 5, T. 57 N., R. 31 W. It was met again on the Cliff and beginning at the south end of this property at the Ojibway, it has been drilled, explored and mined at very frequent intervals. Yet while the sections are in some respects similar, they are in others different.

For the thirty-two miles that has been followed, the large pheno-

[5]In envelope.

crysts of feldspar persist, sharply distinct from the ground mass (Plate VII the two cores in the third row from the left, show lode and foot) and from each other, but very little agglomerated. The Wolverine sandstone persists as a sandstone, though it varies enormously in thickness. It is curiously lacking in the felsitic debris which is so conspicuous above. When thick, it is dark red, but it may be very epidotized and turned yellowish. A slide may cut it out entirely.

The porphyritic trap which is the foot of the Kearsarge lode is an ophite, but the mottling does not show close to the margin. The rate of increase (A) is less than half that in the Greenstone. It is in some places one heavy bed 100 to over 200 feet thick. On top of this will be the well-marked cupriferous amygdaloid which is the Kearsarge lode and then there will be no difficulty in identification. But this is not everywhere so. In places it will be broken up into successive gushes, each with its own amygdaloid and decrease of grain due to cooling. Besides this there may be irregular streaks of amygdaloid in the bottom of the trap. A few illustrative sections may be given, taken between the Cliff and the Franklin Junior. (a) While at the Cliff the distance from the Kearsarge to the Wolverine sandstone was about 90 feet and the Kearsarge foot was thick and characteristic, at the Ojibway there is a little red sandstone not far above the Kearsarge amygdaloid (cf. Caldwell Hole 1, at 148 feet) and there are from four to eight streaks of Kearsarge amygdaloid within 140 feet above the Wolverine sandstone. The lode enters near the north quarter-post of Section 13, T. 57 N., R. 32 W. The shafts are sunk in the foot wall, so that the drifts over to the lode give numerous very short sections. Though so near the Gratiot there are here a number of amygdaloid belts. The formation is badly faulted just here. I am tempted to connect this fact with certain gaps in the Greenstone Range as shown on Plate IX.

(b) The Seneca is the next property and has the outcrop of the lode in the northwest quarter of Section 23, T. 57 N., R. 32 W. The exploration by this company upon the lode was not done in time to be incorporated here.

(c) Gratiot Mining Co. This is a subsidiary of the Calumet and Hecla just beyond the Mohawk and less than a mile from the Ojibway. *Gratiot drill hole 31,* Section 27, T. 57 N., R. 32, is a very typical hole. The angle of hole is 55°,—practically at right angles to the dip.

1. Ophite, Kearsarge hanging (30+)
   Trap d 31. 28-58
2. Kearsarge amygdaloid and foot (202)
   Amygdaloid d 31. 58-66
   Foot trap d 31. 66-260
   Large porphyritic crystals of labradorite are abundant, but it is also mottled; at 104, 145, 154, 191, 230 feet
   the augites are 2, 3, 4, (5), 1-½ mm. across.
   The rate of increase A=.000127. Abnormal for an ophite, but characteristic for this.
3. Wolverine (25)
   Red sandstone d 31. 260-280
   Fine grained, red, at right angles to core
   Basic amygdaloid conglomerate 280-285
4. Amygdaloid (5)
   Poor d 31. 285-290
   The beds here are easy to identify. The Kearsarge amygdaloid is also opened up by shafts.

(d) Next is the Mohawk mine in which the amygdaloid occurs in two forms, a red and a hard grey or green form near the cross-fissure that was filled with Mohawkite, etc., described by Koenig.[1] In some parts there is probably a double lode. The lode is opened up by six shafts. (See Pl. IX). See also the discussion of the mine waters, Chapter VII. The dip varies from 36° to 38° in Shaft No. 5.

(e) After passing for a few acres into the Fulton property the lode is next developed by the Ahmeek mine. Mr. Frank Klepetko gives a section of the Ahmeek open cut as follows, dip 42°.

At 0, 120, 320, 460 amygdaloids.

At 740 Calumet conglomerate No. 13.

From base of Calumet conglomerate unexplored, then:

1050-1150 Trap; 1150-1170 am., to 1230 trap; 1230-1245 am., to 1330 trap; 1330-1345 am., to 1545 trap; 1545 fluccan, then Kearsarge conglomerate to 1610 and sandstone to 1620. From base of Kearsarge conglomerate 1620:—

0-40 amygdaloid; to 200 and 230 trap, 230-250 am., to 370 trap; 370-380 am., to 450 trap; 440-460 am., to 480 trap; 480 am.; then unexplored; at 1130-40 Kearsarge amygdaloid.

(f) It is next tapped by the Allouez which not having the outcrop of the lode had to come down on it by a shaft nearly vertical but inclined 80° and curving into the dip of the lode. This gives, of course, a section above the lode, but it was much prolonged, being cut obliquely and belts appear on one side of the shaft at greater depths than on the other.

1. L. S. M. I., 1901, pp. 62-64. Am. Jour. Sci., 1900, p. 439.

(g) The next property is the North Kearsarge opened by shafts on the lode, now a part of the Osceola Consolidated and controlled by the C. & H.

(h) Next comes the Wolverine, the great success on the Kearsarge lode. As this is a small property the management have done some cross-cutting to to see what they have, so that there is a pretty good section here. In different parts of the mine there is an east and west vein,—at least two amygdaloids.

The dip is 40° to 41°,—41¼° at the 24th level of Shaft 3.

In the 8th and 13th levels; we have above the lode beginning at the north end in each case and reading down, trap and amygdaloid alternating.

Wolverine 8th Level Cross-Cut	No.	Width.	Thickness.
Water fresh, T. 48° F., Sp. Gr. 1.001-	14	33	
Trap		31	(53)
Amygdaloid (including a separate flow)	13	36	(23)
Trap		43	(28)
Marked am. gray and white, wet	12	12	
Trap		38	(33)
Marked am.	11	15	
Ophite fine grained		40	(36)
Perhaps not top of flow, water has Sp. Gr. 1.000	10	9	
Trap		30	(25)
Marked hard amygdaloid	9	17	
Trap		36	
A mere skein, chloritic large amygdules	8	12	
Ophite, 5 mm		108	(112)
Red bordered amygdaloid	7	9	
Fine grained trap		34	
	6	7	
Fine grained trap		58	(70)

Kearsarge lode.

The 13th level cross-cut is much longer and reached through the Kearsarge conglomerate.

Wolverine 13th Level Cross-Cut

The Sp. Gr. of the water in this was 1.000. The N. W. end of drift from the hanging of the Kearsarge amygdaloid in August 1905 was distant horizontally 1365 feet.

	Width.	Thickness.	Thickness above K. A. m.
Trap			
Kearsarge conglomerate No. 10, dip 39°-40°	44	(29)	
Base from hanging of Kearsarge amygdaloid	1323		(860)
Amygdaloid	11		
Ophite (augite grain 2 mm. 31 feet from foot of amygdaloid	95	(68)	
Amygdaloid red with green specked amygdules, apparent dip of contact 42°. Trap; coarse feldspathic, with decomposed pseudamygdaloid streaks but no clear division	22		(792)
	164	(122)	
Amygdaloid	10		(670)
Trap	97	(70)	
Amygdaloid	11		(600)
drifted upon			
Trap, damp about 30 feet from base	65	(50)	
Amygdaloid, a well-marked band and characteristic, like No. 18	33		(550)
Trap	74	(70)	
Amygdaloid poor	5		(480)
Trap	68	(50)	
Amygdaloid	6		(431)
Trap	23	(19)	
Amygdaloid with well-marked contact	10		(412)
Trap (a seam of laumontite crosses the drift striking more west and dipping to north)	84	(62)	
Amygdaloid with side drift, marked, coarse, pink and white and chloritic	26		(350)
Trap, ophite	45	(46)	
Amygdaloid. This belt is at the bottom coarse, laumontitic, blotched and includes one or two separate small flows with genuine marked amygdaloids at the top and pipe amygdules at the base of the next flow, at e g. 49 feet from the base and at the very top No. 18	88	(26)	(304)
Trap, solid ophite	40	(58)	
Amygdaloid marked calcitic with red No. 17 ground	22		(220)
Trap a good deal specked and skeined with am. not very coarse	138	(104)	
Amygdaloid carries some copper and was stoped a little, and a long drift run No. 16	24		(116
Trap	30	(35)	
Poor amygdaloid No. 15	5		
Trap	120	(81)	

At 55 feet from foot was a seam dipping steeply to the south yielding a fresh water, Sp. Gr. 1.000, T. 51°.

The section below the lode which is about 7 feet thick is given in the cross-section from the 11th level.

	Width.	Total.	Thickness.
Foot of lode			
Trap (Porphyritic)	287 ft. to	287	(190)
Sandstone (Wolverine) No. 9	32	319	(21)
Trap	87	406	(57)
Amygdaloid	15	421	(10)
Trap	205	626	(135)
Amygdaloid	5	631	(3)
Trap	64	695	(42)
Amygdaloid and epidote	17.5	712.5	(11)
Trap	103	815	(68)
Amygdaloid	32	849	(21)

This is typical, like the Gratiot.

(i) The lode is next opened by the South Kearsarge branch of the Osceola directly on the lode.

(j) The Centennial follows next with two shafts also directly on the lode, diverging in strike and dip, the S. W. one 38.5°, the N. E. 42°.

(k) Next comes the Calumet and Hecla Mining Company Kearsarge shafts 19 and 20 and 21, to locate which holes were drilled near Kearsarge 19 and 20, lettered A, D and C while B and others were near Kearsarge 21. These are given below, in Section 9. See also Figure 37.

(l) Between 20 and 21 the lode passes into the Laurium property, Section 24, T. 56 N., R. 33 W. I have no record of explorations here.

(m) Beyond the Calumet Shaft 21 the lode just cuts the corner of the Torch Lake property. (See Section 10 and Fig. 38.)

(n) It next goes into the property of the La Salle Mining Company, Section 34, T. 56 N., R. 33 W., and the north part of 3 and 4, T. 55 N., R. 33 W. The north part is the old Tecumseh, the south part the old Caldwell. Here are some difficult sections as follows:

La Salle Mining Co. This property includes the old Tecumseh and adjacent lands near the S. line of T. 56N R. 33W (Section 34, 33, E. half and S. E. of S. W. of 32; N. half of 3; N. half of 4; and N. half of S. E. of 4) including practically the lands between the Osceola and the Rhode Island.

The holes on the south part of this property show a not uncommon phase of the Kearsarge amygdaloid in which a number of amygdaloids occur. The same thing occurs at the Ojibway and on the Rhode Island. But down at the Arcadian section it is all together again.

See the correlation under Bed 3.

Caldwell drill hole 1. ¼ mile E. and ¼ mile S. of N. W. corner of Sec. 3, dip 45° to S 50° E.

1. Overburden (40)
2. Feldspathic ophite (80)
   Amygdaloid Cald. d 1. 40 to 47?
   1 to 2 mm. chlorite mottles, red to a colder gray, with forms suggesting pseudoamygdules after porphyritic crystals; at the end red, white and gray epidotic.
   Amygdaloidal trap d 1. 47 to 58
   Red with green amygdules, then gradually coarsely amygdaloid and feldspathic.
   Trap d 1. 58 to 120
   Chloritic, blotched with an epidote laumontitic seam at 22°, grows coarser toward 83, at 92 poor, specked and finer, at 102 mottles begin (3-4 mm.) then finer.
   Cf. 62 Arcadian d 1. 262 to 385
   C. & H. C. 135 to 226
3. Melaphyre (28)
   Amygdaloid Cald. d 1. 120 to 126
   Red with some *copper*, chloritic and pink amygdules.
   Trap d 1. 126 to 148
   Feldspathic but porphyritic crystals are not well-defined.
   If this bed is the bed above the Kearsarge, the total for the Kearsarge beds with the various splits of the Kearsarge amygdaloid would be 133 feet, which checks well enough with Franklin Junior No. 4 (133 feet) and Rhode Island No. 4 639 to 746 feet. (109)
   The porphyritic crystals are absent in this bed and only the copper would lead one to suspect that the top was the Kearsarge.
   The bed below is certainly Kearsarge.
   We may perhaps best compare the following beds:
   1. 148 to 281=(133) ft. with five beds (14), (31), (22), (34), (32) feet thick:
   2. 72+;
   3. 63 to 93+;
   4. 202 to 311=(109) with five beds (7)?, (14), (28), (15), (45), feet thick;
   5. 49 to 151+ a vertical hole=(73+) feet with four beds (9+), (12), (18), (28+) ft. thick;
   10. 528 to 628 a vertical hole (71) feet with three beds (30), (18), (17) feet thick;
   Tecumseh 1. 228 or 256 to 410 (154) in one bed;
   Rhode Island 1. 333 to 463 (130) with at least three beds (48), (34), (48) feet thick;
   63 Arcadian (1. 358 to 428+2. 42 to 143) 109 feet thick.
   We call these beds, but their irregularity and the similar peculiar trap between each of them show that they are presumably overlapping gushes of the one flow. They are *not* repetitions by faulting, for when the bed is really one thick flow, as at the Tecumseh and farther north, the grain is different and an ophitic mottling comes out characteristic of thick flows.
4. Sediment (0)
   Just a little? Much lost, fissure?

5. Beginning of Kearsarge No. 1, porphyritic traps (plagiophyres) (14)
   Amygdaloid d 1. 148 to 155
   Epidote and gray or white amygdaloid.
   Trap d 1. 155 to 159½
   Amygdaloid d 1. 159½ to 160
   Trap d 1. 160 to 162½
   With marked porphyritic crystals.
6. Kearsarge amygdaloid and foot No. 2 (31)
   Amygdaloid d 1. 162½ to 164
   Contact well marked, only 5° from right angles to core.
   Trap d 1. 164-193
   Porphyritic.
7. Kearsarge amygdaloid and foot No. 3. (22)
   Amygdaloid d 1. 193 to 205
   Trap d 1. 205 to 215
   Porphyritic
8. Kearsarge amygdaloid and foot No. 4 (34)
   Amygdaloid d 1. 215 to 221
   Gets lighter, epidotic at base.
   Trap d 1. 221 to 249
9. Kearsarge No. 5 (32)
   Amygdaloid d 1. 249 to 253
   With copper.
   Trap d 1. 253 to 281
   From d 1. 255 to 267 very fine grained with few phenocrysts, at 281 is very fine grained; at 295 is a fissure at 5° from right angles to the core, but a seam makes 18°.
10. Wolverine sandstone No. 9 (7)
    d 1. 281 to 288
    Beneath is broken and fissured, with a calcite vein.
11. Melaphyre (14)
    Amygdaloid d 1. 288 to 295
    Trap d 1. 295 to 302
12. Melaphyre (4)
    Amygdaloid d 1. 302 to 305
    Trap d 1. 305 to 306
13. Melaphyre (10)
    Amygdaloid d 1. 306 to 312
    Trap d 1. 312 to 316
    With clasolites.
14. Melaphyre (4+)
    Amygdaloid d 1. 316 to 320. Practically these are all one heavy amygdaloid belt which does not seem to appear in the Arcadian section.

Caldwell arill hole 2. About 100 feet N. of No. 1 Caldwell along the strike.

1. Overburden to d. 2.25 (125)
2. Feldspathic melaphyre (47)
   Amygdaloid Cald. d 2. 25 to 39
   Green and white specked amygdules.
   Trap Cald. d 2. 39 to 72
   Coarsest, feldspathic about 48, then finer.

3. Kearsarge amygdaloid and trap
   Amygdaloid d 2. 72 to 75
     Red with *small* porphyritic crystals.
   Amygdaloidal trap.
     Coarse, cf. Cald. d 5 at 62 feet.

Caldwell drill hole 3. Further N. W., therefore it should strike the same point at a greater depth.

1. Ophite 38+
   Trap d 3. 0 to 38
   Coarse 5 mm. mottles.
2. Ophite 25
   Amygdaloid d 3. 38 to 45
   Trap d 3. 45 to 63
     Fine grained, laumontitic ophite.
     Cf. d 2. 25 to 72
3. Kearsarge amygdaloid and foot
   Amygdaloid d 3. 63 to 74
     Epidotic, red at first, at 64 a contact showing inclination? at 67 the odd shaped pseudoamygdules which may be after the porphyritic feldspar, which is yellow-green, blue-green and white; epidotic amygdaloid to d 3. 74.
   Trap d 3. 74 to 93+
   Regular Kearsarge foot.

Caldwell drill hole 4.
   Overburden (73)
1. Feldspathic ophite
   Amygdaloidal trap d 4. 73 to 147
     Coarse at first and growing coarser.
     At 90 and 115 feet there are mottles
       3-4? and 5-7 mm.
     At 142 is a vertical seam with copper nearly parallel to the core.
2. Melaphyre.
   Amygdaloid d 4. 147 to 157
     Hard, fine grained, with scattered amygdules.
   Trap d 4. 157 to 166
3. Ophite
   Amygdaloid d 4. 166 to 173
   Amygdaloidal trap d 4. 173 to 187
     Poor, some signs of porphyritic crystals.
   Trap d 4. 187 to 202
     Ophitic? fine grained and decomposed at 191-2
     Here at 202 feet begin the Kearsarge group.

4. Kearsarge amygdaloid and foot No. 1 (7)
   Amygdaloid d 4. 202 to 209
     Growing finer, reddish, with porphyrite crystals to 209.

     At 209 an epidotic contact nearly at right angles to the hole.
   Trap d 4. 209 to 223
     Fine grained reddish porphyrites, not amygdaloid to 223.
5. Kearsarge amygdaloid and foot No. 2
   Amygdaloid d 4. 223 to 227
     Small chloritic amygdules were like the bottom of a flow.
   Trap d 4. 227 to 251
     Seamed and decomposed at the top, some joints nearly parallel to the hole. Porphyritic crystals conspicuous, grows finer from 244 down
6. Kearsarge amgdaloid and foot No. 3
   Amygdaloid d 4. 251 to 258
     Epidotic
   Trap d 4. 258 to 266
     Typical Kearsarge foot. The labradorite phenocrysts are as much as 30 mm. long.
7. Kearsarge amygdaloid and foot No. 4
   Amygdaloid d 4. 266 to 269
     Epidotic
   Trap d 4. 269 to 311
     Contains some big porphyritic crystals, toward the base becoming a dense blue-black trap.
8. Wolverine sandstone (No. 9) at (311)
   Small fragments of conglomerate and crushed stuff below.
     Cf. 64 Arc. 2. 178
9. Feldspathic ophite 7 mm. (66)
   Trap d 4. 311 to 377
     About 1 mm. mottles at first, chloritic not porphyritic, at d 4. 323 is a little seam with *copper*, faulting below, and mottles up to 7 mm.
     Cf. 65 Arc. 2. 178 to 262
10. A vein from 369 to 377.
11. Ophite (83)
   Amygdaloid d 4. 377 to 381
     Pink amygdules on dark ground.
   Trap d 4. 381 to 392
   Amygdaloid bomb, not contact, 392 to 394?
   Trap d 4. 394 to 460½
     Massive, uniform, ophitic, growing redder and finer from 431 on. Cf. 66 Arc. 2. 262 to 315
12. Ophite (15)
   Amygdaloid d 4. 460½ to 465
     There is a little seam of sandstone, banded.
   Trap d 4. 465 to 475
13. Marked sedimentary contact at d 4. 475
14. Amygdaloidal melaphyre (58)
   Amygdaloid d 4. 475 to 482
   Trap d 4. 482 to 483
     Fine grained, dark chloritic, with basal amygdules.
       Cf. 68 Arc. 2. 315 to 464 which also has sediments above and below.
15. Conglomerate d 4. 483 to 486 or 490
     Well-marked felsitic conglomerate. Then possibly a gray trap boulder from 486 to 488, then dark basic conglomerate with brown sandstone and

white and black scoria, shading into amygdaloid. This bed 182 feet only below the Wolverine is quite likely to be mistaken for it, and probably has been in the early work at the Tecumseh and elsewhere. It seems fairly persistent. Cf. Belt 59 of the Central mine section; Calumet and Hecla A 10, 401 to 405 ft.; 67 or 69 Arcadian, about 133 to 286 ft. below the Wolverine; Franklin Junior No. 3 at 535 to 539 ft. where the Wolverine is at 373′ 11″ to 376′ 9″.

All these beds show under the Wolverine heavy ophites with a tendency to scoriaceous amygdaloid tops containing a little red sandstone.

16. Feldspathic ophite (24+)
d 4. 490 or less to d 4. 514 or more.

Caldwell drill hole 5. Vertical. Hence the true thickness is about .7 of that along the hole.

1. Overburden top 49
2. Kearsarge foot 9+
   Trap d 5. 49 to 62
   Fine grained at first. Along from 56 to 58 this has large porphyritic feldspar crystals, up to 25+ mm. and is a fine grained, (say 2 mm.) ophite.
3. Kearsarge amygdaloid (*not* the uppermost one) No. 2 and foot (30)
   Amygdaloid d 5. 62 to 79 17
   Typical Kearsarge amygdaloid, a clay seam at d 5. 72, after which it is coarser.
   Trap d 5. 79 to 97
   Porphyritic greenish gray plagioclase. At 95 they become pinker and so more conspicuous.
4. Kearsarge amygdaloid and foot No. 3 (25)
   Amygdaloid d 5. 97 to 104
   Marked epidotic
   Trap d 5. 104 to 112
   Fine grained to 106, then coarser with the porphyritic plagioclase plain.
5. Kearsarge amygdaloid and foot No. 4 39+ (28+)
   Amygdaloid d 5. 112 to 120
   Epidotic with pink crystals
   Trap d 5. 120 to 151+
   Matches No. 4 at 281 to 313; fine grained, black.

Caldwell drill hole 6 did not reach ledge.

Caldwell drill hole 7 dipped with the lode.

Caldwell drill hole 10. Vertical. To determine the top of the Kearsarge amygdaloid for their shaft. From indications in the drill cores the dip is about (tan-1 5:4) 51° ⅓, but this is not comparable in accuracy with the correlation by dip.

1. Overburden 38
2. Ophite (15)
   Trap d 10. 38 to 56
3. Ophite 34 (24)
   Amygdaloid d 10. 56 to 67
   Trap d 10. 67 to 90
   Faintly mottled.
4. Fine grained melaphyre 10 (7)
   Amygdaloid d 10. 90-96
   Trap d 10. 96-100
5. Melaphyre 10 (7)
   Amygdaloid d 10. 100 to 110
   Contact at 110 sharp, red, fine grained, dip (tan-1 5:4=51°⅓)
6. Feldspathic ophite 32 (23)
   Amygdaloid d 10. 110 to 124
   Specked at 119 pink, faintly mottled, prehnitic.
   Trap d 10. 124 to 142
7. Melaphyre 9 (6)
   Amygdaloid d 10. 142 to 145
   Gray
   Trap d 10. 145 to 151
   Fine grained.
8. Ophite 117 (83)
   Amygdaloid d 10. 151 to 160
   Coarse red and pink
   Trap d 10. 160 to 253=268?
   Fine grained, specked with amygdaloid to 181, 3 mm. mottles 191 to 204, 2 mm. at 221, growing finer.
   The relatively slow decrease of grain shows the oblique section of the bed. There are chloritic amygdules at about d 10. 253
9. Feldspathic melaphyre 41 (29)
   Amygdaloid d 10. 268 to 278
   Pink and white amygdules, almost like pseudamygdules after porphyritic feldspar.
   Trap d 10. 278 to 309
   Chloritic with rather coarse feldspar, red to 309.
   Flows 10 and 11 are probably all one.
10. Feldspathic ophite (7 mm?) (75)
   Amygdaloid d 10. 309 to 311
   Trap d 10. 311 to 337 to 415
   Chloritic and specked; at 337 epidote with *copper*. About 345, 2 mm. feldspar, coarsely feldspathic and about 370, 12 mm. feldspar, and faint (7 mm?) augite mottles. Toward 412 it grows finer and reddish. Cf. R. I. d 4. 535 to 611, and Caldwell d 4. 73 to 147, and Arc. 62 d 1. 262 to 385, or should this correspond to d 10. 451 to 527?
11. Melaphyre 36 (25)
   Amygdaloid d 10. 415 to 433
   Marked contact, fine grained amygdaloid with red ground, pink amygdules and feldspar to 426, then epidotic to 433.
   Trap d 10. 433 to 451
   Blotched to 441, epidotic to 444, decomposed, coarse to 449. Cf. R. I. d 4. 611 to 624; Caldwell d 4. 147 to 166.

12. Ophite (54)
Amygdaloid d 10. 451 to 462
At 459 much seamed and fine.
Trap d 10. 462 to 527
Blotched and faulted parallel to a fault at 22° with the core, then chloritic, coarse, feldspathic, mottled 2 to 3 mm. at about 510, altered olivine at 513, joints at 31° to core perpendicular to dip? At 527 a seam, perhaps cutting out something. Cf. R. I. d 4. 624 to 631 and 631 to 639; Caldwell d 4. 166 to 202; Caldwell d 1. 148.

13. Kearsarge amygdaloid and foot No. 1 43 (30)
Amygdaloid d 10. 528 to 530
Specked amygdules, epidote and porphyritic crystals.
This is only (528 to 620) 92 feet above the Wolverine along the core or something like (65) feet true thickness. There appears to have either been something cut out in this hole or doubled in some of the others, and as the less disturbed and more regular the grain is, the more nearly we have the customary thickness of over 100 feet, it is probable that the formation is cut out here.
Trap d 10. 530 to 571
Well-marked porphyritic labradorite.

14. Kearsarge amygdaloid and trap No. 2 (18)
Amygdaloid d 10. 571 to 580
Well-marked epidotic with porphyritic crystals to 573, with calcite and green prehnite to 580.
Amygdaloidal trap d 10. 571 to 596
Porphyritic crystals not marked to 585, some sediment and porphyritic crystals to 589, some especially long green ones to 596.

15. Kearsarge amygdaloid and foot No. 3 24 (17)
Amygdaloid d 10. 596 to 600
Trap d 10. 600 to 612
Mottles ½ mm. at 600 to 601; porphyritic crystals, well-marked
Amygdaloid d 10. 612 to 620
Cf. R. I. d 4. 725 to 746
63 Arc.

16. Wolverine sandstone 19 (13)
Sandstone d 10. 620 to 634
Dip 48° ⅔
Conglomerate d 10. 634 to 639 or 665
Much brecciated, shading into amygdaloids with numerous slips at an angle of 40°, and broken and disturbed sandstone and conglomerate. Cf. Caldwell d 4, at 311, R. I. d 4 at 746, 64 Arc.

17. Ophite
Amygdaloid d 10. 665 to 683
Trap d 10. 683 to 699
Ophite with 1-2 mm. mottles. Cf. 4. 311+. In holes less deep the sandstone is mainly gone and here it is the overhanging Kearsarge amygdaloids,—an effect which might be produced by an upthrust on a flat hade.

Tecumseh. N. E. part of Sec. 34, T. 56 N., R. 33 W., near shaft. R. M. Edwards put down two holes. Having put down No. 1 about at right angles to the formation, and struck the Kearsarge, he then went back to the outcrop of the Kearsarge and in Hole No. 2 aimed at a point 265 feet down in Hole 1, thus dipping with the formation at an angle of about 42°, and remaining in the lode practically all the way. No. 1 is inclined at an angle of 45°.

1. Overburden
2. Feldspathic ophite 8 mm. 130+?
Trap d 1. to 90 At 25, 45, 86
mottles are 8, 7, 1–2 mm.
3. Doleritic melaphyre
Amygdaloid Tec. d 1. 90 to 92
Trap d 1. 92 to 113
Chloritic doleritic vein 92 to 93; at 106 somewhat glomeroporphyritic.
4. Doleritic ophite 7 mm. 111
Amygdaloid Tec. d 1. 115 to 122
Poor, perhaps not a real top, with small amygdules and calcite.
Trap d 1. 122 to 226
At 155 marked doleritic, coarse feldspar with chloritic amygdules, then faintly ophitic; at d 1. 205 and 212 feet the mottles are vaguely 7 mm. and 1 to 2 mm. respectively.
5. Copper bearing lode, feldspathic melaphyre (31)
Amygdaloid d 1. 226 to 228
Red and white with copper. Cf. Cald. d 1. 120 to 126 to 148.
Trap d 1. 228 to 257
Coarse, feldspathic, with curious amygdules, but no plainly porphyritic crystals.
6. Kearsarge amygdaloid No. 1 and foot (150)
Amygdaloid d 1. 257 to 274
Trap d 1. 274 to 407
At 281 to 284 the labradorite crystals are quite conspicuous. The ophitic mottling becomes apparent at:
305, 318, 342, 358, 388 feet where the mottles are 2–3, 4–5, 7+, 3–4, 2 mm.
7. Basal amygdaloid or Kearsarge No. 2 (3)
d 1. 407-410. Coarse, grayish white, with *copper*.
Gradual transition to Wolverine sandstone by epidote band.
This was first mined on as Kearsarge amygdaloid.
8. Wolverine sandstone (11)
Amygdaloid conglomerate d 1. 410 to 421
Amygdaloid and gray sandstone within 7° of right angles to core.
9. Melaphyre (4)
d 1. 421 to 424′ 8″
Crushed, decomposed, ending in feldspathic, poor amygdaloid.

(o) Rhode Island, Franklin and Arcadian. The Kearsarge lode is, I think, also identifiable in the Rhode Island, Franklin and Arcadian sections described below. (Figs. 40, 41 and 42.) Beyond to the south I have not yet been able to identify it, which is the more strange since it is of good thickness at the Arcadian and it

ought to be exposed somewhere between Houghton and Hurontown where I have made careful search at its horizon without identifying the peculiar and characteristic trap, though exposures are frequent.

§9. CALUMET (FIGS. 36 AND 37 AND PLATE IX.)[1]

The cross-cuts from the Calumet and Hecla conglomerate of the Calumet and Hecla Company and especially the system of hoisting from an inclined lode by vertical shafts of the Tamarack Mining Company have afforded abundant opportunities for sections summarized in Figures 36 and 37. The sections of the shafts extend nearly from the Copper Harbor conglomerates to the Kearsarge lode, which was, indeed, reached by a drill hole 970 feet from the bottom of Tamarack No. 2 shaft. To this drilling has recently been added, so that through the Lower Keweenawan down to the fault almost every belt liable to contain copper has been opened in more than one place. The old section (which we owed to the Calumet and Hecla Mining Company) published in Volume V must now be replaced by one more up to date. (Fig. 37.) Surface exposures indicate that the marked ridge through the center of Section 34, T. 57 N., R. 33 W., is conglomerate. The outer Copper Harbor conglomerate is on the lake side and trap on the southeast and it is topographically like the ridge at Carp Lake in the Porcupines. There are exposures on Section 34 and Section 3 just south that would seem to outline for us nearly the position of the Lake Shore trap belt and the Great Copper Harbor conglomerate. With the customary strike the boundary of the Upper Keweenawan would pass close to the northwest corner of Section 16. The drill section is as follows: All the drill holes were inclined 45° to S. 55° E.

Calumet drill hole 10. Elevation 390 feet above datum. 436 above Lake Superior, 1036 A. T. Location 880 NW. down hill from a wood road[2] on the 1079 ft. beach. Water flows from about 80 feet depth, temperature 43°. 3 F. Analysis of the water is given below. Dip of hole 45°; of rocks probably 25° (2:9) Depth 500 feet. Reduction to get thickness (0.975)

Overburden 56

1. Scoriaceous or amygdaloidal conglomerate d 10. 56-26 (10)
2.
   Trap d 10. 66-94
   Trap and green epidotized sediment d 10. 94-100
   This is quite possibly clasolitic or enclosed mud.
   Trap, faintly ophitic d 10.-131 (65)

[1]Figs. 36, 37 and Plate IX are in envelope.
[2]The Standard Mining Company put down a hole where this road turns off.

3. Feldspathic melaphyre (12)
   Amygdaloid d 10. 131-144
   Trap, fine grained d 10. 144-163 (31)
4. Ophite (3)
   Amygdaloid d 10. 163-166
   Trap, faintly ophitic d 10. 166-187 (21)
5. Ophite
   Amygdaloid d 10. 187-213 (26)
   Trap, faintly ophitic d 10. 213-239 (52)
6. Amygdaloidal conglomerate d 10. 239-255 (15)
   Bedding apparently cutting core at (1:3) 18°½ from right angles.
7. Feldspathic melaphyre d 10. 255-278 (22)
   Fine grained.
8. Melaphyre
   Amygdaloid d 10. 278-295 (16)
   A coarse amygdaloid with thomsonite (33)
   Trap d 10. 295-312
9. Sandstone d 10. 312-316 (4)
   Fine
10. Melaphyre (30)
    Trap d 10. 316-347
11. Melaphyre (44)
    Amygdaloid d 10. 347-358 (11)
    Trap d 10. 358-392
    Black
12. Feldspathic melaphyre (15)
    Amygdaloid d 10. 392-395 (3)
    Very faint, but contact shows.
    Trap d 10. 395-407?
    Fine grained with 1 mm. feldspar laths.
13. Ophite? (43)
    Amygdaloid d 10. 407-410? (3)
    Laumontitic.
    Trap d 10. 410-451
    Dark, faintly ophitic.
    Perhaps part of Belt 12 above
14. Conglomerate. The Great Conglomerate of Copper Harbor.
    d 10. 451-500=d 9. 283-500
    Fine grained, bedding at about 12½° from right angles to hole. It contains black grains, magnetite, laumontite and calcite, pebbles of amygdaloid, ophite and other basic rocks, anorthosite?! diabase, syenite, etc.
    This correlates closely with d 9. 283, and the dip to be inferred is 25°. (See Fig. 36)
    All of Holes 8 and 7 are in this bed and possibly 6 and 4, so there can be no question in calling it the "Great Conglomerate."

Drill hole 9. Elevation 402. 400 feet across the strike southeast from 10. Depth 550.

Overburden (47)

(5.) Ophite d 9. 47-65
Faint
(6.) Absent. Local
(7.) Amygdaloid d 9. 65-72
Trap d 9. 72-92
Hard and dense d 9. 86-90
(8.) Amygdaloid d 9. 92-99
Marked at first, turning to red feldspathic with occasional amygdules.
At 103-105 a green rock with minute amygdules, like an altered mud.
Amygdaloidal trap d 9. 99-113′ 6″
Toward the base red
(9.) Brecciated sediment or slide d 9. 113′ 6″-116=d 10. 312-316?
(10.) Trap d 9. 116-203
Faintly ophitic
(11 and 12.)
Amygdaloid d 9. 203-205
Amygdaloid trap d 9. 205-232
Trap d 9. 232-251
Fine grained, dark
(13.)
Amygdaloid d 9. 251-257 (6)
Red and green, feldspathic, poor.
Trap d 9. 257-283 (26) (32)
Fine grained
14. Conglomerate. The Great Copper Harbor Conglomerate
d 9. 283-500
At 322 dark red shales, at 12½°, while lower beds are at 18° and 24° from being at right angles to the drill core.
The difference is probably dip of deposition.

Calumet drill hole 8. Elevation 437. 720 feet southeast from No. 9, the other side of two roads at about 440 and 620 feet. The overburden was 50 feet thick. The depth was 510 feet, all in conglomerate. Dip (8:36) averages 24° from right angles to core.

(14.) The conglomerate was fine grained like the bottom of No. 9, but also coarser with syenite and dolerite pebbles,—Keweenawan material.

Calumet drill hole 7. Elevation 470. 690 feet from No. 8. The overburden is uncertain. It seems like 20 feet, then 30 feet of soft conglomerate, then 20 feet of sand. The depth was 512 feet all in conglomerate. Dip 13.5:54.

(14.) There was much basic sandstone and debris. The conglomerate was fine grained.

Calumet drill hole 6. Elevation 508. 720 feet from No. 7. Overburden 99. About 60 feet deep. The depth was 1110 feet. Dip (9.5:36) about as before. From 80-840 was conglomerate with pebbles of fine grained trap not uncommonly, and much sandstone of basic debris; at 131 was a fluccan

15. Trap d 6. 840-868 (27)
A fine grained trap, possibly a boulder or intrusive. There was no amygdaloid above but one below for two feet. I should have counted it only a huge boulder were it not that something similar comes in Hole 4.
16. The rest of the way was basic sandstone and pebbles.

Calumet drill hole 4. Elevation 517. 1367 feet from No. 6. There is a road crossing the line of section at 1040 to 1070 and the profile is at 530 elevation. Depth 500 feet. Dip (6:27) about as before. Overburden 40 feet on the incline, 30 feet thick.

14. Great Copper Harbor Conglomerate continued. d 4. 40-188
With syenitic pebbles frequent, also large dark pebbles of fine grained trap, less of basic sandstone, more of conglomerate.
Total thickness from d 9. 283 about (1400)
15. Trap d 4. 188-224 (36)
Fine grained, with no amygdaloid above or below and little sign of variation of grain;—a boulder or a sill? But the correlation with Hole 6 precludes the boulder idea. It seems fine for a sill, but deserves farther examination. From the foot of this trap it is estimated to be 7920 feet to Calumet conglomerate foot by E. S. Grierson.

Possibly beginning of Eagle River series 1.

16. Conglomerate.
The rest of the way is either rather fine grained conglomerate or red or dark sandstones, the latter with more basic matter. This heavy conglomerate, which occurs also through Holes 3 and 2, would be the Great Copper Harbor conglomerate if one calls No. 14 the middle or lays no stress on No. 15. I think we can hardly use 15 for division. I am not at all sure it persists or is a bed. In that case, 14, 15 and 16 would all be the Great Conglomerate. On the other hand 15 *may* represent No. 1 of the Eagle River section. So that we must be prepared to find 16 connected with 2, which is a heavy sediment to 9 of Eagle River. The base of this trap d 4. 224 is (if 28° is assumed for the average dip) above the base of the Calumet conglomerate (7420)
Hence above the Mesnard (5940)
But if this be the thickness of the Eagle River (4259) and Ashbed (1681) combined, then the Eagle River group is enormously thicker than elsewhere. But with a thickening of these lava formations goes a thickening of the individual beds. This seems not to have taken place. Bed 15 is of questionable character anyway. I feel sure, therefore, that Bed 16 should be counted as belonging to the "Great Conglomerate." Even then we have much more in the Eagle River beds than might be expected. So that it is a fair question whether we should not also include Bed 23, which is so closely parallel to Conglomerate 22, which Irving rightly enough includes as practically part of the Great Conglomerate. Farther drilling will be needed before we know which of these traps persist. The section brings out well, however, the desirability of a term like Copper Harbor Conglomerate to apply to all these heavy conglomerates, full of debris of the Lower Keweenawan in which

the flows that were the last products of dying volcanic activity occur as lentils.

Calumet drill hole 3. Elevation 525. 690 feet from No. 3. The cross-section abreast is at 560 feet elevation. Depth 502. Dip (17:54) about as before. Overburden on the slant 13. There is said to be a foot or so of trap at first. Is this the same as d 4. 224 or only a pebble?

16. Conglomerate d 3. 25-237 (227)
    Center red, with streak of red sandstone, basic sandstone, and all kinds of pebbles, labradorite porphyrites, etc. Cf. Eagle River 8 to 6.

BASE OF COPPER HARBOR CONGLOMERATES. BEGINNING OF EAGLE RIVER SERIES.

17.
    Amygdaloid d 3. 237-240
    Marked white and laumontitic
    Trap d 3. 240-255
18. Ophite
    Amygdaloid d 3. 255-260
    Trap d 3. 260-290
    Mottles faint
19.
    Amygdaloid d 3. 290-294
    Trap d 3. 294-325
    Fine grained with white calcite blotches and streaks on a gray ground; possibly a contact of a gush at 305.
20. Conglomerate, scoriaceous amygdaloidal d 3. 325-326
21.
    Brecciated amygdaloid d 3. 326-328
    Trap d 3. 328-343
22. Basic sandstone and fine grained conglomerate d 3. 343 to end.
    Amygdaloidal at top passing into conglomerate; basic sandstones, etc., at 12° ½ from right angles to core. Various pebbles of anorthosite and red rocks.

Calumet drill hole 2. Elevation 490. 640 feet from No. 3. Elevation of profile 532. Depth 505. Dip (10⅝:36) about as usual.

Overburden on the slant (13)

22. Ophite
    Trap d 2. 13-26
    Just a little of that in Hole 3
    Fine grained (1 mm.), bottom black and calcitic
    Nos. 17 to 22 *may* be Eagle River 10 to 16
    Total from No. 16 (104)
23. Conglomerate (Conglomerate 22 of Portage Lake)
    With pebbles of syenite, coarse gabbro, amygdaloid, and real rhyolitic felsite

Calumet drill hole 1. Elevation 520. 648 feet from No. 2. Depth 500. Dip (11:45.) (5700 from Calumet conglomerate foot?)

Overburden on the slant (40)

23. This is all the same conglomerate (22?) with dark basic greenish (180) sandstone, pebbles of felsite and gabbro, hard green trap. Streaks of red shale (280) make an angle of 7° from being at right angles to the hole, other beds more.
    Red and felsitic pebbles d 1. 280-505
    From this point to the top of the Tamarack No. 5 are about 850 feet unexposed. At Portage Lake there are not 250 feet of traps over No. 19 (which occurs in the Tamarack No. 5 shaft) between it and No. 22, and No. 22 is a very heavy conglomerate above which no traps are known. There is then rather a presumption that this is No. 22 conglomerate, and that to it belongs a good part of the unexplored 850 feet. But I have not thought it wise to assume this or number the beds consecutively (600)
    If so in the Eagle River section it would be presumably the heavy beds 17 and 18.

For the character of beds we pass to the description of No. 5 shaft. (See figure and annual report for 1903 and the following notes on the specimens from that shaft and the 29th level cross-cut taken by McNair for his specific gravity tests. See also records by Rominger in Volume V.)

If we then supplement the mine sections with the Calumet and Hecla drill work around the horizon of the Kearsarge lode (Section 8) and pass to the record of the Torch Lake and Old Colony we have a section across the range almost without a break which nevertheless shows very little of the Bohemian Group in which the Baltic lode occurs. Other sections compiled by F. Klepetko are given in File 15-8.

While the record of the report for 1903 and Figure 37 is more systematic, there is a certain importance in putting on record my notes on the samples in this part of the section used in McNair's specific gravity tests. The numbers given were those on the paper bags used in collecting the samples, and in a few cases errors have probably crept in.

The belt numbers given in the samples below are those given by the mine captains in sinking the shaft. There was usually two belts to each flow,—one for the trap and one for the conglomerate. Occasionally, however, we differed. They do not, therefore, exactly correspond to the flows and the flow numbers as given for Shaft No. 5 in Figure 37, but they can usually be identified readily, without reference to the Report for 1903, where the exact correspondences are given on pages 254 to 268, by remembering that Conglomerate No. 19 is Belt 4, Conglomerate No. 18 is Belt 7, Conglom-

erate No. 17 is Belt 12. The flow which I have labeled 12 includes Belts 18 and 19. Conglomerate No. 16 is Belt 23. The Greenstone, flow 31, is Belts 50 and 51. The Allouez conglomerate is Belt 52 and the Calumet and Hecla Conglomerate is Belt 84.

NOTES ON SAMPLES FROM NO. 5 SHAFT USED IN SP. GR. DETERMINATIONS.

Belts 6. S. 2. Fine grained with small chloritic amygdules and conspicuous specks changed to iron oxide up to 1-2 mm. which I take to be altered olivine.

Belt 7. S. 1 A. Well-marked conglomerate pebbles, mostly felsitic, very well rounded. One small seam goes through cement and pebbles. The finer matrix seems to be calcite.

Belt 8. S. 9. A fine grained trap with reddish ground and greenish porphyritic feldspar 1-2 mm. upon a matrix of the Tobin porphyrite type.

No. 10. A massive trap. Probably luster mottled, with calcite and laumontite seams.

9. S. 11. Well-marked amygdaloid with pink lined amygdules of calcite. Brown base.

No. 11. S. 51. Amygdaloid and dark, almost black base, and lots of pink amygdules. In certain streaks instead of pink they are green and chloritic, and occasionally the large ones are filled with calcite.

S. 19. No. 11. This seems to be a red to yellowish indurated clay.

S. 26. No. 13. A dark massive fine grained trap with one amygdaloid showing perhaps laumontite in the center, then a marginal agatoid zone and reddish infiltrations in trap adjacent.

No. 16. S. 16. Very well marked amygdaloid with lots of small amygdules with laumontite and calcite. Ground mass dark.

No. 17. Typical ashbed diabase. One joint coated with calcite. Ground is a dark gray and on it lighter gray-green feldspars stand out conspicuously. This is of the melaphyre porphyrite type.

Label erased. May be 16. Dense fine grained trap.

S. 15. Label erased. Amygdaloid with gray ground, and amygdules either large ones of quartz lined with chlorite, or in a few cases with calcite. There are also some small epidote amygdules and a few show some copper. This bag is also marked: "500 label inside".

No. 18. S. 18. Very well marked amygdaloid. Dark brown with calcite. Greenish seams bordered red with pink or pink and white amygdules of extremely minute size at times, and perhaps also altered porphyritic feldspars.

No. 19. S. 14. Has a coarse look owing to feldspar crystals of a greenish color and 1-2 mm. long. There are numerous chlorite specks and spots red with iron oxide are abundant. This is of the general type of the rocks above the Pewabic lode—the Ashbed group.

No. 20. S. 20. Amygdaloid ground, generally greenish gray, occasionally brownish. Amygdules filled with some hard mineral—perhaps quartz.

No. 21. No. 5. Massive trap with calcite.

No. 22. S. 24. A very well marked amygdaloid with a chocolate brown or gray base, and white calcite and pink laumontite amygdules.

No. 24. S. 29. This is a very well marked amygdaloid with lots of amygdules—some entirely calcite, clear and colorless; others pink, but also carbonated, at least in large part. This type of amygdaloid with lots of amygdules seems rather characteristic of this horizon.

No. 26. Laumontite amygdaloid.

No. 27. S. 40. Fine grained massive trap with one feldspar crystal 2-3 mm. long. Another somewhat larger but isolated and not standing out from the ground.

No. 28. This is probably amygdaloidal conglomerate. Red seams and areas of amygdaloid coarsely spotted with pinkish or pink with green bordered amygdules. There is probably quite a little laumontite.

Belt 29. Bottom. S. 6. Shows greenish feldspar decomposed quite conspicuous on a reddish ground.

No. 14. S. 30. Very marked amygdaloid. Much laumontite and the amygdules close together. Dark brown.

No. 30. Top. S. 56. This is probably glomeroporphyritic. There are numerous small amygdules either of dark chlorite or light chloritic stuff and sometimes filled with calcite which also occurs in the seams.

31. Grayish, appearing rather coarse grained, with light greenish feldspar standing out. Dark chloritic blotches. There are also pink seams of calcite and green chalcedonic seams very hard, but probably not datolite, although they are either datolite or chalcedony. This type occurs near the Pewabic lode; also in the Atlantic cross-cut.

No. 12 Center. S. 32. A good many coarse up to 40 mm. fairly well rounded pebbles, and similar fragments which, with calcite, make up the matrix. Very little basic matter. No signs of copper.

No. 32. S. 55. Has a glomeroporphyritic appearance, the feldspars being up to 2 mm. and are reddish instead of the usual green. Amygdules are only partly filled with a nearly white kaolinic substance of green hue, or with a reddish feldspar? Quite clearly belongs to the Ashbed family.

Belt 33. S. 46. Has a coarse appearance, owing to the glomeroporphyritic feldspar which is greenish or pinkish, up to 2 or 3 mm; coarse, with chloritic amygdules; of the same type of the traps near the Quincy mine.

To Belt 34 A. Amygdaloid with open chlorite lined amygdules. The chlorite does not occur in solid radial forms, but in fibers. There are also amygdules of epidote and quartz.

Belt 35. S. 42. A light colored, coarse appearing trap, owing to the plagioclase which is 2-3 mm. long, with chlorite amygdules. It is a lighter greenish gray than the ophites and belongs to a series near the Pewabic lode, just above the Greenstone. In one place is a larger porphyritic feldspar 8 x 2 mm.

Belt 35. S. 12. This is thoroughly massive, and of a coarse feldspathic type like beds just above the Greenstone. There are a few large phenocrysts of feldspar; one 7 x 7 mm. of the oligoclase melaphyre type.

Belt 36. S. 10. Amygdaloid. Dark brown. Studded with small green crystals of feldspar and amygdaloid. Large amygdules are white calcite.

Belt 37. Bottom. S. 54. Fine grained ophite much jointed with occasional crystals 2-3 mm. not standing out from the ground, as they are merely extra long feldspar laths.

Bed 37. S. 14. Light greenish or reddish with numerous little chlorite seams, wavy, and under a lens one can see banded chlorite filling pores. Feldspar quite conspicuous but not strictly of the Ashbed type. Almost a chloritic amygdaloid.

Belt 38. S. 45. Amygdaloid on a reddish ground showing small pinkish or greenish feldspars of the Ashbed type. There are numerous amygdules of light chlorite. Quite different from the delessite of lower belts.

Belt 39. Fine grained. Possibly slightly luster mottled with small chlorite amygdules.

Belt 42. Top. S. 47. A gray-green amygdaloid with amygdules of quartz and

chlorite. A good chance to study the light greenish coating which sometimes occurs.

Belt 44. A. Coarsely amygdaloidal rock grained with calcite amygdules.

Belt 43. S. 52. Like the last sample but much finer and much more full of chlorite amygdules which occasionally are filled with quartz. The ground feldspathic.

Belt 45. Bottom. S. 4. Four or five pieces. Fine grained ophite with occasional chlorite amygdules. In one or two cases the feldspar attains the length of 1-2 mm. but it does not stand up from the ground in the same way as the Tobin porphyrite type.

47. S. 48. A well-marked ophite, and probably quite coarse. Possibly 10 mm. or so.

Belt 46. S. 49. Coarse amygdaloid. Dark reddish ground and amygdules lined with chlorite or filled with a pink and green radiated zeolite or calcite. The pink zeolite seems to be of two types; one of a reddish color, fibrous, changing to green. Hardness 4 minus. The other pink, with copper, less cleavable and unquestionably prehnite. Hardness above 6.

Belt 48. S. 44. Grey amygdaloid. Hard with white amygdules of quartz and some chlorite.

Belt 48. Middle. S. 23. Dark gray with white or chlorite amygdules, and some copper in them. The ground seems to be made up of small red fragments with a green cement in part.

Belt 49. Massive with faint chloritic flecking, but on the whole probably ophite. Much chlorite on joints.

Belt 50. S. 36. Amygdaloid with greenish ground and numerous small amygdules filled with a fibrous radiated, often pink mineral—hard,—thomsonite or prehnite—probably prehnite. Others are filled with laumontite. There seems to be a sort of mottling. The pink prehnite is colored by copper.

Belt 51. Dark massive fine grained ophite, with slickensided chlorite.

Belt 52. S. 34. A conglomerate of felsitic pebbles, mostly pretty well rounded. Some very fine grained; some medium, and one or two with a grain up to 3 or 4 mm. There seem to be a number of dark brown and small feldspar phenocrysts. The dominant type seems to belong to the gabbro or syenite aplite family. I do not notice any with conspicuous quartz, such as is common in the Calumet, while there are a number almost granitic. There are distinct signs of copper.

Belt 53. S. 43. A coarse amygdaloid with calcite amygdules and some red laumontite at one end. There are also seams of a deep maroon, red effervescent, which may be an iron carbonate.

Belt 54. S. 33. A coarse trap with a rather feldspathic look, probably feldspathic ophite, and if so the mottling may be quite coarse. Red specks are distinct. Not much chlorite; some epidote. One or two cavities are chlorite lined and filled with calcite.

No. 55. S. 38. Amygdaloid with dark blue-black back-ground. Calcite and laumontite amygdules.

Belt. 56. Probably fine grained ophite. Massive and free from seams.

Belt 57. S. 39. Amygdaloid with calcite and laumontite amygdules.

Belt 58? S. 17. Fine grained, luster mottled ophite with 1 or 2 chlorite amygdules.

Belt 60. S. 25. Well-marked ophite. Mottles 3 mm. or more.

Belt 61. S. 50. Brecciated amygdaloid with a dark base. Amygdules lined with chlorite and epidote, and sometimes empty. Interstices filled with chlorite. A little laumontite occasionally.

Belt 61. Amygdaloid; dark brown base; white calcite amygdules and reddish, apparently sedimentary matter, in a few cases yellowish with epidote, which seem to indicate transition to amygdaloid conglomerate.

Belt 62. S. 35. Massive fine grained ophite with small chlorite amygdules.

Belt 63. S. 31. Brecciated amygdaloid, with dark red brown amygdaloid and lots of calcite in the interstices; sometimes have pink borders but not always.

Belt 64. Two pieces. Dark fine grained ophite. Red specks rather unusually conspicuous. One joint surface coated with calcite.

Belt 69. A. Brecciated amygdaloid. Dark chocolate red amygdaloid with chloritic amygdules and calcite and laumontite. Chlorite and epidote in the interstices.

Belt 66. S. 7. Well-marked ophite. 2-3 mm.

Belt 68. S. 3. Well-marked ophite with one or two amygdules and a joint covered with calcite and laumontite.

Belt 73. Brecciated amygdaloid with a great deal of calcite and epidote.

Belt 75. S. 36. A brecciated amygdaloid. Dark red amygdaloid with dark specks of epidote, and calcite amygdules and the interstices large and filled with calcite with a border of epidote.

Belt 76 A. Three pieces. Well-marked ophite 2-3 mm.

No. 77. S. 27. Like a belt in a cross-cut. Red amygdaloid fragments in a sort of breccia with epidote and calcite in the interstices. Some calcite is in poikilitic patches.

No. 78 A. Massive fine grained ophite with few chlorite amygdules.

Belt 79. S. 53. Well-marked amygdaloid with large amygdules. On the average larger than S. 52. Filled with calcite and lined with chlorite. Ground dark purplish.

Belt 80. Dark massive ophite, with chlorite on joints.

Belt 85. S. 21. Fine grained; reddish, with chlorite amygdules.

The 30th level cross-cut which was examined by Mr. G. W. Corey and myself running from near the bottom of Tamarack No. 2 shaft continues the section of the Tamarack 5 shaft down below the Kearsarge conglomerate. A drill hole from Tamarack No. 2 shaft reached the Kearsarge amygdaloid in 970 feet.

Notes in 30th level. Tamarack cross-section. 4300 feet down. Strike of lode N. 28° E., of cross-cut 54° E.

Belt.	Corey's distance from S. E. of shaft T 2.	My.	Specimen No.	
72.	2–½		1	Coarse amygdaloid with gray trap, hard between 5 and 11 ft.
71.	16		2	Specimens 1, 2 and 3
	22		3	in amygdaloid belt.
	23		4	Next to a little calcite seam dipping 50° to S. E. (i. e., nearly at right angles to dip).
	35	40	5	Coarse amygdaloid.
	43			

Belt.	Corey's distance from S. E. of shaft T 2.	My.	Specimen No.	
	52	60	6	Trap.
	61	65	7	Trap.
	67	72	8	Trap.
	76	80	9	Trap, jointed at right angles to bedding.
	84	88	10	Heavy trap, joints dip 70° to N. E.
	93	98	11	All solid trap, ophite probably.
	102	105	12	All solid trap, almost vertical seam and seam perpendicular to it (12x11 feet of trap to amygdaloid).
	112	112	13	
	118	119	14	Laumontite seam.
70.	125	125	15	A few amygdules.
	136	132	16	Gray feldspathic laumontitic.
	140	139	17	Laumontitic, coarsely amygdaloid.
	147	145	18	Laumontitic amygdaloid.
	151	149	19	Marked hard gray and white amygdaloid.
	153	152	20	Greenish epidote altered.
	159	155	21	First class amygdaloid.
69.	163	158	22	Trap fine grained.
	170	162	23	Trap fine grained.
	176	167	24	Trap fine with a calcite seam.
	184	175	25	Still massive fine grained trap.
	188	185	26	Same.
	191	192	27	
68.	199	197	28	Amygdaloid, gray and white, wet.
	203	200	29	Amygdaloid, gray and white, wet.
	207	204	30	Amygdaloid.
	211	205	31	Fine grained red trap, a laumontite seam running to W. dips S.
	216		32	Amygdaloid conglomerate.
	220		33	Amygdaloid conglomerate.
	227		34	Amygdaloid conglomerate.
	231	220	35	Amygdaloid conglomerate.
	236		36	Amygdaloid conglomerate.
	240		37	Amygdaloid conglomerate (at 239 trap).
	246	235	38	A well-marked amygdaloid conglomerate with red sediment.
67.	253	237	39	Trap.
	262		40	
	271		41	Amygdaloid, pink and white.
	280	280	42	Red trap.

Belt.	Corey's distance from S. E. of shaft T 2.	My.	Specimen No.	
	288	280	43	Red trap.
	293	293	44	Red trap.
	301		45	Coarse amygdaloid.
	309		46	Marked amygdaloid, coarse gray and white, then amygdaloid with small amygdules, laumontite.
66.	318	318	47	Markedly clasolitic (with red seams of sediment).
	328		48	
	343		49	
	357	357	50	Epidote, spotted and getting amygdaloidal.
	370		51	Coarse amygdaloid, but mainly trap.
	384		52	Amygdaloid.
				Winze, which were generally sunk in amygdaloid I am told for ease of working. The water from the winze floats the urinometer above the bottom of the scale=1.060 plus.
	401	401	53	Amygdaloid poor.
65.	414	414	54	Brecciated marked amygdaloid just above contact.
	421	421	55	Near top of amygdaloid.
	422	422	56	Fine-grained amygdaloid.
	428	428	57	Sparsely amygdaloid.
	434	434	58	
	448	448	59	Trap with irregular jointing.
	462	462	60	Coarsely spotted with amygdules.
	478	478	61	Slickensides and marked irregular amygdules.
	490	490	62	
	494	494	63	Massive trap.
	509	509	64	Coarse amygdaloid skeined parallel to the bedding but not the contact of a new flow.
	525	525	65	Trap.
	544	544	66	
	559	559	67	
	575	575	68	
	590	590	69	
	605	605	70	
	625	625	71	
	641	641	72	Coarse amygdaloid begins.
	656		73	

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
64.	668	74	
	675	75	
	683	76	
	697	77	
	700	78	Kearsarge Cg. Dip 35° L. or 35°⅔ McNair.
63.	702	79	Two feet of fluccan on top of Kearsarge conglomerate, decomposed upper bed, dip of this fluccan 37°½ to 36°.
	708	80	Trap. Surveyor's plug 10 at 710.
	724	81	Massive trap.
	731	82	
	741	83	The same, laumontitic.
	749	84	Somewhat amygdaloid.
	756	85	Trap just beyond a seam parallel to the dip.
	762	86	Trap, close to laumontite seam.
	769	87	Laumontitic seam dipping 42°.
	773	88	Trap, marked massive.
	780	89	Trap, marked massive.
	786	90	Cross-course to the North dipping 59° to the E.
	792	91	
	799	92	Trap with occasional coarse amygdules.
	804	93	Trap with occasional coarse amygdules.
	813	94	
	821	95	
	834	96	Well-marked amygdaloid.
62.	841	97	Trap with joints parallel and perpendicular to the bedding.
	850	98	
	858	99	
	876	100	
	884	101	Very massive.
	892	102	Calcite seam dipping E. in massive trap.
	900	103	All massive trap.
	906	104	All massive trap.
	914	105	All massive trap, flat seams.
	922	106	All massive trap.
	929	107	Amygdaloid in spots.
	936	108	Trap.
	943	109	Trap.
	951	110	Massive trap.
	958	111	Coarse amygdaloid.
	965	112	Amygdaloid showing amygdules elongated parallel to the bedding.

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
61.	973	113	
	979	114	
	985	115	
	992	116	
	996	117	Poorly marked amygdaloid.
	1004	118	
	1010	119	
	1016	120	Columnar jointing perpendicular to the bedding.
	1022	121	Massive trap all along to Sp. 127.
	1028	122	
	1036	123	
60.	1043	124	
	1049	125	
	1055	126	
	1061	127	
	1069	128	
	1077	129	
	1083	130	
	1087	131	Massive. Surveyor's plug P. B. near it.
	1094	132	
	1098	133	
	1107	134	Still massive, with a big spot of calcite.
	1115	135	Still massive. (The roof caves.)
	1121	136	
	1127	137	
	1134	138	
	1139	139	Still massive.
	1144	140	
	1150	141	
	1156	142	Amygdaloid.
	1161	143	Red and white amygdaloid, fairly well developed.
59.	1166	144	
	1172	145	Trap.
	1177	146	Trap.
	1184	147	Trap.
	1191	148	Trap, with calcite.
	1196	149	
	1203	150	Contact well-marked.
58.	1206	151	Trap.
	1212	152	Trap.
	1217	153	Trap.

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
	1224	154	Trap.
	1228	155	Trap.
	1233	156	Trap.
	1238	157	Trap.
	1246	158	Trap.
	1251	159	Trap.
	1256	160	Still massive trap.
	1263	161	
	1266	162	
	1271	163	
	1279	164	Marked red and white amygdaloid just below contact.
57.	1283	165	
	1289	166	
	1294	167	Trap.
	1300	168	Very coarse amygdaloidal spots (pseudamygdaloid?)
	1308	169	
	1313	170	
	1320	171	
	1326	172	
	1332	173	
	1337	174	
	1346	175	
	1354	176	
56.	1362	177	
	1371	178	Black chloritic trap.
	1377	179	
	1384	180	
	1389	181	
	1397	182	Trap.
	1404	183	
	1411	184	Coarse ophite, augite patches 3 to 4 mm. across.
	1417	185	
	1424	186	
	1430	187	Seam parallel to cross-cut, i. e., to the drift.
	1437	188	
	1443	189	
	1450	190	Trap.
	1457	191	Still seamed parallel to the cross-cut (S. 40° F.)
	1464	192	

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
	1471	193	Trap still.
	1478	194	Trap.
	1484	195	Trap.
	1491	196	Trap.
	1497	197	Trap.
55.	1502	198	Trap.
		199	
	1509	200	A seam of copper and prehnite is parallel to the bedding or steeper.
	1518	201	
	1524	202	Surveyor's plug 18.4.
	1530	203	Amygdaloid.
	1539		
	1544	204	
	1547	205	Coarse amygdaloid.
	1554	206	
	1564	207	
	1568	208	
	1575	209	Between 209 and 210 is a drift on the Osceola amygdaloid.
	1594	210	
	1599	211	
	1607	212	
	1621	213	
	1630	214	
	1645	215	
	1654	216	
	1661	217	
	1666	218	Timbered.
	1672	219	
	1679	220	
	1689	221	
	1698	222	Massive trap.
	1706	223	Amygdaloid.
	1714	224	
	1721	225	
	1729	226	
	1736	227	
	1742	228	
	1751	229	
	1761	230	
	1769	231	
	1777	232	
	1785	233	Well-marked amygdaloid.

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
	1794	234	Here is a watering spot from which the sample analyzed by F. B. Wilson was taken. See Chapter VII.
	1800	235	
54.	1809	236	
	1816	237	Trap.
	1824	238	
	1831	239	
	1836	240	
	1843	241	
	1851	242	
	1861	243	Surveyor's plug.
	1869	244	Winze.
	1870	245	
	1887	246	
53.	1893	247	
	1899	248	
	1907	249	
	1915	250	
	1922	251	
	1929	252	Irregular trap.
	1935	253	
	1942	254	Irregular trap.
	1950	255	Massive trap.
	1956	256	
	1963	257	
	1969	258	
	1976	259	
	1987	260	
	1994	261	Somewhat seamed parallel to the bedding.
	2001	262	
	2007	263	
	2016	264	
	2024	265	
	2031	266	
	2037	267	
	2047	268	
	2054	269	
	2059	270	
	2068	271	
	2074	272	
	2081	273	

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
	2088	274	Amygdaloid.
	2098	275	
	2104	276	
	2112	277	
	2119	278	
	2124	279	
	2137	280	
	2143	281	
	2150	282	
	2169	283	
	2177	284	
	2185	285	
	2192	286	Much brecciated, no slips of importance beyond to 303 I think.
52.	2200	287	
	2208	288	
	2218	289	
	2227	290	
	2236	291	
	2244	292	
	2256	293	
	2264	294	
	2273	295	
	2283	296	
	2292	297	
	2303	298	
	2312	299	
	2324	300	
	2336	301	
	2343	302	
51.	2360	303	16 feet to center of drift,—a level on the C. & H. lode.

The section is continued by a drift from the 29th level over to Tamarack No. 5 shaft. This is above the Calumet and Hecla Conglomerate No. 13. It may be noted how copper collects on the low parts of the roof of this level and makes a green copper carbonate stain which shows that it has copper in solution. According to other green streaks of altered copper the copper occurs in the conglomerate in streaks parallel to the bedding. As this drift is at a considerable angle with the direction of the dip I have noted whether the specimens were taken from the left (S. W.) side by L. or the right (N. E.) by R.

705–3 304 Distances referred to plug specimens numbered 304-308 are all from the C. & H. conglomerate. The copper comes first in the cement. Then there is a halo bleached

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
			in the conglomerate pebbles, then the outside turned to copper.
	705–2	305	
	16	306	
	25	307	
	31	308	
	35	309R	Rather sandy.
50.	41	310R	At iron pin, hanging amygdaloid with large patches of calcite with red border, also clear amygdules.
	47	311R	Jointed dip with contact.
	54	312L?	Marked contact dip 32°-36°. Very clear, sandy? just above it.
49.	61	313R	Just above contact on right.
	67	314R	Ophite.
	75	315R	Ophite growing coarser.
	81	316R	Ophite growing coarser.
	87	317R	Ophite growing coarser, cupriferous.
	94	318R	Ophite growing coarser.
	99	319L	
	106	320L	
	121	321L	All massive trap.
	129	322	All massive trap.
	138	323	
	146	324L	A seam crosses the drift with a steep dip running nearly parallel to the strike.
	156	325L	
	168	326L	Spotted.
	177	327L	
	188	328L	
	199	329L	Chloritic seams abundant.
	206	330L	Epidotic altered.
	221	331L	
	232	332L	
	233	333L	Genuine amygdaloid, damp.
	249	334L	Seamed.
		335	
	262	336?	
	270	337R	Marked green and white amygdaloid
	279	338R	Spotted clay seam.
	289	339R	
	299	340L	
	309	341L	Calcitic rock soft.

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
48.	318	342L	Fine grained ophite.
	335	343L	2 to 3 mm. patches of ophite.
	345	344L	
	354	345	
	366	346R	Coarse ophite.
	376	347R	
	388	348	Massive.
	397	349L	Bedding joints marked.
	411	350R	Fine grained massive.
	425	351R	Broken up.
	436	352	
	451	353L	Massive.
	464	354L	Veined.
	479	355	Surveyor's plug 9, Trap.
	491	356	Surveyor's plug 8.
	501	357R	Wet amygdaloid.
	520	358R	Red and green amygdaloid.
47.	530	359L	Looks massive.
	542	360L	Coarse.
	548	361L	Coarser.
	555	362R	
	571	363R	Ophite with 3 mm. patches.
	583	364R	Coarser.
		There is no 365.	
	595	366L	
	606	367	
	618	368L	Joints parallel to bedding.
	625	369L	
	638	370R	Ophite patches 1 to 2 mm.
	648	371R	Fine. A slickensided face striking N. dips to the W. and makes an angle of about 30° with the course of the lode. The striations incline to the N.
	659	372R	Coarser?
	668	373R	Coarser?
	680	374R	Coarser?
	690	375R	
	703	376R	Decreasing? irregularly jointed.
	712	377	Plug 5, water begins.
	722	378	Slickensided, light green. In this part of the section there are on top of the traps and fading into them often greenish light amygdaloids.

Belt.	Corey's distance from S. E. of My. shaft T 2.	Specimen No.	
	736	379R	Looks like pink and green castile soap.
	751	380	
	761	381R	Amygdaloid, decomposed, wet, both sides.
46.	776	382R	Dry.
	788	383R	
	800	384R	
	813	385R	
	825	386R	
	835	387R	
	841	388	
	851	389	Marked amygdaloid.
	865	390	391 to 395 are in the No. 5 shaft plat.
	874	391	
	895	400	Face of drift.

DETAILED NOTES ON THE SAMPLES FROM CROSS-CUT USED IN PRESIDENT McNAIR'S SPECIFIC GRAVITY TESTS.

Belt 72. 1. Ophitic trap-luster mottled, perhaps 2 mm. Epidote seams. Amygdaloid spots. Epidote border and sometimes a quartz center. The band of greenish, radiated, cleavable zeolite is perhaps laumontite. The main mass of the trap, like ophites generally, shows greenish chloritic or epidote spots; rusty brown specks which I attribute to altered olivine, which are not largely conspicuous ; faint, light greenish indications of feldspar laths and a dark ground which is presumably an augite. This is a general description of ophites and will be understood unless special notes are made. No. 1 will ordinarily be classed as trap.

Belt 71. 2. Amygdaloid with dark chocolate red base. The amygdules have a border of blue-green chlorite or yellow-green epidote. The center is light colored, white calcite. Between these there is a pinkish layer, so far as tried non-effervescent—soft and friable and I presume laumontite.

Hereafter white minerals of the calcite cleavage will be called calcite; the light pinkish friable minerals, laumontite; yellow-green, epidote; and bluish green, chlorite, unless there is some special mention. The walls of the amygdules are well defined and often rounded, being clearly bubbles.

3. Ophite, mottles not over 2 mm. with a small seam of laumontite and calcite amygdules at one side. Both are in a previous specimen. There is occasionally a spot of the light greenish color which seems to shade into the laumontite and might be taken for prehnite if it were not too soft. 3 pieces.

4. Probably an ophite. The feldspar laths are somewhat more conspicuous on certain surfaces and the brown-red alteration more extensive and minute laumontitic seams a fraction of a mm. can be seen in the

interstices of the ground mass. There is also considerable white material (calcite) pervading the ground mass. The alteration of reddish and greenish spots is more conspicuous. This is an ophite.

5. Ophite. Luster mottling may be 3-4 mm. One side is covered with laumontite and the quartz with epidote. There is also one large amygdule filled with laumontite and quartz, with epidote and chlorite in the border. This should be counted as a trap and the amygdules are such as are likely to occur only sporadically in the trap.

6. Ophite. Mottles perhaps 2-3 mm. Some surfaces coated with slickensided chlorite. 2 pieces.

7. Ophite. Massive although there are some irregular chloritic seams.

8. Probably ophite. More decomposed feldspar about .6 mm. There is a good deal of calcite in irregular seams. It contains some copper which has turned slightly green to carbonate.

9. Massive trap, much reddened and on one side coated with shining irregular face of iron oxide. Next to a little seam of laumontite there is the crystalline form. While it is probably ophite the mottles cannot be identified in the hand specimen. Feldspars may be .8 mm.

10. Ophite. Massive and broken up; rather smooth joints. One joint is covered by patches of calcite which are not to be mistaken for luster mottling. This is probably about 3 mm.

11. Ophite. Luster mottles probably about 2 mm. Has small irregular calcite seams.

12. A good deal seamed with calcite and a little laumontite. Mass of the rock shows considerable epidote. Mottling is probably about 2 mm.

13. Ophite. In one place there is a little mottling of secondary calcite but the genuine augitic mottling appears to be about 1½ mm.

14. Ophite. Crossed by an irregular quartz stringer with epidote border. Luster mottling is about same size as 13. Is well-marked. One side of the specimen is coated with pink laumontite; the other with a soft gray stuff that looks like mud or varnish, being a shiny coating.

15. Ophite. A good deal decomposed. Laumontite in little seams runs all through especially in certain lines. Large irregular epidote quartz pseudamygdules. In these there is red matter which may be copper oxide or iron oxide—a reddish band rather extra decomposed may represent flow line. The ophitic mottles probably between 1 and 3 mm.

16. Much decomposed. Very coarse mottling—is due to patches of calcite. The mass of the rock is uniformly flecked red or green. It is traversed by little irregular seams of fine grained red sediment (clasolites). These clasolites are probably considerably lighter and may affect its gravity.

17. Ophite. Mottles 1-2 mm. probably, but the whole rock much decomposed. There is a good deal of reddish brown clasolitic matter in it. It is also more or less epidotic. Number of specimens.

18. Ophite. With one or two amygdules. One shows a quartz border very sharply defined and one side a laumontitic center, the farther part of the amygdule not being so clear against the ground mass.

19. Genuine amygdaloid. Amygdules 3 mm. more or less. Sometimes lined with radiating chlorite and then empty; also with quartz;

epidote often occurs at the border and the epidote specks in the mass seem to be rather pseudamygdules, the epidote forming more at the expense of the ground. The ground mass is the usual red and white flecked of the ophite, but the mottling is now probably not 1 mm. This is the first genuine amygdaloid.

20. Probably at or near contact. A breccia of a very fine grained trap and epidote and quartz masses and fine grained amygdaloid in a reddish clasolitic matrix. This may be from a scoriaceous or amygdaloidal conglomerate, but it might be only a seam in the amygdaloid.

Belt 70. 21. Similar to 20 with fragments of amygdaloid. Apparently more than one kind; at least there are two different classes. There is a greenish gray amygdaloid, then there is a dark reddish amygdaloid. Amygdules are calcite. Brown to red matrix shows line of sedimentation. In some parts it is quite epidotic.

22. Well-marked ophite. Quite fresh looking and apparently not very fine grained with coarse chloritic flecks. This is rather dark colored.

23. A massive fine grained trap, covered with chlorite on four faces, the striations running not very systematically. Two faces are smooth; two faces are tortuous.

24. Similar to 23 with chloritic joints also fine grained.

25. A similar ophite. Fresh looking; fine grained; not so prominent chloritic joints. Mottles possibly 1-2 mm.

26. Same with slickensided chlorite on joints; reddened; slightly amygdaloidal with chloritic spots.

27. A small, similar reddened trap with little spot of laumontite and calcite one end.

28. Three or four pieces. More amygdaloidal with more laumontite and calcite. Amygdules are small and grade into secondary specks.

29. Well-marked amygdaloid; fine grained, dark maroon with occasional porphyritic feldspars up to 1 mm. long. Amygdules of calcite and laumontite, and a little epidote at the margin. Smooth walled. There seem also to be secondary epidotic specks, and there are also seams coated with calcite, laumontite, chlorite, and a little epidote.

30. A number of pieces. Fine grained, dark maroon. Some amygdules and secondary specks of laumontite and larger aggregates of calcite.

?Belt 69. 31. Two or three pieces. Somewhat brecciated and of amygdaloidal conglomerate type, made of black fragments mixed together and seamed by calcite, but no sedimentary matrix like that in Beds 20 and 21 noticeable. This is more probably merely a shattered bed at the top of the amygdaloid.

32. Three or four pieces. Dark colored with much calcite infiltration seams, also laumontite on fissures. Brecciated.

33. Dark; full of calcite and laumontite similar to the last.

34. Shows mixture of red sediment although fine grained, compact trap fragments with one porphyritic feldspar 2-3 mm. long. Twinned and chloritic amygdules.

35. Two pieces and more. Fragments of fine grained trap are imbedded in the sandy matrix in which small cavities of laumontite and calcite occur. There are also signs of crushing. While on the whole it seems rather more likely that this is an amygdaloid conglomerate, we can not say that it is not crushed clasolitic amygdaloid or trap.

36. Is mainly sediment; red; and under the microscope appearing somewhat sandy. There are striated slickensided faces and some fragments of trap imbedded.

37. Three pieces. Amygdaloidal with seams of sediment. Here the sediment appears distinctly intrusive into the amygdaloid while in 36 the amygdaloid is in the nature of fragments in the sediment. The amygdaloid is nearly black with small amygdules of calcite.

38. Amygdaloid; appears somewhat ophitic. Amygdules irregular and laumontitic and larger ones with calcite centers.

Belt 68. 39. A blotched somewhat ophitic trap with clasolitic irregular seams; also crossed by a stringer of calcite.

40. Fragments of amygdaloid imbedded in a brown sediment, sometimes yellowish, epidotic and distinctly stratified and sandy. The fragments appear, however, to be of the same kind and much like the specimens last described with blotches of epidote and laumontite.

41. Rather decomposed, fine grained trap with a lot of clasolitic seams or sediment matrix to fragments. There seems, however, to be a certain fitting of the fragments together so as to indicate that they were once part of a continuous mass.

42. Like 41. Full of red clasolite matter, and not any very defined amygdules. The amygdules are small and there are also decomposition patches.

43. Is mainly clasolitic sediment. Should give a pretty good idea of the specific gravity of that sort of stuff, but I doubt if it is a fair sample of any regular bed. There is some amygdaloid clinging to it.

44. A mixture of rather coarse, sandy, clasolitic stuff with a dark, fine grained, not very amygdaloid trap.

45. Brecciated amygdaloid with the interstices filled with laumontite and green calcite. There is also epidote on the edges. The laumontite in some places appears to become green, but I think it is due merely to mixture with green calcite which is unusually well marked.

46. Well-marked amygdaloid, rather coarse grained. Amygdules of laumontite and quartz. Rather small.

Belt 66. 47. Well-marked ophitic trap with mottles not over 2 mm. and amygdaloid spot in one corner, and calcite seam on opposite face. The whole mass of the trap seems to be decomposed and have minute red, probably laumontitic specks.

48. Ophite. Fine grained with small clasolitic streak, which seems itself to have somewhat amygdaloidal texture but the amygdules are not sharp. The main trap is full of small amygdules largely laumontitic.

49. Two or three pieces. The small pieces are fresh looking ophites although there are little calcite stringers traversing it and upon close examination there is an unusual amount of chloritic alteration. The main base is covered all over with a white coating probably due in some way to the specific gravity treatment.

50. Apparently almost solid epidote up to a little laumontitic seam beyond which the trap is not quite so much decomposed and the structure can be somewhat made out. It was probably moderately ophitic. There appears to be more chlorite and less epidote in this part.

51. Ophite. Probably about 2-3 mm. A few specks of laumontite and calcite and also one appears to be solid laumontite, the alteration throughout the ground mass to iron oxide being unusually conspicuous.

52. Somewhat amygdaloidal but still coarse grained rock, probably having a mottling of 2 mm.

53. Well-marked, fine grained amygdaloid with white amygdules of calcite, numerous bright red specks on a gray-green ground with little epidote. This should be near the top of a flow.

Belt 65. 54. Ophite with calcite and laumontite amygdaloid spots. Rather inclined to be pseudamygdaloid, but there are a few small genuine amygdules. Red specks of iron oxide on the ground.

55. Rather fine grained amygdaloid with small amygdules, and also large patches of laumontite and calcite. Chocolate ground mass.

56. Fine grained, filled with laumontite and chlorite; much decomposed. The most typical amygdaloid along here is No. 53.

57. Decomposed laumontite amygdules. They are much saturated with laumontite. Amygdules comparatively scarce.

58. Like 57. Full of laumontite with large patches of amygdules of calcite. 56, 57, and 58 are practically similar.

59. A decomposed ophite. There is a good deal of epidote, and the base has a brown and green mottling of about 2-3 mm.

60. Ophite. Probably 2-3 mm. with occasional large amygdules of calcite. Some laumontite in cores. Amygdules are somewhat bordered with chlorite and laumontite.

61. This appears like a very fine grained trap near the bottom of the bed. There is some epidote and a few blotches of calcite and quartz.

62. Two pieces. Fine grained; very epidotic with blotches of quartz.

63. Somewhat laumontitic trap 1-2 mm. with pores filled with laumontite.

64. This has a few amygdules clearly defined of calcite. The feldspar is rather extra long—2-3 mm., and there may be an approach to a doleritic texture.

65. Apparently fine grained, dark chocolate red with 2-3 mm. feldspar and some amygdules of quartz and chlorite.

66. Quite coarse and feldspathic, the feldspar laths being conspicuous and there are also spots of iron oxide. This is sometimes in the interstices of the feldspar and after augite; perhaps also after olivine. One face is covered with calcites which are striated with slickensides.

67. Coarse, massive, feldspathic ophite. This is almost the first in which the mottling can be determined with any real precision. It is here up to 4 mm. across. Usually about 3 mm. Is a well-marked feldspathic ophite.

68. Same type. Mottles very vague.

69. Same type, getting coarser, but the mottling is too vague to measure accurately. There is a little calcite seam.

70. Same still coarser. At one end a seam of calcite. Dominant appearance of the rock is gray with reddish specks.

71. Seems to be getting finer. There are a few amygdules of calcite.

72. About the same—little darker. One chlorite amygdule.

Belt 64. 73. Felsitic Kearsarge conglomerate pebbles of dense feldspathic porphyry. Coarser grained rocks of the gabbro aplite type also of quartz porphyry make up the mass of the rock down to the very small fragments which are still felsitic or broken out quartz and feldspar. The last matrix is calcareous. There is very little basic material and no copper apparent. Hardly any epidote or any secondary mineral but calcite.

74. Another specimen of the conglomerate which has, however, one distinct fragment as much as 13 mm. long of some decomposed basic rock, probably amygdaloid. Plenty of quartz porphyry. Matrix of small fragments—little but calcite secondary.

75. Same as 74. Lots of quartz porphyry. One or two streaks of dark stuff like serpentine.

76. Same conglomerate. Matrix grayer but more epidotic. The pebble mainly near quartz porphyry with feldspar crystals 16 mm. long, and quartz bi-pyramids something like 5 mm.

77. Some conglomerate. Felsite pebbles generally quite small—one or two pebbles—one or two dark pebbles up to 37 mm. long. These have a dark soft matrix and crystals of feldspar that stand out and show terminal faces. Probably belong in the trachyte or andesite family. Mr. J. L. Nankervis has given me a similar pebble from the C. & H., largely changed to copper, with a matrix very soft so that the Karlsbad twins can easily be picked out. Mr. Jos. Pollard has Karlsbad twins picked out probably from a similar rock. The cement is calcite and epidote.

78. Similar conglomerate, with various kinds of porphyry. The matrix of epidote and calcite and one or two green serpentine grains only a few mm. in diameter.

79. Soft grayish green clay. This appears to be decomposed and crushed trap.

80. Fine grained, reddish trap, with a few coarse chloritic amygdules. These are dark green at the center, and seem to bleach to a lighter color at the margin. They do not seem at the center to have the usual fibrous structure of delessite. In part of the specimen the seams are specked with calcite.

81. Probably a fine grained ophite. 1-2 mm. with much laumontite in specks throughout, and the same covered with patches of calcite.

82. Massive ophite. Small amount of laumontite on seams.

83. Ophite. With a few scattered calcite amygdules surrounded by laumontite or chlorite. The mottles may be 3 mm. across. It is not plain.

84. Fine grained amygdaloid with hard amygdules and quartz; very little epidote; some pinkish material. This must be near a contact.

85. Massive ophite. Mottling not over 1-2 mm. One seam face covered with laumontite; another with slickensided chlorite.

86. Ophite. Rather fine grained. One face covered with laumontite—just a film.

87. Ophite; somewhat coarser. One seam covered with a white coating of small granular crystals. Are they analcite? They do not effervesce in acid, and seem to be reasonably soft.

88. Massive ophite. Mottles 3-4 mm. Occasionally prismatic forms of augite 7 x 2 or 5 x 2.

89. Another coarse ophite. One face covered with laumontite. Mottles distinct and about 4 mm.

90. Well-marked ophite. Mottles about 3 mm. One face covered with laumontite, pink and white.

91. Ophite. Mottling faint—about the same as heretofore. Perhaps somewhat more chloritic.

92. Coarse ophite. Mottles about 3-4 mm.

93. Medium grained ophite. Two faces making an angle of 105° covered with laumontite. Mottles 2-3 mm.

94. Ophite. One face covered with laumontite. Mottles somewhat finer. 2-3 mm.

95. Massive ophite about the same grain.

96. Slightly amygdaloidal with blotches of epidote, radial chlorite, calcite.

Belt 62. 97. Distinctly finer but of massive trap. The chlorite on seams and in smaller chlorite amygdules. I should not have taken 96 to be amygdaloid top, but as my notes say there is a well-marked amygdaloid and finer grain is distinct, it had better be counted.

99. Massive ophite. Curved faces covered with slickensided chlorite. Mottling 2-3 mm.

100. Massive ophite. Two faces covered with a dark serpentine or chlorite. Mottling is less than 4 mm. Perhaps nearly 5.

101. Many surfaces covered with slickensided chlorite. Mottling 5 mm.

102. One face covered with laumontite; one with chlorite. Mottles 5 mm.

103. Massive ophite. Mottles 5-6 mm.

104. Coarse ophite. Mottles 6 mm.

105. Coarse ophite. Mottles quite conspicuous. 4 mm? The luster patches are a little smaller than the general effect of the mottling perhaps.

106. Ophite. Mottles 3-4 mm.

107. Massive ophite. There are some little white specks but they are not sharp walled and do not appear to be genuine amygdaloids. They have a fibrous structure and are hard. Probably prehnite or thomsonite. May be a little copper. This is not a compact amygdaloid.

108. Well-marked ophite. One face covered with laumontite. Mottles about 3-4 mm.

109. Well-marked ophite. Dark. Mottles about 3 mm. and very plain—colored and dark and full of serpentine or chlorite. Brownish inge of the augite is faintly visible.

110. Well-marked ophite. Mottles about the same—3-4 mm. This piece seems to show no secondary minerals and seams.

111. Well-marked ophite. Small speck of native copper and little stringer of calcite, mottles being 2-3 mm. This is not properly amygdaloid.

112. Luster mottled 2-3 mm. with amygdules of pink copper-bearing prehnite.

Belt 61 not independent. 113. Massive ophite. 2-3 mm. with one or two amygdules of pink prehnite.

114. Massive ophite. Rather decomposed with a few chloritic amygdules and one or two of prehnite. Mottles not plain but probably rather coarse.

115. Massive, fine grained ophite with numerous chloritic blotches, and one showing calcite, epidote and copper in the center beside a chloritic rim.

116. Fine grained ophite. Not over 1 mm. Few chlorite amygdules. There is a confusion here between samples and records.

117. Well-marked amygdaloid. Brecciated and perhaps amygdaloidal conglomerate. A cement of calcite; prehnite; trace of copper.

This is peculiar in that there is a border of earlier, slightly brownish calcite on top of which occurs a light greenish mineral which I take to be prehnite. This is evidently close to a contact.

118. Fine grained, brecciated, decayed amygdaloid with epidote and calcite.

119. Fine grained well-marked ophite. Mottling not over 1½ mm.

120. Fine grained massive trap. A little laumontite in one seam.

121. Fine grained massive ophite. Little stringer of laumontite and calcite. Mottles less than 2 mm.

122. Fine grained ophite with a few coarse amygdules of epidote, and quartz and smaller ones of chlorite. Epidote is very yellow and has distinct needles.

123. Trap similar to 122, but with chloritic amygdules. These often show a fibrous layer of chlorite with a hollow center in which it has grown. The ground is chocolate brown.

124. Fine grained, well marked amygdaloid. Probably near contact with porphyritic feldspar laths 1 mm. or so long.

125. Massive trap, fine grained. Laumontite and chlorite seam.

126. Dark ophite. Mottles well-marked but not more than about 1½ mm. Very fresh looking.

127. Two pieces. Ophite about 2-3 mm. Chloritic slickensided joints.

128. Massive ophite. 2½ mm.

129. Massive ophite. 2-3 mm. One seam covered with soft white effervescent stuff in pearly coats—I presume calcium carbonate. Is it possibly magnesium carbonate?

130. Massive, luster mottled ophite 3 mm.

131. Massive ophite 1-2 mm.

132. Massive ophite about same grain. One face heavily coated with striated chlorite and calcite.

133. Massive ophite. 2 mm? One seam coated with striated chlorite.

134. A rather fine grained ophite with 2 or 3 parallel seams.

135. Rather fine grained ophite. On one side a seam 2 mm. thick of chlorite, on the other 10 mm. thick of calcite and chlorite. The calcite shows pressure banding very finely.

136. Apparently still ophite, much decomposed and seamed chloritic.

137. Fine grained with chlorite amygdules.

138. Apparently not very coarse ophite. Rather decomposed with bluish chlorite on some places. Mottles probably 1-2 mm.

139. Massive ophite. Mottles probably not over 1-2 mm. Red and green ground. Somewhat coated with chlorite, laumontite, etc., on faces.

140. Ophite not over 1-2 mm., with fine chlorite amygdules.

141. Ophite fine grained with frequent chloritic blotches.

142. Ophite. Mottled and with vague amygdules.

143. Fine grained, red matrix, and one end well-marked amygdaloid spot filled with chlorite and calcite.

Belt 59. 144. Fine grained ophite. About 1 mm.

145. Two or three pieces. Massive ophite about 2 mm.

146. Ophite with chlorite and laumontite near face. About same grain.

147. Ophite, fine grained, with chlorite amygdules.

148. Well-marked amygdaloid with a grayish-brown base, fibrous, greenish, hard prehnite in irregular amygdules. Little epidote older than the prehnite. Probably a little copper.

Belt 58. 149. Fine grained ophite, with slickensided chlorite seams.

150. Ophite. 1-2 mm. with a face heavily slickensided with chlorite.

151. Ophite. 2½ mm. Some faces heavily slickensided with chlorite. The direction of the striations comes together on two faces sloping toward each other.

152. 3 mm. ophite, with one face having slickensided striations.

153. Massive ophite about same grain, with a seam of slickensided chlorite 8 mm. thick. Is it not possible that in knocking off small specimens there is a tendency to get too much of this chloritic seam material?

154. Well-marked massive ophite. Mottles 3-4 mm. One face heavily slickensided with chlorite.

155. Fine grained; uniform in color; apparently decomposed mass of quartz and chlorite with seams of quartz and prehnite containing quite a little native copper.

156. Marked coarse ophite. Mottles 3-5 mm.

157. Marked coarse ophite. Mottles 4-5 mm.

158. Finer ophite. Mottles 4-5 mm.

159. More feldspathic looking. Lighter colored. Mottles about 4 mm.

160. Marked ophite. Mottles about 4 mm.

161. Marked ophite. Mottles somewhat lighter. About 5 mm., or even 6 mm. long. Tend to be prismatic. In one side of the specimen is a little seam of cupriferous pink prehnite and chlorite.

162. Marked ophite. Mottles about 3-4 mm. One side heavily slickensided with chlorite.

163. Marked ophite. Mottles 3-4 mm.

164. On one side ordinary laumontite. Ophite with mottles perhaps 3-4 mm. Transition can very easily be seen through the doleritic texture which occupies about ⅔ of the specimen. In this the feldspar is much coarser. There are porous irregular blotches filled with epidote and calcite, around which the green appears to be finer, but probably not so. The feldspars are something like 3 mm. long. The augite is still probably coarse. Along the contact between the doleritic texture and the regular ophite there is an unusual amount of chlorite, but there is no sharp line or growing finer of either texture. In fact the augite patches in the doleritic may be seen, but owing to the feldspar they are not so conspicuous. This doleritic streak seems to have been used to divide belts.

Belt 57. 165. Coarse ophite. 3-5 mm.

166. Ophite. 2-3 mm.

167. 2-3 mm.

168. Ophite, with few chloritic amygdules. 2-3 mm.

169. 2-3 mm. A few chloritic amygdules. One shows a fibrous chlorite at the margin, and then solid chlorite at the center. Mainly delessite.

170. 1-2 mm.

171. Fine grained ophite.

172. Fine grained ophite with chloritic spots, probably arranged in flow lines.

173. The parting due to the chloritic spots quite well marked, which probably indicates the flow or direction of dip. Both massive and radiate chlorite occur.

174. Fine grained ophite with few chloritic specks.

175. Fine grained ophite with chloritic coated face.

176. Finer grained trap. Seam coated with chlorite and yellow earth.

177. Fine grained ophite. About 2 mm. mottling. Chlorite seams.

178. Ophite. 2-2½ mm. With chlorite seams and dark color.

179. Ophite. Mottles 2½-3 mm. One face is covered with slickensided chlorite.

180. Marked ophite. 1-2 mm. One face is very finely polished and slickensided. Another is studded with chlorite and calcite in patches.

181. Very dark ophite; patches about 3 mm.

182. Lighter ophite; patches 3-4 mm.

183. Coarse ophite; patches from 4-5 mm.

184. Coarse ophite, with numerous chlorite slickensides; patches 3-5 mm.

185. Distinct ophite; patches 4-5 mm.

186. Ophite with chlorite slickensides. Some very highly polished. The slickensides tend to run together, not exactly, but not far from at right angles to the line of intersection of the planes on which they are. Mottles about 3 mm.

187. Ophite. 2-3 mm. It seems also to be full of secondary quartz, or is it possibly primary olivine? It looks fresh but is a clear, glassy mineral with little specks all through it. On one side there is a heavy chlorite slickenside.

188. Fine grained ophite. Two pieces in this bag which do not match.

189. Fine grained trap with chlorite and calcite seams.

190. Fine grained trap with chlorite and calcite seams.

191. Fine grained trap.

192. Ophite. 1 mm. or so.

193. Fine grained ophite.

194. About the same.

195. Full of chlorite seams; probably 1-2 mm. ophite.

196. Distinctly mottled; about 2 mm. With a few chloritic specks and chlorite slickensided joints.

197. Fine grained ophite.

198. Fine grained ophite with chlorite slickensided joints.

199. Very fine grained trap; feldspar sometimes standing out in some chloritic relief with small chlorite flecks.

200. Fine grained trap with chloritic flecks. Chlorite on one face.

201. Fine grained trap. Perhaps little copper; chlorite flecks.

202. Fine grained trap and occasionally feldspars which stand out in relief, traversed by a seam of calcite. One face is coated with calcite and chlorite.

203. Fine grained, but not entirely dense, with numerous chlorite and a few calcite amygdules coated on two faces with chlorite and calcite. Note how the calcite is separated into concentric layers by red bands and agatoid appearance.

204. Rather fine grained trap with chlorite amygdules.

205. Rather fine grained trap with chloritic seams and blotches to a slight extent, but no well-defined amygdules.

206. Fine grained trap with some chlorite amygdules. This is a trap rather than an amygdaloid.

207. Fine grained trap and chloritic blotches and reddish streaks which may be altered olivine are some what more conspicuous.

208. Very fine grained, dense trap. Reddish brown with chlorite on joint faces. Not particularly striated.

209. Osceola amygdaloid. Gray, decomposed looking; full of calcite in large patches and with poikilitic effect; also epidote; and in spots; there are numerous round, smooth walled amygdules with pink prehnite.

210. Amygdaloid with red fine grained base, and various sized amygdules, smooth walled, coated with chlorite and filled with chlorite, epidote and calcite. Here as generally the epidote and chlorite are early; the calcite and prehnite are late.

Belt 56. 211. Massive fine grained trap. Few small chlorite specks.

212. Fine grained ophite and joints abundantly covered with chlorite.

213. Ophite with heavy slickensided chlorite. Mottles probably about 2 mm.

214. Ophite. Chloritic slickensided joint plane. Mottles about 2½ mm.

215. Ophite. Must have been a little copper on one of the joints, as it has bluish stains. The mottles are 3 mm.

216. Coarsely mottled ophite. 4½ mm. Soft chlorite on joints.

217. Coarse ophite. Not less than 3 mm.—probably much more.

218. Coarse ophite. 4-5 mm.

219 and 220. In here probably about the same.

221. 3-4 mm.

222. Massive ophite with chloritic joints. 4 mm.

223. Well-marked massive ophite, about 3 mm.

224. Finer ophite. 2-3 mm.

225. 2 mm. Chlorite specked in spots.

226. Full of chlorite amygdules, small and at one side greatly altered in epidote with a formation of small cavities lined with crystalline epidote and occasionally filled with calcite. Copper is disseminated in minute quantities.

Belt 55. 227. Common fine grained ophite. Some chlorite spots or amygdules.

228. Fine grained ophite with chloritic amygdules; in one case with some laumontite and a little copper. The laumontite is on seams.

229. Fine grained massive ophite.

230. Amygdaloid. Very much decayed. Full of calcite. Gray with stains of copper.

231. Fine grained. Not very amygdaloidal but full of disseminated epidote, and a hollow amygdaloid showing crystals of epidote or something else.

232. Amygdaloid with unusual chocolate red base and amygdules of epidote or a very light colored chlorite lining, and pink or white calcite centers. This very light chlorite reminds one in color of prehnite.

233. Well-marked brecciated amygdaloid. The fragments and reddish or gray amygdules with chlorite or calcite amygdules are seamed by a matrix of epidote and calcite.

234. Well-marked amygdaloid with reddish or gray ground, the latter made up of grayish white alteration of feldspar being more conspicuous. The amygdules are calcite or light colored chlorite.

235. Amygdaloid. Hard, red and dense base and chlorite or calcite amygdules. Chlorite also occurs on seams.

Belt 54. 236. Distinct ophite. Mottles about 2-3 mm.

237. Massive ophite. Mottles 2 mm. One spot of chlorite amygdaloid. These are likely to occur anywhere in the trap.

238. Well-marked ophite. 3 mm. Slickensided chlorite face.

239. 3-4 mm. Ophite.

240. 2-3 mm. Ophite. One face has a 2 mm. calcite seam; another is heavily coated with slickensided chlorite and calcite.

241. Rather finer grained ophite. 2-3 mm. perhaps. One side is slickensided and coated with chlorite and pink calcite.

242. Fine grained massive ophite. Two pieces.

243. Probably fine grained. All cut up with chlorite seams. Massive trap.

244. Fine grained ophite. 1-2 mm. mottling. One large amygdaloid.

245. Finer grained with numerous small chlorite amygdules and few large calcite amygdules. The matrix is the usual chocolate brown.

246. Fine grained, reddish brown with few large amygdules, showing the first epidote, and about the same time also near the margin of the amygdaloid, a red calcite. This seems to be, however, a little later than the epidote in the interior. There is a clear white calcite much more vigorously effervescent, showing pressure twinning very finely, and then powdered light greenish with chlorite. The contact between the two types of carbonate is very marked.

Belt 53. 247. Two pieces. Fine grained with chlorite on the joints. Slickensided.

248. Fine grained with a reddish band of alteration passing through it, and at one side the surface slickensided and coated with calcite, chlorite and apparently iron oxide.

249. Fine grained trap with few small chlorite amygdules.

250. Dark and fine grained. Chlorite in the joints.

251. Massive, fresh, fine grained ophite. Feldspar not over 1 mm. At one end there are chloritic joints. The mottles certainly less than 1 mm.

252. Very similar. Perhaps 1 mm. mottling.

253. A good deal slickensided with chlorite and calcite. Probably somewhat mottled.

254. Massive, fine grained trap.

255. Decomposed with considerable epidote and chlorite, and fine mottling 1-2 mm. is brought out. There is also some chloritic flecking.

256. Very much altered. Apparently fine grained. Crossed by seam of epidote and one of epidote and calcite. Mass of rock seems to be full of epidote, chlorite and quartz, perhaps also some laumontite.

257. Ophite. 2-3 mm. mottling with chlorite spots and chlorite on seams.

258. Distinct ophite. 3 mm. with chlorite and epidote seams. Also a grayish green calcite and chlorite.

259. Coarse ophite, very heavily slickensided, course of the striations being at right angles to each other.

260. Fine grained ophite. Massive; somewhat reddish.

261. Ophite. 1-3 mm. Rather full of epidote and chlorite.

262. Light gray; much altered, and probably heavily charged with calcite, which also occurs as an earthy encrustation on one face. The mass of the rock appears to be white in laths with red interstices occasionally replaced by green spots.

263. Massive ophite, dark and rather fresh looking outside, and numerous chlorite slickensided faces.

264. Rather coarse and feldspathic. Faintly ophitic with a few chlorite blotches.

265. Fine grained and fresh looking.

266. Several pieces. Reddish; rather fine grained, with some small chlorite spots and fissures several mm. wide full of striated calcite and chlorite.

267. Medium grained trap, with chlorite and calcite on the faces. Mottles perhaps about 2 mm.

268. Fine grained, very red, but the feldspar laths are often conspicuous under the microscope. Apparently quite feldspathic. One seam is coated with chlorite.

269. Very similar to 268.

270. Probably somewhat mottled. 2-3 mm. Reddish with chlorite on seams.

271. Shows contact between the red, not distinctly mottled ophite and a seam of the doleritic type, with coarse feldspar 3 mm. long, coarse chlorite blotches, and apparently everything coarser.

272. Mottled 2-3 mm., probably with blotches of calcite and chlorite.

273. Apparently fine grained, massive, dark brownish trap with only occasional amygdules of chlorite.

274. Very like 273. Two pieces.

275. About similar to 274 in general ground mass, but there are well-marked banded amygdules, generally whitish at the circumference and light green at the center. There appears to be no epidote. The center may be altered prehnite. Hardness is about 4.

276. Rather fine grained reddish trap, and red specks which may be altered olivine are rather conspicuous.

277. Reddish fine grained ophite with a few chlorite amygdules.

278. Reddish, fine grained ophite with slickensided chlorite on the irregular joints.

279. Reddish trap with faint mottling, if any.

280. Massive trap, rather fine grained, with occasional small amygdules.

281. Rather fine grained with small chlorite blotches, and on the joint faces, laumontite and chlorite.

282. Rather fine grained with disseminated chlorite and laumontite and chlorite on the joints.

283. Well-marked amygdaloid. Reddish chocolate fragments. Small white amygdules and irregular filling of epidote, red calcite and white calcite.

284. Also well marked amygdaloid, with fine grained chocolate base. Disseminated chlorite and epidote, and red and white calcite in irregular fissures.

285. Same. Well developed.

Belt 52. 286. Same. Calcite shows pressure twinning very finely.

287. Fine grained trap; massive. Reddish alteration line.

288. Rather fine grained ophite. Calcite and chlorite on joint plane.

289. Massive ophite about 2 mm.

290. Dark, fine grained trap. Probably faintly mottled.

291. Ophite. 2-3 mm.

292. Ophite, with a decomposed seam, calcite and a little copper, chlorite. Mottles 3-4 mm?

293. Ophite with a heavy seam of slickensided chlorite. Mottles 3 mm.

294. Ophite, well-marked; massive. Mottles 3 mm.

295. Mottled 3-4 mm. More or less altered reddish and with heavy slickensided chlorite on seam.

296. Well-marked ophite; chlorite on seams. Mottling about 3 mm.

297. Well-marked ophite. Mottling 2-3 mm.

298. Well-marked ophite. Mottling 2-3 mm. One amygdule. One end reddish altered.

299. Massive ophite. Mottling about 2 mm. Some laumontite and calcite on seam.

300. None.

301. Rather fine grained ophite. 1-2 mm., with some chlorite and calcite on seams.

302. Fine grained ophite about 1 mm., with some blotches of chlorite; fairly distinct amygdules, also laumontite and a little copper on the joint face.

Belt 51. 303. Fine grained and a good deal crushed. Full of slickensides covered with chlorite and laumontite.

304. Probably all a piece of one pebble in conglomerate, though about 12 mm. long and fairly coarse grained rock composed of oligoclase and orthoclase and quartz. Somewhat patchy. Probably belongs to the augite syenite family. The joint is coated with calcite and there are copper stains.

305. Calumet conglomerate. Pebbles of quartz porphyry and red base, and quartz crystals several mm. across, and feldspar up to 20 mm. Orthoclase. Little stains of copper can even be seen in the quartz in the small fissures traversing the seam. The matrix consists of a red feldspar which comes next the pebble and in the little seams of the same. This is often a brighter red than the felsite matrix. The very margin of the feldspar is often bleached and it appears to have passed into a granular, secondary aggregate. Separated in most cases from the pebbles by a red zone around areas of calcite and in this copper often occurs. Besides the felsite there is at least one pebble which appears to be of the common amygdaloid, gray with calcite filling. Calcite shows pressure twinning.

306. Same as 305 with rather more matrix. One of the felsites with a darker base shows marked oligoclase phenocrysts. There is also a pebble with quartz and oligoclase phenocrysts and a rhyolitic ground. Probably some other crystals besides. In one case they seem to be replaced by epidote, which seems to line several open pores, though not apparently abundant on the rock as a whole. One green streak of carbonate of copper.