

REPORT
OF THE
STATE BOARD OF GEOLOGICAL SURVEY
OF MICHIGAN
FOR THE YEAR 1906

ALFRED C. LANE
STATE GEOLOGIST
SEPTEMBER 10, 1907.

BY AUTHORITY

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EIGHTH ANNUAL REPORT
OF THE
STATE GEOLOGIST
ALFRED C. LANE
TO THE
BOARD OF GEOLOGICAL SURVEY
FOR THE YEAR 1906
ACCOMPANYING THE PRECEDING PAPERS.

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OFFICE OF THE STATE GEOLOGIST,
LANSING, MICHIGAN, Nov. 14, 1906.

*To the Honorable the Board of Geological Survey of the
State of Michigan:*

HON. F. M. WARNER, *President*.
HON. W. J. MCKONE.
HON. P. H. KELLEY, *Secretary*.

Gentlemen—I beg to submit my report for the fiscal year July 1, 1905, to June 30, 1906, inclusive, and for the field season of 1906.

The following is the usual statement of expenditures from the annual appropriation:

FINANCES.

FINANCES.				
	Salaries.	Field.	Office.	Total.
July	\$595 50	\$154 09	\$48 62	\$798 21
August	667 50	351 27	93 68	1,112 45
September	463 32	80 73	29 61	573 66
October	388 59	122 09	53 90	564 49
November	373 67	22 09	44 23	439 99
December	438 50	17 01	18 80	474 31
January	392 20	97 81	52 80	542 81
February	603 84	42 04	37 81	683 69
March	392 20	66 15	239 58	697 93
April	384 80	27 74	269 35	681 89
May	370 40	35 02	64 36	469 78
June	612 06	318 19	130 54	960 79
	\$5,682 49	\$1,234 23	\$1,083 28	\$8,000 00

In addition to this we had: For the year 1905-6, to be used in the topographical survey through the United States Geological Survey \$2,000 00
Of this there was expended in the survey of the Marquette quadrangle 1,683 79

Concerning the value of this see letter below.

The balance, together with \$3,000 for 1906-7, is being expended in Oakland and Livingston counties—Rochester, Pontiac, Milford and Howell quadrangles.

The appropriation for biological survey, Act 250, Session 1905, was expended as follows:

To C. A. Davis, for botanical work in connection with a study of peat producing plants of the bogs, including all his expenses in accompanying Prof. Russell in the Upper Peninsula	\$1,000 00
To T. L. Hankinson and his assistants, under the direction of Prof. J. G. Reighard, in a survey of the fauna and flora of Walnut Lake, Oakland County, with especial regard to the food habits of the Whitefish	1,000 00
Of publication funds there remains for reprinting reports— not enough to do anything	93 27

Our annual reports now come out of the general fund and there is no special provision for continuing the series of green volumes.

PUBLICATIONS.

On the new system, practically the sole publication of the Board is its annual report. The report for 1905 which should be out in November, 1906, will therefore be almost double the size of its predecessors— a book of some 600 pages. Besides my personal report it contains a report of the University expedition to Isle Royale and the Porcupines, W. F. Cooper's report on Bay County with valuable maps showing thickness of the drift, and the report of Bryant Walker on the land snails of the State.

We have also issued a good many copies of the small geological map of the State for which there is a steady demand. We have given this away one at a time. But as it is used in teaching, when enough to supply a whole class is asked, it seems fairer to ask cost price. The money thus received, however, goes into the general fund.

Of the Joint Topographic Survey a small provisional edition of the Marquette sheet in black and white for the use of engineers has been issued. The Dexter, South Lyon, Saline, Ypsilanti, Wayne, Detroit, Wyandotte, Romulus and Grosse Point sheets have also been issued.

I also prepared for the Lake Superior Mining Institute a brief description of the geology of Keweenaw Point with a general map,¹ reprints of which I have found of value in distributing to enquirers.

The reports by Robert E. Horton to the Michigan Engineering Society of the State, on water power, and various publications of the United States Geological Survey referred to later, will also afford valuable information to the seeker and are to be obtained from the United States Geological Survey at Washington, D. C.

¹Printed in Vol. XII of their transactions.

WORK PRACTICALLY READY FOR PUBLICATION.

Your annual report for 1906 will also be a considerable volume, and it may contain at least the following reports:

1. The report of Prof. I. C. Russell on the surface geology of the Iron Mountain district, a posthumous report and perhaps the last which will appear from that able and interesting writer.
2. The report of C. A. Davis on peat and the peat producing flora.

This report not only gives a concise summary of the state of the peat industry and its prospects in the State, but describes a new variety of peat of great interest in connection with the origin of coal. It also emphasizes several new or little regarded facts, that peat will absorb

up to 15 per cent, of moisture, even when under cover, and therefore need not be dried below that point, that the sphagnum moss is not the principal ingredient of peat, but that the moss creeps over the already nearly filled up bog, etc.

3. The report of W. C. Gordon on the Black River section of the Keweenaw rocks north of Bessemer, with some additions by myself in the way of general correlation, calling attention to a region of copper bearing rocks hardly at all explored.

4. Prof. Hankinson's report on the biological survey of Walnut Lake, Sherzer's report on Wayne County, Davis' report on Tuscola County, Grabau's on the Traverse limestone, Gregory's on Arenac County, and Prof. Ries' on moulding sands; also Kaufmann's report on the fleshy fungi (mushrooms), are in a more or less advanced state of preparation, and represent the work of the year in greater or less part.

CO-OPERATION.

As far as possible I have tried to work hand in hand with the agencies and individuals who are studying the resources of the State scientifically.

A list of these may serve as a useful guide to those places in the literature where information regarding Michigan may be found.

The United States Department of Agriculture under Milton Whitney has been making a soil survey of Cass County, and have issued a soil map of the Oxford area.

The Topographic Survey, under A. M. Walker has practically finished the Rochester and Pontiac sheets, and made a start on the Milford and Howell sheets.

With the Hydrographic Division in various branches there has been exchange of information, especially with Mr. Frank Leverett, in getting out a series of water supply papers to replace Nos. 30 and 31 by A. C. Lane, now entirely out of print. No. 160 on the water supply of the region north of Lake Michigan is out. Nos. 182 and 183 on the Lower Peninsula will soon appear.

We have also taken up the collection of well records which the United States Geological Survey for lack of funds has been compelled to drop.

I have done all I could to help Prof. C. A. Palache, who prepared an erudite study of calcites for Volume VI of your reports, in his further studies¹ for the United States Geological Survey.

We have tried to keep informed of our work the Detroit Engineering Society, the Michigan Engineering Society, the Lake Superior Mining Institute, the Michigan Academy of Sciences, the Pioneer and Historical Society, etc.²

¹A note on quartz from Hancock recently appeared in the Neues Jahrbuch. BB 13, p. 155.

²In many cases we have reprints of their papers for general distribution.

The State of Illinois has recently revised its Geological Survey, appropriating therefor \$25,000 per annum, and at the invitation of the newly appointed State Geologist, J. Foster Bain, a meeting of the State Geologists of the Mississippi Valley was called to consider topics of common interest, such as common names, relations to the Federal Survey, etc.

Informal co-operation with the University, Agricultural College and College of Mines is always in progress. The biological survey has been largely conducted by and under the University teachers of botany and zoology.

The main co-operation with the College of Mines has been in connection with Pres. McNair's interesting tests of the weight of the earth. A pendulum swung at the bottom of one of the deep shafts has a notably different rate owing to the less force of gravity, nearly 5,000 feet of the earth's crust being above it. If we know the exact weight and shape of the crust immediately above the pendulum, we can from its lessened rate of vibration infer what the density and weight of the whole may be. I have helped in the needful examination of the rocks, and Mr. A. H. Meuche is preparing a contour map of the surface of the adjacent country. Both pieces of work have geological value independent of Mr. McNair's researches.

Analyses have been made for us at the various State institutions under the same arrangements that have heretofore prevailed. They mainly find their fit place in special reports—those of W. F. Cooper and others.

A number of tests of mine waters and other brines are to be incorporated in a bulletin I am preparing on that subject. Some preliminary notes were read before the Geological Society of America and appeared in the *Journal of Geology*.¹

We may, in some cases, be able to date our rocks by the character of the water contained.²

¹XIV, 3, April, 1906, p. 221.

²Further notes on this subject appeared in the *Portage Lake Mining Gazette*, March 3, 1905. Trans. Lake Superior Mining Institute, Vol. XII.

WORK OF THE SURVEY.

During the past year Mr. W. F. Cooper has been mainly employed getting out his Bay County report, and quite largely in editorial work, indexing, etc., on the annual report for 1905. But there has also been time to compile deep well records, etc.

Mr. W. C. Gordon nearly finished his report on the Black River section, and then resigned to take a position with the Oliver Iron Mining Co., leaving me to add a little on the intrusives and iron bearing rock.

Mr. A. H. Meuche was appointed in his place, and continued contour work around Calumet, with the assistance of Mr. Leon Meuche, and work on copper country sections.

Prof. C. A. Davis has continued the study of the surface deposits of the Upper Peninsula to the broken but intensely interesting region of the Huron Mountains, upon which the ice sheet which crept down from the Labrador Highlands over the Lake Superior basin seems barely to have lapped. I may note that he finds that, owing to less evaporation probably, light sandy soils seem to do unusually well in the Upper Peninsula, and support hardwood timber.

While there is, as we have seen, a large demand for the map of the surface geology of the State, there is even a larger demand from teachers of physical geography from the Agricultural Department and from numerous private sources, for the map of the surface geology of the State upon which Prof. Davis is at work. In fact we should not wait for the completion of the whole State, but get out sheets as far and as fast as possible. The work of preparation of these have been in the hands of Mr. J. F. Nellist, who informs me that he will soon be ready to send to press, but has been delayed by a variety of circumstances.

GOLD.

But Prof. Davis' studies also have bearing in my mind on the development of our gold resources. When we know just how and in what direction the ice moved over the State we can tell in what direction we are most likely to find in the gravel the gold of the gold quartz veins known to exist, and vice versa may be able from the results of panning to trace gold to its source. Mr. W. M. Courtis, A. I. M. E., of Detroit, has prepared the following summary for us. His plan of campaign commends itself to follow Prof. Davis' studies.

I have inserted one or two places in his list.

GOLD IN MICHIGAN.

BY W. M. COURTIS.

Dear Sir:—

At your request I am sending you a list of the newspaper clippings I have in regard to gold discoveries in Michigan, both quartz and placers or gold in gravel.

The little map shows places where reports say gold has been found in the gravel. Some of these I have authenticated myself, washing out the particles of gold. In two cases, Ionia and Hillsdale, found not substantiated, I found in the former place what appeared a large nugget taken from 20 feet down in a well. By my test it proved to be brass, and history shows a building burnt down here many years before, probably melting some brass, which gradually sunk through the fine sand there.

At Hillsdale, in digging a ditch bright flakes were found that looked like gold dust. Tests on these showed that they were brass filings that had been washed down from some workshop and in high water had been spread along the small creek bars. Many of the gold quartz

finds when looked up proved to be pieces of float quartz and when not wilful swindle were float ore from up the lake country as native copper was also found in these deep gravel beds.

At Lowell and along the Grand River there is gold in a certain channel that crosses the river near this place. This gravel is composed of a different kind of pebbles from the gravel found in the high banks along the river which rise in some places two or three hundred feet above. The gold in the Grand River begins at Maple River and was found down to Ada Creek and probably down to the lake, no gold being found in the most favorable bars above the former place.

These high bluffs are stratified in some places, at others irregular deposits. None of these strata would pan gold even taking the ferruginous seams, the most promising, except in the lower seams a few colors were found.

The gravel in the old river channel seems sufficiently rich to work with dredges in some parts where the land is not too valuable and as this old channel apparently comes from the northwest, it is worth looking into by the Geological Survey, as its course may be found and prove rich on bed rock. There seemed to be a steady increase in the colors of gold as depth is gained—pans running from four to thirty colors. The total average of all our tests was about three cents per cubic yard, though very little digging was done, only taking up the mussels and panning the gravel. The estimate of three cents included all the barren dirt that was tested, barren gravel that overlays the old bed and is not any criterion of what the river channel would run, which should be tested with six holes. The gold was much coarser than I would suspect, some of it being like mustard seed.

I thought it had been "salted" but I walked out a rod or two from the shore, dug up the mussels and alone washed the dirt. Here I got but one to four colors to the pan. This gravel contains a large amount of black, magnetic sand, iron, garnets, zircons and is analogous to those deposits worked in Russia which in their richest parts yield from two to four dollars per cubic yard.

The following is a list of the places where gold is said to have been found in the gravel:

Washed by myself.

Maple River, Ionia County.
Lowell, Kent County.
Ada Creek, Kent County.
Grand River, below Lyons, Ionia County.
Flat River, Ontonagon County.
Iron River.
Ishpeming, Marquette County.

Reported discoveries.

Ionia and Hillsdale (brass mistaken for gold)
Birmingham, Oakland County.
Union City Branch, to the S. E. and S. W. (?).
Marcellus, St. Joseph County.
Burr Oak, St. Joseph County (pyrites likely).

Grand Haven, Ottawa County.
Allegan, Allegan County.
Greenville, Montcalm County.
Howard City, Montcalm County.
County Line, Newaygo County.
Muskegon River, Newaygo County.
Whitehall, Oceana County.
White River, Oceana County.
Elbridge, Hart, June 7, 1906.
Little Sable River, Manistee County.
West Summit, Wexford County.
Manistee River, Manistee and Wexford Counties.
Walton, Kalkaska County.
Rapid River, Kalkaska, Kalkaska County.
Leelanau County, near Lake.
Antrim County, same river (nuggets, reliable).
Boyne River, Charlevoix County.
Little Traverse, Emmet County.
Victoria Copper Mine (large nugget).
Ishpeming district, near gold mines, perhaps good placers.

The following places were reported but believed to be only pyrites:

Cheboygan, Cheboygan County.¹
Alpena, Presque Isle County.¹
Caseville, Genesee County.¹
Flushing, Genesee County.¹
Caro, Tuscola County.¹
Near Fargo, St. Clair County.
T. 8 N., R. 14 E., (\$6.00 a ton?)
N. E. ½ S. E. ¼ Sec. 33, T. 49 N., R. 42 W., Tr. Au.
15c Ag.

It can easily be seen how many places report the discovery of gold in the gravel, and if it should be proved it came from an old channel, also why some of the tests have failed in the same district.

It is certainly worth the expense to test the gravels at different points on the west side of Michigan. If the testing were successful, and it seems certain it will be, as some of the finds were by men who understood placer washing, and in one place in Antrim County, quite large nuggets were gotten from the gravel by an experienced man who intended to have gone back the following summer but died during the winter. He had told one of the wealthy pine lands men, who asked me if it were possible but did not know the exact stream where the find had been made.

A systematic examination of the river would soon plot out the source and course of the river. A party of six men with a camp outfit and light star drill rig on wheels with two mining students who would work for their expenses and experience, and keep records, would do a great deal of work in one summer and perhaps all that would be necessary to start up a new industry which would repay the State many times the outlay.

Having laid out such work in San Domingo, where I surveyed the gold field of Mont Pueblo, Columbus' gold

field (though he got most of his gold robbing the graves), I learned how quickly it could be done.

It was finished much quicker than estimated for each river being platted as barren or gold bearing, the district was soon surrounded and measured out.

A rocker, small sluice box with balances and blowpipe outfit, measuring box for fraction of a cubic yard made our kit.

A jointed hand drill of gas pipe with auger end fifty feet long in five foot lengths with movable handle costing about \$15.00 is very convenient for determining the depth of clay, sand or marl.

The information would be useful in other ways as determining beds of clay, marl or bog ore that might be met with and the character of the surface gravel with their depth. The survey could begin at Lowell in early spring, working north with warm weather and south again from Lowell in the fall.

Very truly yours,
W. M. COURTIS.

(Signed.)

P. S. Also on lands south of the Gogebic iron fields.

Have assayed many ores from N. M. (North Michigan), which carry gold up to \$250, not at Ishpeming.

Ishpeming ore sample ran into thousands—\$2.99.
Average 50 tons.

¹Iron pyrites, examined.

At Williamston, Ingham County, Mr. Taylor found a little nugget at bed rock. Mr. Jas. B. Seager reports having washed as many as 20 colors to a pan in the Huron Mountains, where most of the drift is very local, while tests I made of Lake Superior sands gave no visible result.

LAURENTIAN.

These were made in the course of a brief visit to the Keewatin-Laurentian areas north of Marquette, meeting Prof. Davis and E. R. Downing and looking over their results.

The results of my studies of the Keewatin-Laurentian agree so closely with those of another working geologist on the other hemisphere that I am tempted to quote, verbatim but condensing, as my own experience, the words of F. P. Mennell in the Geological Magazine for June, 1906 (p. 255):

"The great granite masses," like those north and south of the Marquette range, "as a rule indicate anticlinal or domelike structures" and "the relative distances of the different rocks from the granites may be taken as one of the chief aids in determining the succession." Any indication, however, of marked transgression on the part of the igneous rock prevents such a criterion being relied on. Metamorphosed igneous intrusions figuring amongst the schists"—the greenstone schists and

amphibolites for instance—"may behave as rocks of any date earlier than their real period of formation. Their intrusive character has to be inferred from (1) petrological character, (2) unexpected appearances among the old sediments, (3) traces of central action, (4) absence of pebbles from them in conglomerate beds." "Very few developments fail to show important conglomerate beds" "invaluable as datum lines." "Their pebbles afford important evidence of their age." "At their roots granite masses do not show those features which we have learned to regard as characteristic of intrusion where we have seen them invading normal sediments. Actual dikes do not extend far from the main mass of the rock. The characteristic feature of this invasion of crystalline schists is in fact the production of lit-par-lit injection." "The off shoots from the deep seated portions must corrode their way into the surrounding rocks or insinuate their material between their laminas. The last process is the usual one and even the few large dikes that are seen are mere feeders by which the injection is carried on, and which soon became exhausted in their process."

They therefore scarcely ever extend beyond the zone of injection "lit-par-lit."

CALCIFEROUS.

I also visited near Marquette, the Upper Peninsula Experiment Station, intelligently presided over by Mr. L. Geismar.

The United States Department of Agriculture have recently made a soil map of this area with his aid. The station is situated on a number of terraces where the bed rock conies close to the surface.

This bed rock is on the Calciferous formation, which for Michigan may be conceived as taking its locality name from Calciferous station of the Marquette & Southeastern R. R., outcropping also extensively at Eben, the junction with the Chicago & Northwestern R. R. and extending from the Lake Superior sandstone below up to the St. Peter sandstone, or an unconformity where the St. Peter sandstone should be, above which comes the well marked "Trenton," Ordovician or lower Silurian fossils. It is represented by the beds about 404 to 642 feet in the Gladstone well, from about 320 to 550 at Marinette, and probably from 280 to 630 feet in the Rapid River well, being thus about 230 feet thick. According to Rominger the Calciferous is "Cambrian-Primordial."

In connection with this Calciferous lime-bearing formation it is interesting to note that Mr. L. Geismar informs me that over it the soil is much better than over the Lake Superior sandstones which lie outside it, and Mr. Harris, the intelligent and wide awake manager of the Marquette & Southeastern R. R. changed the preliminary location of a spur of that line several miles to the south at Mr. Geismar's suggestion upon examining a

geological map of the State, in order to bring it into the region of a better land.

BAYPORT LIMESTONE.

Another term which has come up for definition has been the Upper Grand Rapids. The United States Geological Survey objected to my using the Ohio term, Maxville, on the ground that its equivalence with the Upper Grand Rapids has not been proved, though I know no respect in which they can be seen to differ, and suggested that I had already used the term Bayport limestone, which indeed I had, as a commercial and local term applied to the well-known and valuable quarries without really meaning thereby to introduce formally a new geologic term, a thing I am slow to do. But as they rather insisted, the term Bayport may be used for that upper part of the Grand Rapids characterized by the predominance of light colored high grade limestone (90% CaCO₃) and white sandstone, and freedom from gypsum and much shale.

It includes the upper 60 feet of the Huron County and South Bay City sections, and about the same thickness at Saginaw.¹

¹At East Saginaw 399 - 451 = 52 feet; at Plate Glass Works 550 - 625 = 75 feet; at Mt. Pleasant 970 - 1,020 = 50 feet. See Volume VIII, Part II, Plate I, pp. 12, 13, 97, 98, 112, 213-215.

EARTHQUAKES.

For some time there have been earth disturbances in the copper country, of which exaggerated sensational reports have been wired abroad. Few (see report Peter Dawe, Mine Inspector, Houghton County), have been hurt thereby, and in fact the shocks are often less noticeable in the mines than on the surface. Still they have for some time been felt at a distance of several miles from any mining, indeed, perhaps, outside the copper country. There was a notable shake, breaking window glass in Calumet, in August, 1905, upsetting bottles in Dr. W. S. Whislers' office on the north wall but not on the west, so that I got some idea of its direction. At that time, following a hint of Mr. McNaughton, I put a pencil in a dish of sand in the basement vault of the Geological Survey building (125 East street, Houghton), which was upset February 8, 1905, to S. 30° E. This shock was also felt at Calumet but was not so severe as the previous August. Other shocks occurred April 18-20, and on May 26 it was again upset away from the Atlantic mine lode in section 9, the South Pewabic lode, which at that time was closed and went out of commission. The tracks crossing the lode were buckled so as to indicate a shortening of some six feet and while there was some indication of tension further back from the mine I failed to find as much stretching as compression. It may, however, have been diffused. There are three theories in explanation.

First, that the shakes are purely local, due to the yielding of pillars and caving in of huge masses of rocks overhanging the mines, only a fraction of an inch, however, at a shock.

Secondly, that these waves are set off by shocks from some distant point.

Thirdly, that there is really a state of compression and unrest in the rocks of the copper country, while mining operations have provided lines of weakness along which it relieves itself. One side of the copper range is bounded by a famous old break or fault, and the country around the Great Lakes is known to be tilting.

On this matter there was a lively discussion at the Lake Superior Mining Institute meeting in August, 1906. I do not see how there can be any settling of the question definitely until we have installed near the copper country, at Marquette or Calumet or Houghton, a modern instrument for the careful record of earth waves (seismograph). The United States Weather Bureau is installing a number of such instruments in their stations, but only where the Federal Government owns the building, and I would earnestly recommend that all those interested join with me in doing what we can to secure the location of at least two such instruments in the Upper Peninsula.

We may note that in the iron country there are immense caves which alter the whole appearance of nature, to which anything in the copper country is not a circumstance. Nor is the Lower Peninsula exempt. Complaint is already made of settling over coal mines beneath Saginaw and Bay City, and the salt caverns at Manistee are already said to be causing settling there and breakage of water mains. We may expect to see the same thing along Detroit and St. Clair rivers, and anywhere where salt is made, not by pumping an already existing brine, but by pumping down water on rock salt and dissolving it out. It do not know whether it would be worth while to have the water mains of South Detroit with elastic joints yet.

My personal work, besides the executive routine of answering letters, writing and editing reports, in which I have been helped by Mr. Cooper, and the papers on the work of the Survey for the various State societies, has been mainly in the study of the grain of rocks, the composition of mine waters, the origin and distribution of copper in connection therewith, and especially the examination of samples variously located.

MOULDING SAND.

In my annual report for 1902 there were some comments on moulding sands. In the course of a preliminary investigation it seemed to me curious and perhaps needless that so many foundries should go way out of the State to the Ohio River for their moulding sand, while others found a supply nearer by. It seemed fitting therefore, to employ a special expert, Prof. H. Ries, of Cornell University, to investigate the matter for a few weeks and report upon the distribution of such sands at a cost not to exceed \$500.

CLAY.

Samples of surface clays from the Sault to the southern line have generally proved to be calcareous, though often very fine and gritless, approaching in character a slip clay. The ordinary Michigan surface clay is about one-fourth limestone flour. Such a clay from near Cheboygan, sent by A. M. Gerow, is said, however, to make a good material for art pottery, and shale clays near Grand Ledge, Omer, Turner and Cheboygan, are, I understand, to be further exploited for paving brick, etc.

WATER.

Our work on waters will be found largely in the water supply papers of the United States Geological Survey Nos. 160, 182 and 183. The subject of mine waters will make a special report. I published a preliminary article on it in the Portage Lake Mining Gazette, March 8, 1906, to be reprinted in the Lake Superior Mining Institute proceedings, and also an abstract of a paper at Ottawa, in the Journal of Geology, 1906, p. 221.

Besides advancing the rock salt developments around Alpena, we have made a number of visits to the rock salt shaft at Oakwood, where E. F. Bradt and Mr. Luke have been pluckily fighting their way against very great obstacles. The shaft is now down over 300 feet and the rock is less likely to be creviced as the work proceeds.

In the exploitation of mineral and other waters it is becoming more and more common to consult this office. Among the wells of exceptional interest are:

(1). One at Grand Lake near Alpena, by F. B. Preston, giving a section from the Bell shale the base of the Traverse down into the Salina. Alpena with its wealth of salt and suitable limestone at hand to shipping facilities is, as I have said, an ideal place for the manufacture of soda.

(2). A group at the Saginaw Plate Glass Works, and one at the Saginaw High School, which give us a better set of samples than we have had before.

This last well is interesting since it is for salt baths, a great preventive of cold after exercise or manual

training. There is not a town in Lower Michigan that could not have salt baths if they chose.

Pamphlets on the water supply of Ann Arbor, by Prof. I. C. Russell and W. H. Sherzer have appeared recently and Battle Creek still discusses the advisability of using artesian wells. The experience of Bay City and the Green Bay towns indicates the inadvisability of using surface waters, even of the Great Lakes, without adequate filtration. Regarding the use of artesian wells, referring to the water supply papers 182 and 183 for details, I would emphasize two points. First, they will practically always be hard and charged with carbonates so as to attack pipes. Second, they will always flow more at the beginning than later, their permanent flow being determined by the porosity of the rock, and the area of the drainage basin. The old well points will clog with lime, and with the growth of the cities, new wells will be required. This has been true this past year at Lansing and Owosso. It is from a geological point of view a decided advantage to scatter these wells so that they will not interfere with each other so much. This can be readily done by using electrically driven pumps such as the one used at Houghton.

COAL.

The usual development of coal fields within the coal basin has gone on, and—in spite of what geological reports show—also in the Devonian black shales. I wish especially to record and commend the courtesy of those who remembered to write me that I was right in my forecasts, even the unfavorable, and send records of their work. Every drilled well record is of geological interest, and is likely to throw light on valuable deposits of shale and limestone, and on the water possibilities if nothing else. Reports of 11 foot coal seams and of anthracite have never proved reliable. The only new work concerning which I am in doubt is near Cadillac. There, coal has been reported a few miles outside the coal basin as mapped, and as the whole region is covered with drift with no outcrops the map may be in error, though the reports are certainly premature.

OIL.

The development of the Port Huron field by new wells of modest yield goes on. The report of a development of a paying field of oil on Manitoulin Island has naturally led to the exploration of the country south of Sault Ste. Marie of similar geological structure.

The first well close to Pickford is at this writing down some 800 feet, having struck an artesian flow at 600 feet.

SAND LIME BRICK.

This has become an established industry and the use of the bricks is spreading. There are, counting some failures, 16 plants in the State. The difficulties have been in maintaining even quality and size, and securing also even pressure on each brick. But practice is making perfect. At the Manistee plant 94 per cent sand and 6 per cent quick lime is used. The brick are steamed at 125 pounds steam pressure. The sand is improved by being ground in a tube mill with French pebbles, thus giving a greater variety in size and permitting closer packing. About 25 per cent will pass 100 mesh sieve, 50 per cent a 75 mesh sieve, all a 20 mesh sieve. The pressure per brick is 150 tons, and the resulting brick has a crushing strength of 2,000-3,000 pounds per square inch and 8 per cent. absorption. They sell at \$6.00 per thousand.

In regard to crushing the sand, I have had sent in from Ypsilanti, from L. C. Holden at Sault Ste. Marie and other places, samples often taken for clay which proved to be merely fine sand, such as would do very well to mix with coarser sand to make a less porous brick.

WINCHELL NOTES.

I received this year from Prof. N. H. Winchell, a ledger containing a copy of the notes of work which he did for your Board in 1869. Owing presumably to the fact that his brother soon after ceased to direct the Survey none of that work was published, though quite a little of it is still of value, and should be issued. It includes observations on the Lake Michigan and Green Bay shores, around Alpena and down the Au Sable.

EXAMINATION OF SPECIMENS.

The examination of specimens from wells arid otherwise is becoming more and more important. It is customary for all geological surveys to name gratis all specimens sent them—not going into complete and expensive examination, the cost of which should be paid by the one benefitted, but such an opinion as an experienced man may give in a few moments, as to whether a sample is likely to have value and if so what kind of examination should be given to it, thus saving useless expense to those perhaps ill able to afford it. Especially since the time of C. E. Wright has the Survey taken pains to collect samples from churn drills, and records of such borings for oil, gas, salt or salt water, coal, etc.

On the other hand where mining companies desire we examine extensive suites of the cylindrical rock cores extracted by the diamond drill. It is often more convenient for both parties, for them to pay my expenses to visit the cores as our Houghton office is crowded. In fact, I have examined the past year the cores from over 20,000 feet of drilling already and this has been the

largest piece of work of the kind I have had. It is a pity that we have not better accommodations for them, for there are thousands of feet of drill cores costing tens, perhaps hundreds of thousands of dollars, stored in temporary wooden buildings scattered over the Upper Peninsula, of very great scientific as well as practical value, exposed to great fire risks, often in damp places so that the boxes rot and can hardly be handled, and where the cores coat with mold so that they can scarcely be recognized, which would, as appears from letters submitted, be freely donated to the State and to science if we only had any place to take care of them. I would earnestly plead for a fireproof building of concrete and steel for their preservation, a stone library for a library of stone.

Not only the smaller companies but the larger companies such as the Quincy, the Keweenaw and others would be glad to send cores which have cost thousands of dollars to such a place for examination and preservation, as will appear from letters which I submit to you. To try to keep pace with the exploring done by the great iron companies is, however, so large a task that the money needed would be out of the question. And besides, these great companies employ able geologists for their exclusive service.

There is no work of the Survey that pays the State better, besides being of direct benefit to the individual, even though there is no printed work to show for it, than information leading to judicious exploration. Fruitless exploration is a waste of labor. More than that it may give a region an undeservedly bad name. When Mr. Jas. McNaughton, manager of the Calumet & Hecla Mining Co., writes: "Your advice," based on the study of the grain of some drill cores, "was valuable inasmuch as we at once found the lode and at practically the distance from the shaft which you indicated, for which we are exceedingly obliged," it justifies the time I have spent on the study of the grain of the traps of Keweenaw Point.

BIOLOGICAL SURVEY.

This seems to me to have started off remarkably well with the modest means at hand. The first paper, the only one published, that of C. C. Adams and others of the University expedition to Isle Royale and the Porcupines is already in good demand.

At this writing Walker's paper on the snails of the State is printed but not bound.

The extensive peat report already mentioned as ready for the printer, is needed, judging from the inquiries for information.

The work this summer under the direction of Prof. Reighard, by Prof. T. L. Hankinson and his assistants, Elmer McDonald and E. L. Michael, bids fair to tell us under what conditions whitefish will thrive in deep, cold ponds, like many of our marl lakes, where the water is kept aerated and in circulation by bottom springs and so capable of supporting the proper fish food as well as the

fish themselves. Assistance has also been had from Prof. J. G. Needham, of Lake Forest University, who made a short stay, Prof. N. H. Harvey, of Ypsilanti, Prof. W. B. Barrows, of the Michigan Agricultural College, and numerous other members of the biological department of the University, and Dr. John F. Eastwood, of the medical chemical laboratory. A careful map of the lake was prepared by A. Adams, of the civil engineering department of the University.

JOINT TOPOGRAPHIC SURVEY.

The Joint Topographic Survey does not extend as far as its usefulness would. The Marquette sheet, though as yet only issued in a not very clear black and white edition has been of value: to the scientific departments of the Normal school, as witnessed by a letter from Prof. Downing; to the city of Marquette as witnessed by letters from J. E. Sherman, chairman of the Electric Light and Water Board; and to engineers generally, as witnessed by the following letter of J. E. Jopling, chief engineer of the Cleveland-Cliffs Co., which suggests some of its uses:

Ishpeming, Nov. 1, 1906.

Dr. Alfred C. Lane, State Geologist, Lansing, Michigan:

Dear Sir:—The work so far accomplished by the State Geologist and through the cooperation of the United States Government has resulted in a topographic sheet covering Marquette and its vicinity. The topographer in charge of the work, Mr. Whitman, has taken great pains in doing the work accurately and has made us a map which we as engineers have found extremely useful in many ways. During the past summer the opportunity has arisen to check a good deal of this work by means of surveys for different projects, and it is with pleasure that we can state that the work so far carried on has been of great use and our only wish is that it could be extended throughout the county.

The work above alluded to was in connection with protective improvements of the company's water power in the neighborhood of Marquette, and it has occurred to me that for this industry alone the State would largely benefit from an extended survey over a large part of this territory.

Another instance in which the map is very useful is the new location of wagon roads, as before the work of improving existing roads is undertaken it would always be well to ascertain if a better route is not obtainable, which can be determined very often by the use of the topographic map.

The development of the mining resources of northern Michigan could well be helped by a map, as we have always found that business men as well as engineers continually refer to these maps in talking over mining projects.

In case it should be determined to extend the survey in Marquette county, part of the information which large

holdings have obtained in the way of correct levelling and location of township and section corners might be used. The men connected with these enterprises have expressed their view of the subject to me and I feel sure that their cooperation can be relied upon. Some of this information is so extensive that the State could be saved the expense over several square miles, leaving the appropriation to cover a still larger area.

Such topographic maps are almost useless in a rough and uncultivated country such as is to be found in a good deal of this district without the true location of the section corners. You will remember that on the Marquette sheet, Mr. Whitman connected his work with these corners, although it had not been customary to do so.

Very truly yours,
(Signed) J. E. JOPLING,
Mining Engineer.

Hon. Chas. Ward wrote of their value to him in planning for the water power development of the Huron River and if they were only ready they would be of great use in preparing electric road projects, automobile maps, drainage projects, and assessments.

Ann Arbor, May 12, 1905.

Prof. A. C. Lane, Lansing, Michigan:

Dear Sir:—I notice that you are asking the Legislature for an appropriation to continue the very commendable work in surveying and mapping the topography of this State.

I am interested in the development of water powers in this vicinity and your recently published map of the Ann Arbor quadrangle has been of practical daily assistance to me in my work.

The future prosperity of Michigan manufactures will depend very largely on the development of the water power that is now running to waste and to that end alone a continuation of your work is valuable. I trust that you will be successful in securing your appropriation.

Very truly,
(Signed) CHAS. A. WARD.

Students of physical geography like Prof. Jefferson, of Ypsilanti, are at the same time the most earnest advocates of these maps, and the most lynx eyed of critics, and we owe him gratitude in each capacity. There is not one of the Normal schools of the State from which does not come a demand for topographic maps.

RECOMMENDATIONS.

In making the following suggestions as to special appropriations that might be asked from the Legislature and could be expended wisely and with profit to the State, I add a brief statement of the reasons for each.

Cases, cement walk, electric wiring and brick veneer to present building, \$1,000.00.

The Auditor General rules that such items require special appropriation. The risk of fire is greater than it was originally.

Addition to our present lot, \$750.00.

The land adjacent to it has been under option to the College of Mines. But since the Legislature did not provide for its purchase it has been plotted into lots. Not merely for the sake of the drill core stack but for protection we should secure this lot directly in the rear.

Fire-proof stack for drill cores, of concrete and steel, \$10,000.00.

This will be very plain, but of capacity to hold nearly 5,000 boxes each holding core from 25-50 feet of hole, and should have room for all that may come in twenty-five years, if we do not get too many iron country cores and at times only save selections.

The following sample letter presents the appeal for this. The arguments are briefly the cost of the cores—\$3.00 to \$5.00 a foot—the risk of loss by fire and disarrangement, the greater accessibility and ease and closeness of comparison if brought together.

Houghton, Mich., Oct. 22, 1906.

Alfred C. Lane, Houghton, Michigan:

Dear Sir:—It has occurred to me since talking with other mining men that there ought to be some central place for the storing of diamond drill cores taken out by the different mines which seldom have a suitable place for their safe keeping. If your office, for instance, had such a place, I have no doubt that you could get the cores from the different mines for storing, and this would be of value to your office as well as conferring a favor upon us.

Kindly let me know whether you now have a suitable place for the safe keeping of diamond drill cores. We drilled some ten thousand feet in the Arcadian Copper Co.'s lands and the cores are now stored in the basement of our office in wooden boxes. If the office should be destroyed by fire of course they never could be replaced.

We have no objection to allowing the States to examine these cores and so you can see it would be a mutual advantage.

Yours very truly,

(Signed) R. H. SHIELDS,
Superintendent.

For continuance of the biological survey—the survey of the plants and animals of the State—as authorized by Act 250 of the Session of 1905, per annum, in accordance with recommendation of Board of Scientific Advisors, \$4,100.00.

With only \$1,000 per annum you have gained information as to peat and as to where whitefish will thrive which will be worth many times its cost to the State.

Of course in scientific work one cannot be sure of so prompt valuable results. We seem to have been exceptionally fortunate.

Yet there are other problems which would sooner or later be answered by such a survey, for instance, the limits of venomous reptiles, and the malaria infested mosquitoes the practical value of which it needs no specialist to see.

For United States Geological Survey, to continue joint topographic survey, per annum, \$10,000.00.

I do not need to repeat the arguments of these maps, which have been set forth in memorials of the Michigan Engineering Society, Michigan Academy of Science, etc., as well as other State societies and the National Survey.

Illinois is now spending \$15,000 per annum; Ohio, \$25,000. To say nothing of their value in schools, drainage assessments, map making, electric road promotion, city water supplies, the one item of the power developments they suggest may often repay in taxes all their cost, and secure a loss of power never to be regained rather than lead to a waste of resources never to be restored. The Marquette sheet as I am informed led to the project of a \$500,000 dam. Three years' taxes on such a plant would repay the cost of the map, and of course the taxes collected are but a minute fraction of the benefit to the community of such a plant.

But scientific work has paid in the long run in every way, though the motive thereof is never primarily commercial but rather a better conception and knowledge of the world around us, in which we live and move and have our being.

To meet as far as might be without legislation certain desires of the Academy of Sciences discussed in my last, annual report, the Board appointed the following Board of Scientific Advisors:

Dr. L. L. Hubbard, of Houghton, and Prof. I. C. Russell, of Ann Arbor, geologists.

Prof. W. J. Beal, of Agricultural College and Prof. F. C. Newcombe, of Ann Arbor, botanists.

Prof. W. B. Barrows, of Agricultural College and Prof. J. Reighard, of Ann Arbor, zoologists.

To these gentlemen¹ as well as to my co-employees and many friends of science and mining men outside the Survey, I wish to express my hearty thanks for advice and assistance.

Very respectfully
ALFRED C. LANE.

¹Though Prof. Russell has passed, at the prime of his life, usefulness and fame, being this year president of the Geological Society, beyond the reach of earthly thanks.



BOARD OF GEOLOGICAL AND BIOLOGICAL SURVEY,
1906.

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