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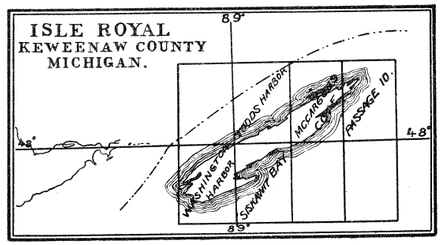


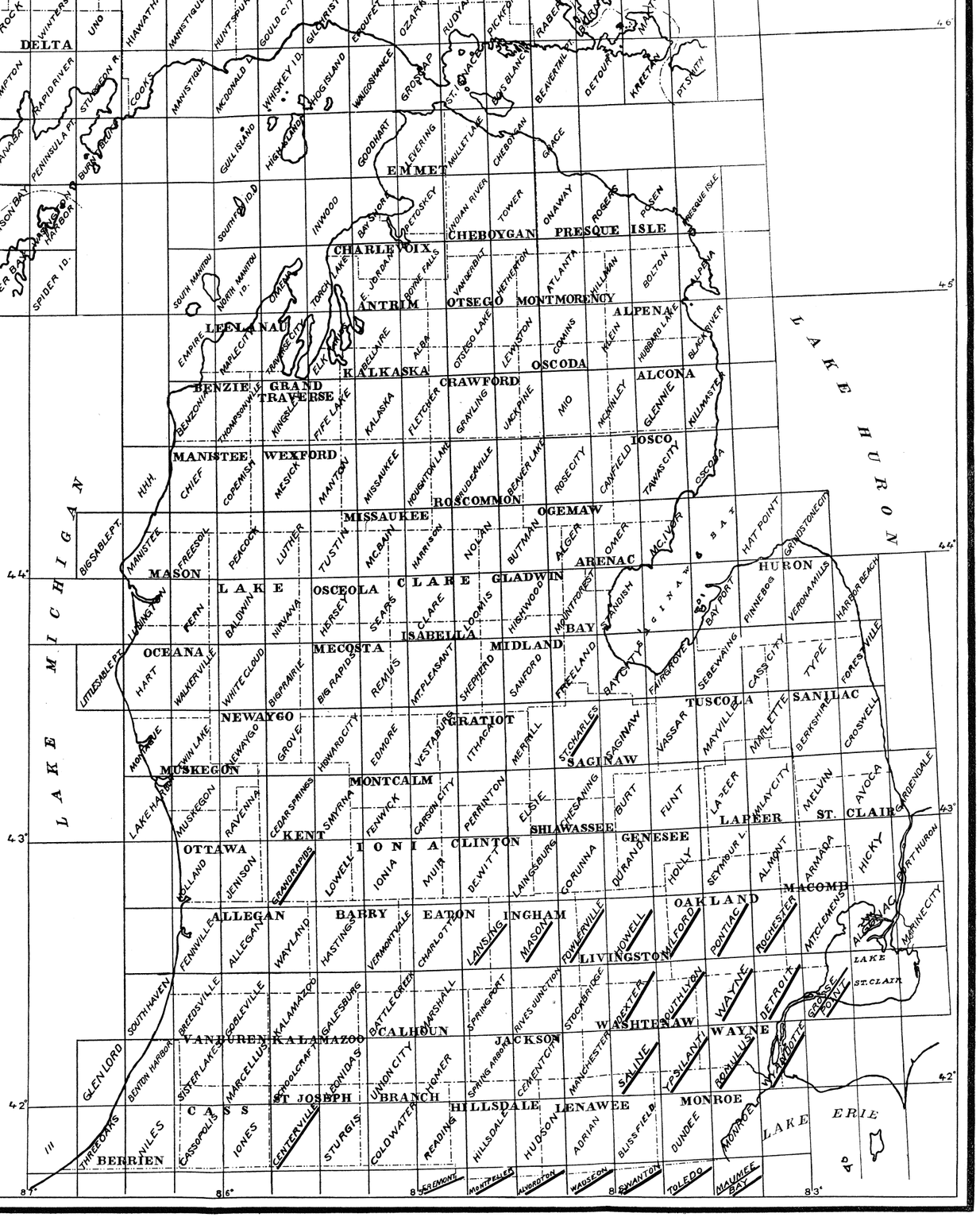

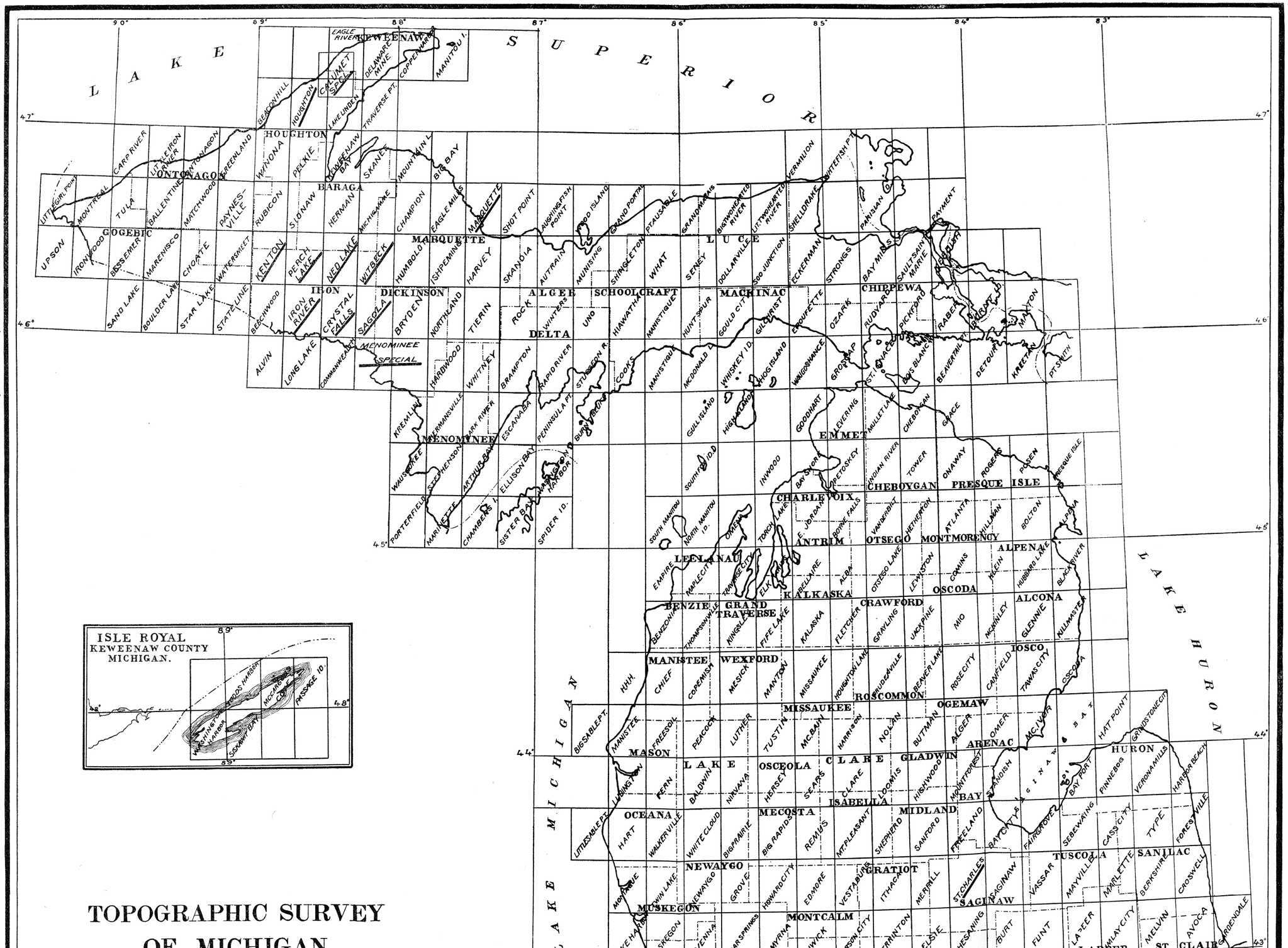


# TOPOGRAPHIC SURVEY OF MICHIGAN

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OF THE

# PUBLICATIONS

OF THE

# MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY

1838-1914

NOTE: The greater part of the publications of the Michigan Geological and Biological Survey are distributed gratis to public libraries and exchanges, and also to citizens of Michigan on the payment of forwarding charges. A considerable number of copies of each publication are reserved for sale at the list price.

DOUGLASS HOUGHTON, State Geologist

Reports from 1838-1846 were published with Legislative documents as follows: S. D. means Senate Document: H. D., House Document; J. D., Joint Document. State Geologist is abbreviated S. G., and State Geological Survey, S. G. S.

*1838. Report of a select committee of the Board of Regents of the University on the collection of the S. G.
H. D. Vol. I, p. 1-2; S. D. No. 1, p. 1. H. D. No. 55 is duplicate of No. 1. Statement of the expenditures on account of the S. G. S. for the year 1837.
H. D. No. 8. pp. 115-118; S. D. No. 21. (First annual account of the S. G.), pp. 315-318.
Report of the S. G. (first annual).
H. D. No. 24, pp. 276-317, separately, No. 14, pp. 1-39.
Communication from the S. G.
H. D. No. 46, pp. 457-460.

*1839. Report of the S. G. in relation to the improvement of State Salt Springs.
H. D. No. 2, pp. 39-45; S. D. No. 1, pp. 1-7.
Report of the committee on the S. G.'s report in relation to the improvement of the State Salt Springs.
H. D. No. 4, p. 123.
Report of the S. G. in relation to the iron ore, etc., on the school section in town five south, range seven west, in Branch county.
H. D. No. 21, pp. 342-344.
Second annual report of the State Geologist.
H. D. No. 23, pp. 380-507; S. D. No. 12, pp. 264-391.
Report of the Committee of the Senate on Manufactures, to whom was referred the communication of the S. G. relative to salt springs and the salines of the State.
S. D. No. 3, pp. 85-86 (parallel to H. D. No. 4).
Communication from the S. G. relative to the S. G. S.
S. D. No. 25, pp. 463-466.

*1840. Report of S. G. relative to the improvement of the salt springs.
H. D. No. 2, Vol. I, pp. 18-23; S. D. No. 8, Vol. II, pp. 153-158.
Annual report of the State Geologist (third, map of Wayne county).
H. D. No. 27, Vol. II, pp. 206-293; S. D. No. 7, Vol. II, pp. 66-153, separately No. 8, pp. 1-120.
Report of the select committee to whom was referred the several reports of the S. G.
H. D. No. 46, Vol. II, pp. 455-461.
Report of the majority of the Committee on Finance on the communication and accounts of the S. G. for 1839.
Report of the minority of the Committee on Finance on the same subject.
Report of the select committee on S. G.'s report and accounts relative to improvement of Salt Springs, etc.
S. G.'s account for the year 1839, the same being the subject matter of the three preceding reports.
S. D. No. 15, 16, 17, 18, pp. 209-224.

*1841. Special message concerning State Salt Springs.
H., S. and J. D. No. 5, pp. 235-254.
Annual report of the S. G. (fourth).
H., S. and J. D. No. 11, pp. 472-607, separately H. D. No. 27, pp. 1-184.
Report of the S. G. relative to county state maps.
H. D. No. 35, pp. 94-98.

*1842. Report of the S. G. relative to the State Salt Springs.
H. D. No. 2, pp. 15-21; S. D. No. 1, pp. 1-9.
Report of the select committee in relation to the report of the S. G.
H. D. No. 19, pp. 77-79.
Annual report of the S. G. (fifth).
J. D. No. 9, pp. 436-441.

*1843. Annual report of S. G. (sixth).
J. D. No. 8, pp. 398-402.
Report of the S. G. relative to the State Salt Springs.
S. D. No. 9, pp. 402-408.

*Publication out of print.

*1844. Annual report of the S. G. (seventh).
S. D. No. 11 (three pages).
D. Houghton undertook an arrangement with the Linear Survey of the U. S. Land Office by which a certain amount of geological work was done, which was never published by the State, the results of which appear largely in the township plats of the Land Office, and in the report of C. T. Jackson, 1849, U. S. S. Ex. D. No. 1, pp. 371-935, H. Ex. D. No. 5, Vol. 3, Part 3, including sub-reports of W. A. Burt and Bela Hubbard on the geology of the sub-divisions of the Linear Survey, First Session 31st Congress, and of Foster & Whitney, U. S. Geologists, Part I, H. Ex. D. No. 69, pp. 1-224 and 12 Plates, First Session 31st Congress; S. Ex. D. No. 2, Vol. 2, p. 147, Second Session 31st Congress; Part II, S. Ex. D. No. 4, Vol. 3, p. 3, Special Session 32d Congress.
The work of the Geological Survey was interrupted by the death of D. Houghton while actively engaged in explorations.

*1846. Report from Geological Department by S. W. Higgins, principal assistant.
J. D. No. 12, 22 pp.
Report of the joint committee relative to the Geological Survey.
J. D. No. 15, 8 pages.

## A. WINCHELL, State Geologist.

*First Biennial Report of the Progress of the Geological Survey, embracing observations on the geology, zoology and botany of the Lower Peninsula by A. Winchell, 1860. 339 pp. 1 geological map.

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*Annual Report for 1902. 26 pp. 1 geological map. Published in the Michigan Miner, Saginaw, January, 1903.

(a) Preliminary report on the gypsum deposits of Michigan by G. P.

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(g) The Saginaw oil field. 1. The Saginaw Valley Development Company. 2. The Saginaw anticline. 3. The explorations. 4. The oil horizons. 5. Favorable area for exploration. 6. Character and composition of the oils.

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(f) Salt manufacture. 1. Wells—well drilling machinery, boring and pumping methods. 2. Preliminary treatment of brines. 3. Methods of evaporation—direct heat and steam.

(g) Character, production and value of salt in Michigan.

(h) Geology, production and operating companies by counties. 1. Saginaw. 2. Bay. 3. Huron. 4. Macomb. 5. Iosco. 6. Midland. 7. Gratiot. 8. Manistee. 9. St. Clair. 10. Mason. 11. Wayne. 12. Isabella.

(i) Appendix A. Bibliography of Michigan salt deposits.

(j) Appendix B. The salt inspection law..... .60 .10

## Publication 16, Geological Series 13. 1913.

### Mineral Resources of Michigan for 1913 and prior years.

(a) The Michigan Copper Industry in 1913 by R. E. Hore. 1. General conditions. 2. Profits and losses. 3. Cost of mining. 4. Wages paid. 5. Exploration. 6. New construction. 7. Earnings and dividends. 8. Summary of mining operations for 1913 by mines. 9. Statistical tables of production and value of copper. 10. Summaries of financial statements of mining companies.

(b) The Iron Ore Reserves of Michigan by R. C. Allen. 1. A brief description of the iron bearing formations—relation to other formations; thickness, deformation and alteration; the formation of the ore bodies; depth to which iron ore occurs. 2. Importance of the iron mining industry in Michigan. 3. Permanency of the industry—mining at deep levels, development of unexplored lands, opening of abandoned mines, utilization of low grade ores, and recent estimates of Michigan iron ore reserves. 4. Royalty and ownership. 5. Value of iron ore in Michigan in 1913. 6. Statistical tables on production and value of iron ore, on iron ore reserves, mining costs and appraised value of mines, prices of ore, freight rates, iron ore shipments by mines, ranges and counties. 7. List of active iron mines with location, ownership, depth of bottom levels and number of men employed.

(c) Non-metallic Minerals by R. A. Smith. 1. Limestone—general business conditions, description of the limestone formations, location and character of the principal deposits, statistical tables of production and value. 2. Lime—general business conditions and statistical tables. 3. Sandstone—general character of the sandstones of Michigan, causes of the decline of the sandstone industry, statistical tables. 4. Shale—Uses of shale and location of shale resources. 5. Trap rock—location of the trap rock deposits, growth of the industry, statistical tables. 6. Grindstones and scythestones—location of the grit or grindstone quarries and method of quarrying. 7. The Michigan Slate Industry by O. R. Hamilton—location and description of the black slate deposits of Baraga county, attempted developments, former production and value of slate. 8. Sand and gravel—growth of the industry, difficulty of obtaining complete statistical data, the use of sand and gravel for concrete aggregates, statistical tables. 9.

Price. Forwarding Charges.

Salt—general trade conditions, seats of the industry, extent of the salt beds, statistical tables. 10. Cement—growth of the industry in Michigan, increased prices in 1912-1913, future outlook, statistical tables. 11. Gypsum—growth of the industry in Michigan, present developments, extent and distribution of the gypsum resources, statistical tables. 12. Clay—character and uses of the clays of Michigan, statistical tables. 13. Pottery—trade conditions and statistical tables. 14. Brick and tile—general trade conditions, character of the brick and tile products in Michigan, statistical tables. 15. Sandlime brick—growth and importance of the industry in Michigan, location of the plants, statistical tables. 16. Mineral waters—decline and causes of the mineral water industry in Michigan, statistical tables. 17. Natural gas—"shale" and surface gas wells, statistical tables. 18. Petroleum. 19. Graphite—location of the graphite deposits. 20. Quartz. 21. Mineral paints—metallic paint from iron ore. 22. Coal—statistical tables. 23. Summary of the production and value of the mineral products of Michigan for 1913. 24. Directory of mineral producers of Michigan for 1913.

# EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY.

1912-1913 and 1913-1914. (Fiscal years ending June 30th.)

| Work. | Total. | Salary. | Subsistence. | Travel. | Assistance. | Property. | Office. | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Permanent. | Incidental. |
| Appraisal of mines, 1913-14 | $8,059 86 | $6,668 70 | $492 17 | $285 68 | ..... | $26 03 | $50 66 | $536 62 |
| Topographic survey, 1912-13 and 1913-14 | 4,044 93 | 1,788 08 | 1,477 86 | 539 01 | ..... | 240 48 | ..... | 9 50 |
| General and miscellaneous office and correspondence work, 1912-13 and 1913-14 | 3,929 95 | 3,343 92 | ..... | ..... | $12 00 | 199 07 | 40 00 | 334 96 |
| Watersmeet-Marenisco-Gogebic field work, 1912-13 | 2,838 47 | 2,052 83 | 313 96 | 137 70 | 35 55 | 184 07 | 14 34 | 100 02 |
| Biological Survey, 1912-13 and 1913-14 | 2,057 30 | 2,000 00 | ..... | ..... | ..... | ..... | ..... | 57 30 |
| Oil and gas report, 1912-13 and 1913-1914 | 1,586 29 | 1,346 57 | 22 90 | 15 04 | 20 17 | 50 45 | 34 75 | 96 41 |
| Mineral statistics, 1912-13 and 1913-14 | 1,395 64 | 1,244 23 | 90 | 23 47 | ..... | ..... | 27 06 | 99 98 |
| Study of Copper Deposits. 1912-1913 & 1913-1914 | 1,089 12 | 960 00 | 21 85 | 74 29 | ..... | ..... | 9 50 | 23 78 |
| Physiography of Michigan Inland Lakes, 1913-14 | 873 75 | 569 35 | 9 65 | 229 66 | ..... | 54 59 | ..... | 10 50 |
| Delta County, Little Lake and Gwinn District Survey, 1913-14 | 838 67 | 466 15 | 235 88 | 66 59 | 13 10 | 25 13 | ..... | 31 82 |
| Petrographic Studies—Iron Ranges and associated rocks S. and E. of Gogebic Range, 1913-14 | 816 48 | 711 44 | ..... | ..... | ..... | 40 93 | 18 76 | 45 35 |
| Copper statistics and progress of Copper Industry, 1912-13 and 1913-14 | 727 15 | 659 49 | 3 95 | 21 61 | ..... | ..... | 10 50 | 31 60 |
| Study of Limestones, 1913-14 | 677 49 | 336 00 | 65 30 | 67 26 | 97 62 | 67 90 | 15 67 | 27 74 |
| Report on Limestone Mountain, 1913-14 | 343 84 | 200 00 | 32 30 | 96 36 | 4 20 | ..... | ..... | 10 98 |
| General laboratory work, 1912-13 and 1913-14 | 291 34 | 210 53 | ..... | ..... | ..... | 9 55 | 21 24 | 50 02 |
| Traverse-Dundee report, 1912-1913 and 1913-14 | 259 63 | 205 73 | ..... | ..... | ..... | ..... | ..... | 53 90 |
| Re-survey east end of Gogebic Range, 1913-14 | 228 94 | 31 79 | 56 20 | 36 77 | 9 23 | 34 52 | 14 33 | 46 10 |
| Moving equipment from Houghton to Lansing, 1912-13 | 161 12 | 46 57 | 13 25 | 86 78 | 10 50 | ..... | ..... | 4 02 |
| Gage reading on Escanaba River, 1912-13 and 1913-14 | 108 00 | 108 00 | ..... | ..... | ..... | ..... | ..... | ..... |
| Report on salt; balance due, 1913-14 | 62 07 | 62 07 | ..... | ..... | ..... | ..... | ..... | ..... |
| Total | $30,390 04 | $23,001 45 | $2,746 17 | $1,680 22 | $202 37 | $932 72 | $256 81 | $1,570 30 |
| July 1, 1914: | | | | | | | | |
| Unexpended balance, general appropriation | 333 69 | | | | | | | |
| Unexpended balance, Topography | 776 92 | | | | | | | |
| Total | $31,500 65 | | | | | | | |

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1912-1913 AND 1913-1914. (Continued).

| Numbers of vouchers. | Name. | Classification. | Total. | Salary. | Subsistence. | Travel. | Assistance. | Property. | Office. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Permanent. | Incidental. |
| 63 | Adder Machine Co | Supply house | $339 50 | | | | | $339 50 | | |
| 29, 30 | Allen, H. J | Geologist | 51 97 | $42 00 | $1 65 | $8 32 | | | | |
| 1, 8, 36, 56, 75, 87, 101, 119, 136, 152, 163, 174, 183, 1, 3, 5, 6, 8, 18, 33, 73, 36, 37, 90, 45, 47, 50, 51, 114, 133, 145, 163, 63, 72 | Allen, R. C | Director & State Geologist | 5,539 69 | 4,910 37 | 251 71 | 254 20 | $7 00 | 4 25 | | $112 16 |
| 7, 35, 71, 86, 100, 111, 118, 131, 149, 29, 30, 48, 89, 112, 126, 138, 179, 84 | Allen Printing Co | Supply house | 75 31 | | | | | 12 05 | $2 93 | 60 33 |
| 85 | Alverson, Miles C | Compassman | 5 45 | | 1 25 | 4 20 | | | | |
| 67, 78, 95, 112, 133, 147, 162, 171, 181, 34, 62, 72, 97, 111, 131, 132, 143, 162 | American Express Co | Transportation Co | 127 10 | | | | | | | 127 10 |
| 43 | Andrews, A. W | Biologist | 50 00 | 50 00 | | | | | | |
| 72, 99, 144, 71, 168 | Auditors, Board of | Supply house | 29 15 | | | | | | | 29 15 |
| 13, 20, 21, 22, 33, 36, 39, 40, 45, 47, 117, 136, 149, 166, 63, 68, 77 | Barrett, L. P | Assistant Geologist | 980 71 | 812 90 | 84 43 | 77 93 | | 4 75 | | 70 |
| 49, 93, 145, 178, 49, 86, 140, 174 | Beauchamp, Olive & Regis | Gage readers | 108 00 | 108 00 | | | | | | |
| 104 | Berthoud, Mary L | Copyist | 45 60 | | | | 45 60 | | | |
| 218, 219, 241, 242, 253, 254 | Bibbee, E. C | Topographic assistant | 479 45 | 240 00 | 161 00 | 78 45 | | | | |
| 60 | Bibliotheca Co | Publishers | 5 25 | | | | | | 5 25 | |
| 229 | Blunt, H. M | Liveryman | 10 00 | | | 10 00 | | | | |
| 17, 77, 43 | Bovee, F. N | Photographer | 13 67 | | | | | | | 13 67 |
| 52 | Bryan, Katherine | Copyist | 5 00 | 5 00 | | | | | | |
| 120 | Buck, M. J. & B. M | Supply house | 30 00 | | | | | 30 00 | | |
| 206, 207, 216 | Buzan, Walter | Rodman | 90 49 | 39 99 | 50 50 | | | | | |
| 70 | Carlton Supply Co | Supply house | 17 78 | | | | | | | 17 78 |
| 24, 25, 61 | Case, E. C | Geologist | 143 71 | 100 00 | 10 20 | 33 51 | | | | |
| 45, 106 | Chicago, University of | Publishers | 8 00 | | | | | | 8 00 | |
| 33, 31 | Chilson-McKinley Co | Directory publishers | 10 00 | | | | | 10 00 | | |
| 5, 69, 146, 159, 27, 56, 102, 155 | Citizens Telephone Co | Telephone Co | 78 25 | | | | | | | 78 25 |
| 169, 98 | Clear-Bauer Co | Drayage company | 7 01 | | | | | | | 7 01 |
| 253, 256, 266, 267, 269, 270 | Clinite, R. G | Junior topographer | 312 26 | 164 52 | 117 25 | 30 49 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 177 | Columbia Carbon Co | Supply house | 2 00 | | | | | | | 2 00 |
| 109 | Commercial Env. & Box Co | Supply house | 15 50 | | | | | | | 15 50 |
| 21 | Cook, C. W | Geologist | 62 07 | 62 07 | | | | | | |
| 18, 20, 42, 64 | Corless, Geo. B | Compassman | 160 19 | 112 67 | 25 95 | 21 57 | | | | |
| 25 | Crane, Guy W | Geologist | 35 00 | 35 00 | | | | | | |
| 78 | Curry Hotel | Hotel | 14 00 | | 14 00 | | | | | |
| 209 | Davies & Brunger | Liverymen | 36 00 | | | 36 00 | | | | |
| 243 | Dean, John | Liveryman | 6 00 | | | 6 00 | | | | |
| 79, 90, 107, 124, 140, 157, 2, 22, 38, 52, 65, 84, 100 | Dennis, J. H | Draftsman | 922 94 | 922 94 | | | | | | |
| 16 | Dick, Raymond | Compassman | 41 52 | 40 65 | | 87 | | | | |
| 125, 129, 12, 23, 75, 79, 128, 129, 80 | Dietzgen Co., Eugene | Supply house | 130 82 | | | | | 6 20 | 4 38 | 120 24 |
| 255 | Dir, W. H | Liveryman | 22 50 | | | 22 50 | | | | |
| 174, 176, 12 | Dodge, C. K | Botanist | 450 00 | 450 00 | | | | | | |
| 121, 277, 156 | Dreps, H. C | Map framer | 193 50 | | | | | 19 00 | 174 50 | |
| 73, 134, 26, 103, 125, 153 | Dudley Paper Co | Supply house | 57 28 | | | | | | | 57 28 |
| 70, 44 | Dyer-Jenison-Barry Co | Bond company | 10 00 | | | | | | | 10 00 |
| 42, 82 | Economic Geology | Publishers | 10 25 | | | | | 10 25 | | |
| 15, 17, 43 | Fellows, Bert | Compassman | 140 82 | 136 00 | 3 00 | 1 82 | | | | |
| 183, 185, 191 | Freeman, Leon | Rodman | 169 50 | 73 50 | 96 00 | | | | | |
| 3, 14, 50, 61, 80, 91, 106, 123, 139, 155, 167, 177, 8, 24, 39, 53, 68 | Frudy, Pearl A | Stenographer | 707 66 | 707 66 | | | | | | |
| 10 | Gaff & Co., Geo. B | Supply house | 25 35 | | | | | 25 35 | | |
| 65 | Grabau, A. W | Paleontologist | 100 00 | 100 00 | | | | | | |
| 54, 116, 135 | Gd. Rapids Stationery Co | Supply house | 5 33 | | | | | | | 5 33 |
| 178, 181, 185, 191 | Graves, J. T | Rodman | 272 65 | 128 65 | 144 00 | | | | | |
| 27, 28, 9, 31, 76 | Gurley, W. & L. E | Instrument supply house | 81 26 | | | | | 70 35 | | 10 91 |
| 46 | Haarer, John W | State Treasurer | 46 32 | | | | | | | 46 32 |
| 55 | Hager Co., C. C | Supply house | 1 50 | | | | | | | 1 50 |
| 1, 4, 6, 7, 18, 33, 35, 36, 45, 47, 52, 53, 54, 55, 56, 57, 58, 59, 63 | Hamilton, O. R | Mining engineer | 2,571 82 | 2,100 00 | 316 92 | 154 90 | | | | |
| 22, 23, 45, 241, 253, 267, 269 | Havens, R. R | Compassman and rodman | 415 18 | 202 23 | 212 25 | 70 | | | | |
| 93 | Hobbs, W. H | Member Bd. of Advisers | 3 33 | | 75 | 2 58 | | | | |
| 66 | Hopper, W. E | Geologist | 62 50 | 62 50 | | | | | | |
| 4, 10, 29, 37, 47, 60, 82, 92, 108, 126, 143, 148, 158, 166, 182, 3, 40, 51, 54, 66, 67, 81, 82, 64 | Hore, R. E | Geologist | 1,573 97 | 1,435 00 | 21 80 | 95 90 | 16 30 | | | 4 97 |
| 26 | Hus, H | Biologist | 25 00 | 25 00 | | | | | | |
| 53, 117, 35, 95, 122, 144, 160, 173 | Ihling Bros. & Everard Co. | Supply house | 31 34 | | | | | 83 | 2 26 | 28 25 |
| 73 | Imes, Lewis | Photographer | 25 20 | | | | | | | 25 20 |

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1912-1913 AND 1913-1914. (Continued)

| Numbers of vouchers. | Name. | Classification. | Total. | Salary. | Subsistence. | Travel. | Assistance. | Property. | Office. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Permanent. | Incidental. |
| 113, 91 | Iron Trade Review | Publishers | $8 00 | | | | | | $4 00 | $4 00 |
| 206, 207, 216 | Kaster, E. G. | Rodman | 90 49 | $39 99 | $50 50 | | | | | |
| 76, 81 | Kelly Brothers | Supply store | 30 50 | | 30 50 | | | | | |
| 40, 41, 65 | Kelly, J. L. | Supply store | 137 81 | | 137 81 | | | | | |
| 194 | Kelly, T. | Liveryman | 14 00 | | | $14 00 | | | | |
| 191 | Lee, L. L. | Assistant topographer | 167 00 | 125 00 | 42 00 | | | | | |
| 63 | Links, G. P. | Compassman | 36 00 | 36 00 | | | | | | |
| 14, 23, 27, 28 | Ludington Hotel | Hotel | 125 50 | | 125 50 | | | | | |
| 191 | Luther, Geo. B. | Rodman | 45 33 | 19 83 | 25 50 | | | | | |
| 19, 26, 44 | McElwain, J. Millard | Compassman | 120 00 | 118 00 | 2 00 | | | | | |
| 96, 130 | McGraw-Hill Book Co. | Publishers | 7 13 | | | | | | 7 13 | |
| 71 | McKone, Don T. | Compassman | 15 41 | | 2 50 | 12 91 | | | | |
| 15 | Marshall, E. E. | Copyist | 10 45 | 10 45 | | | | | | |
| 68 | Mead Storage Co. | Drayage company | 11 00 | | | | | | | 11 00 |
| 59 | Mich. Central R. R. Co. | Transportation company | 74 40 | | | | | | | 74 40 |
| 30, 83, 128, 130, 142, 170, 179, 13, 14, 28, 74, 87, 88, 124 | Michigan Drug Co. | Supply house | 117 03 | | | | | $102 25 | | 14 78 |
| 32 | Mich. Engineering Society | Publishers | 4 00 | | | | | | | 4 00 |
| 92 | Mich. Press Clip'g Bureau | News bureau | 4 00 | | | | | | 4 00 | |
| 6, 84, 110, 160, 13, 57, 104, 157, 170, 175 | Michigan Telephone Co. | Telephone company | 80 55 | | | | | | | 80 55 |
| 48 | Michigan, University of | Educational Institution | 93 37 | | | | $93 37 | | | |
| 32, 169 | Mining Gazette | Publishers | 4 00 | | | | | | | 4 00 |
| 115 | Mining Journal Co. | Publishers | 2 00 | | | | | | | 2 00 |
| 150 | Mining World | Publishers | 3 00 | | | | | | | 3 00 |
| 31 | Montgomery Ward & Co. | Supply house | 6 15 | | | | | 6 15 | | |
| 186, 193 | Mull, Ira D. | Liveryman | 66 00 | | | 66 00 | | | | |
| 16 | Munson Supply Co. | Supply house | 6 30 | | | | | 6 30 | | |
| 94 | Newcombe, F. C. | Member Bd. of Advisers | 3 33 | | 75 | 2 58 | | | | |
| 44 | Otis, C. H. | Biologist | 25 00 | 25 00 | | | | | | |
| 127, 159 | Proudfit Loose Leaf Co. | Supply house | 9 92 | | | | | 9 92 | | |
| 12, 13, 66 | Raymond, E. B. | Cook | 166 20 | 160 00 | 5 00 | 1 20 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 110 | Reighard, Jacob | Member Bd. of Advisers | 3 33 | | 75 | 2 58 | | | | |
| 71 | Remington Typewriter Co. | Supply house | 2 50 | | | | | | | 2 50 |
| 85, 101, 118, 137, 150, 167, 172 | Richmond, Mrs. K. V | Stenographer | 452 50 | 452 50 | | | | | | |
| 185 | Ripley & Gray | Printing company | 5 25 | | | | | | | 5 25 |
| 16, 17, 41, 42, 49, 62 | Robinson, W. I | Geologist | 189 15 | 100 00 | 22 10 | 62 85 | 4 20 | | | |
| 173, 175, 2, 11, 107 | Ruthven, A. G | Chief Naturalist | 803 83 | 800 00 | 1 25 | 2 58 | | | | |
| 5, 20, 36, 58, 60, 69, 74, 75 | Scott, I. D | Geologist | 830 96 | 569 35 | 4 65 | 229 66 | | 27 30 | | |
| 123 | Seiler, A. G. & Co | Supply house | 7 50 | | | | | 7 50 | | |
| 206, 207, 216 | Seymour, K. D | Rodman | 90 49 | 39 99 | 50 50 | | | | | |
| 109 | Sherzer, W. H | Member Bd. of Advisers | 3 50 | | 45 | 3 05 | | | | |
| 218, 241 | Small, T. L | Rodman | 182 98 | 77 98 | 105 00 | | | | | |
| 9, 38, 57, 76, 88, 102, 120, 199, 200, 137, 153, 164, 175, 4, 18, 9, 18, 19, 33, 36, 38, 45, 47, 115, 134, 146, 164, 63, 70 | Smith, R. A | Geologist | 3,170 34 | 2,759 93 | 170 75 | 172 89 | 35 90 | 24 97 | 2 40 | 3 50 |
| 85, 7, 148 | Smith Typew'r Co., L. C | Supply house | 149 90 | | | | | 149 15 | | 75 |
| 192 | Spaulding, R. L | Liveryman | 25 50 | | | 25 50 | | | | |
| 10 | Thompson, Crystal | Biologist | 150 00 | 150 00 | | | | | | |
| 184, 10 | Thompson, Helen B | Biologist | 250 00 | 250 00 | | | | | | |
| 156, 152 | Tomlinson, W. Harold | Slide manufacturer | 60 95 | | | | | 60 95 | | |
| 178, 179, 181, 185, 189, 191, 197 | Townsend, L. D | Junior topographer | 487 79 | 281 29 | 192 00 | 14 50 | | | | |
| 46 | Turton, C. M | Supply house | 3 00 | | | | | | 3 00 | |
| 34, 51, 62, 97, 114, 127, 151, 161, 172, 184, 33, 47, 61, 80, 96, 113, 142, 161 | U. S. Express Co | Transportation company | 87 23 | | | | | | | 87 23 |
| 1, 6, 18, 33, 36, 45, 47, 52, 53, 56, 59, 63 | Vance, E. E | Draftsman | 1,200 00 | 1,200 00 | | | | | | |
| 188, 195 | Voisin, G | Liveryman | 38 75 | | 17 50 | 21 25 | | | | |
| 183, 185, 190, 191 | Walker, A. M | Topographic engineer | 140 23 | | 134 00 | 6 23 | | | | |
| 108 | Walker, Bryant | Member Bd. of Advisers | 3 50 | | | 3 50 | | | | |
| 180, 182, 187, 196 | Watters, C. M | Liveryman | 149 25 | 13 50 | | 135 75 | | | | |
| 141 | Weed, Walter H | Publisher | 5 00 | | | | | 5 00 | | |
| 173, 59, 78, 83 | Western Union Tel. Co | Telegraph company | 12 92 | | | | | | | 12 92 |
| 34 | Whitmore & Rogers | Supply house | 13 00 | | | | | | 13 00 | |
| 2, 11, 32, 39, 48, 58, 77, 81, 89, 94, 103, 105, 198, 121, 122, 138, 141, 154, 165, 168, 176, 180, 186, 6, 11, 19, 25, 37, 41, 50, 55, 64, 69, 83, 99, 105, 116, 119, 135, 139, 147, 151, 165, 171, 173, 67 | Wight, Harry R | Secretary | 2,684 36 | 2,200 00 | | | | 70 | 15 69 | 467 97 |
| 154 | Wiley & Sons, John | Publishers | 10 27 | | | | | | 10 27 | |

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1912-1913 AND 1913-1914. (Concluded).

| Numbers of vouchers. | Name. | Classification. | Total. | Salary. | Subsistence. | Travel. | Assistance. | Property. | Office. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Permanent. | Incidental. |
| 206, 207, 208, 216, 217 | Wilson, J. H. | Junior topographer | $219 47 | $95 00 | $62 00 | $62 47 | | | | |
| 172, 177 | Wood, N. A. | Biologist | 250 00 | 250 00 | | | | | | |
| 74, 132, 176, 180 | Wynk'p Hallen'k Cr'f'd Co | State printers | 18 80 | | | | | | | |
| 206, 207, 217 | Yoakum, B. H. | Recorder | 95 49 | 44 99 | 50 50 | | | | | $18 80 |
| 21, 24, 46 | Youngs, L. J. | Field assistant | 116 78 | 116 00 | | 78 | | | | |
| Total | | | $30,390 04 | $23,001 45 | $2,746 17 | $1,680 22 | $202 37 | $932 72 | $256 81 | $1,570 30 |
| Unexpended balance July 1, 1914 | | | 1,110 61 | | | | | | | |
| Total | | | $31,500.65 | | | | | | | |

EMPLOYEES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS, JULY 1, 1912 to JUNE 30, 1913 AND JULY 1, 1913 TO JUNE 30, 1914.

| Name. | Position. | Amount of salary received. | Period of time employed. | How employed. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Geology. | Appraisal of mines. | Topography. | Biology. | Mineral statistics. |
| Allen, R. C | Director and State Geologist. | $4,910 37 | 1 year, 11 months, 16½ days | * | * | * | * | * |
| Allen, H. J | Geologist | 42 00 | 12 days | * | | | | |
| Andrews, A. W | Biologist | 50 00 | Contract | | | | * | |
| Barrett, L. P | Assistant Geologist | 812 90 | 10 months, 26 days | * | | | | |
| Beauchamp, Olive & Regis | Gage Readers | 108 00 | 2 years | * | | | | |
| Bibbee, E. C | Topographic Assistant | 240 00 | 3 months | | | * | | |
| Bryan, Katherine | Copyist | 5 00 | 2 days | | | | | |
| Buzan, Walter | Rodman | 39 99 | 31 days | | | | | * |
| Case, E. C | Geologist | 100 00 | Contract | | | * | | |
| Clinite, R. G | Junior Topographer | 164 52 | 2 months, 7 days | | | * | | |
| Cook, C. W | Geologist | 62 07 | Contract | * | | | | |
| Corless, Geo. B | Compassman | 112 67 | 3 months, 2 days | * | | | | |
| Crane, Guy W | Geologist | 35 00 | 7 days | * | | | | |
| Dennis, J. H | Draftsman | 922 94 | 1 year, 10 days | * | | | | |
| Dick, Raymond | Compassman | 40 65 | 1 month, 5 days | * | | | | |
| Dodge, C. K | Botanist | 450 00 | 4 months | | | | * | |
| Fellows, Bert | Compassman | 136 00 | 3 months | * | | | | |
| Freeman, Leon | Rodman | 73 50 | 2 months, 3 days | | | * | | |
| Frudy, Pearl A | Stenographer | 707 66 | 1 year, 4 months, 6 days | * | * | | | * |
| Grabau, A. W | Paleontologist | 100 00 | Contract | * | | | | |
| Graves, J. T | Rodman | 128 65 | 3 months, 7 days | | | * | | |
| Hamilton, O. R | Mining Engineer | 2,100 00 | 1 year | * | * | | | * |
| Havens, R. R | Compassman and Rodman | 202 23 | 6 months, 6 days | * | | * | | |
| Hopper, W. E | Geologist | 62 50 | 3 months | * | | | | * |
| Hore, R. E | Geologist | 1,435 00 | 1 year, 6 months, and contract | * | | | | * |

EMPLOYEES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS, JULY 1, 1912 to JUNE 30, 1913 AND JULY 1, 1913 TO JUNE 30, 1914.—*Concluded.*

| Name. | Position. | Amount of salary received. | Period of time employed. | How employed. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Geology. | Appraisal of mines | Topography. | Biology. | Mineral statistics. |
| Hus, H | Biologist | $25 00 | Contract | | | | * | |
| Kaster, E. G | Rodman | 39 99 | 31 days | | | * | | |
| Lee, L. L | Assistant Topographer | 125 00 | 1 month | | | * | | |
| Links, G. P | Compassman | 36 00 | 27 days | * | | | | |
| Luther, Geo. B | Rodman | 19 83 | 17 days | | | * | | |
| McElwain, J. Millard | Compassman | 118 00 | 3 months | * | | | | |
| Marshall, E. E | Copyist | 10 45 | 4 days, 1 hour, 15 minutes | | | | | * |
| Otis, C. H | Biologist | 25 00 | Contract | | | | * | |
| Raymond, E. B | Cook | 160 00 | 2 months, 4 days | * | | | | |
| Richmond, Mrs. K. V | Stenographer | 452 50 | 7 months | * | * | | | * |
| Robinson, W. I | Geologist | 100 00 | 1 month | * | | | | |
| Ruthven, A. G | Chief Naturalist | 800 00 | 2 years | | | | * | |
| Scott, I. D | Geologist | 569 35 | 2 months and contract | * | | | | |
| Seymour, K. D | Rodman | 39 99 | 31 days | | | * | | |
| Small, T. L | Rodman | 77 98 | 1 month, 29 days | | | * | | |
| Smith, R. A | Geologist | 2,759 93 | 2 years | * | * | * | | * |
| Thompson, Crystal | Biologist | 150 00 | 2 months | | | | * | |
| Thompson, Helen B | Biologist | 250 00 | 2 months and contract | | | | * | |
| Townsend, L. D | Junior Topographer | 281 29 | 3 months, 16 days | | | * | | |
| Vance, E. E | Draftsman | 1,200 00 | 1 year | * | * | | | |
| Wight, Harry R | Secretary | 2,200 00 | 2 years | * | * | * | * | * |
| Wilson, J. H | Junior Topographer | 95 00 | 1 month | | | * | | |
| Wood, N. A | Biologist | 250 00 | 2 months | | | | * | |
| Yoakum, B. H | Recorder | 44 99 | 31 days | | | * | | |
| Youngs, L. J | Field Assistant | 116 00 | 3 months | * | | | | |

FIELD WORK.

| Quadrangles. | Counties. | For publication on scale of | Area mapped sq. mi. | Primary Levels. | | Traverse. | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Miles. | Perm. B. M's. | Primary. | | Secd'y Miles. |
| | | | | | | Miles. | P. Marks. | |
| Burt | Genesee, Livingston, Shiawassee | | | | | 8 | 1 | |
| Carson City | Clinton, Gratiot | | | | | 9 | 1 | |
| Centerville (Mich. por.) | St. Joseph | 1:62,500 | 59 | 90 | 16 | 47 | 4 | 445 |
| Chesaning | Saginaw | | | 15 | 4 | 16 | 1 | |
| Coldwater | Branch | | | 16 | 4 | | | |
| Corunna | Ingham, Livingston, Shiawassee | | | 20 | 5 | 12 | 1 | |
| DeWitt | Clinton, Eaton | | | | | 11 | 1 | |
| Durand | Genesee, Livingston, Shiawassee | | | | | 12 | 1 | |
| Elsie | Gratiot, Saginaw | | | | | 6 | 1 | |
| Freeland | Midland, Saginaw | | | | | 8 | 1 | |
| Grand Rapids | Allegan, Kent, Barry | 1:62,500 | 192 | | | | | 839 |
| Ithaca | Gratiot | | | | | 7 | 1 | |
| Kalamazoo | Allegan, Barry, Kalamazoo | | | 21 | 5 | | | |
| Merrill | Gratiot, Midland | | | | | 15 | 2 | |
| Muir | Clinton, Eaton | | | | | 11 | 1 | |
| Perrinton | Clinton, Gratiot | | | | | 16 | 2 | |
| Reading | Branch, Hillsdale | | | 15 | 5 | | | |
| Saginaw | Bay, Saginaw | | | 16 | 4 | 12 | 1 | |
| St. Charles | Midland, Saginaw | 1:62,500 | 95 | 85 | 20 | 47 | 4 | |
| Schoolcraft | Kalamazoo, St. Joseph | | | 21 | | 8 | 1 | |
| Sturgis (Mich. por.) | Branch, St. Joseph | | | 14 | 4 | 12 | 1 | |
| Wayland | Allegan, Barry | | | 21 | 7 | | | |
| Total | | | 346 | 334 | 74 | 257 | 25 | 1,284 |

TABLE SHOWING PROGRESS OF THE TOPOGRAPHIC SURVEY IN THE UNITED STATES.*

| State. | Surveyed 1912-1913. Square miles. | Total surveyed to June 30, 1913. Square miles. | Percentage of total area surveyed to June 30, 1913. | State appropriation. 1912-1913. | U. S. appropriation. 1912-1913. |
|---|---|---|---|---|---|
| Connecticut | ..... | 4,965 | 100 | ..... | ..... |
| District of Columbia | ..... | 70 | 100 | ..... | ..... |
| Massachusetts | ..... | 8,266 | 100 | ..... | ..... |
| New Jersey | ..... | 8,224 | 100 | ..... | ..... |
| Rhode Island | ..... | 1,248 | 100 | ..... | ..... |
| West Virginia | ..... | 24,170 | 100 | $12,000 | $10,000 |
| Maryland | ..... | 12,327 | 100 | ..... | ..... |
| New York | 622 | 42,227 | 85 | 10,000 | 10,000 |
| Ohio | 1,739 | 34,727 | 84 | 25,000 | 10,000 |
| Utah | ..... | 67,905 | 79 | ..... | ..... |
| Kansas | ..... | 64,159 | 78 | ..... | ..... |
| Virginia | ..... | 29,980 | 70 | 4,250 | 4,250 |
| California | 6,133 | 109,444 | 69 | 14,000 | 14,000 |
| Arizona | 2,299 | 66,760 | 58 | ..... | ..... |
| Oklahoma | 397 | 39,612 | 56 | 1,000 | 1,000 |
| Pennsylvania | 291 | 24,167 | 55 | 5,328 | 5,328 |
| Missouri | 185 | 35,664 | 51 | 2,500 | 2,500 |
| Delaware | ..... | 1,202 | 51 | ..... | ..... |
| Tennessee | ..... | 20,911 | 50 | ..... | ..... |
| Nevada | 7 | 50,682 | 46 | ..... | ..... |
| Kentucky | 67 | 17,654 | 43 | 10,000 | 10,000 |
| Colorado | 1,131 | 45,226 | 42 | ..... | ..... |
| Arkansas | ..... | 21,380 | 40 | ..... | ..... |
| Vermont | ..... | 3,753 | 39 | ..... | ..... |
| Montana | 794 | 55,965 | 38 | ..... | ..... |
| Alabama | ..... | 18,713 | 36 | ..... | ..... |
| New Hampshire | ..... | 3,380 | 36 | ..... | ..... |
| Nebraska | 217 | 26,311 | 34 | 2,000 | 2,000 |
| North Carolina | ..... | 17,661 | 34 | ..... | ..... |
| Washington | 650 | 23,269 | 33 | 13,750 | 13,750 |
| Georgia | ..... | 17,337 | 29 | ..... | ..... |
| Idaho | 382 | 24,462 | 29 | 700 | 700 |
| New Mexico | 320 | 35,850 | 29 | ..... | ..... |
| Wyoming | 157 | 27,538 | 28 | ..... | ..... |
| Maine | 294 | 8,914 | 27 | 3,650 | 3,850 |
| Texas | ..... | 67,387 | 25 | ..... | ..... |
| South Dakota | ..... | 18,594 | 24 | ..... | ..... |
| Illinois | 1,018 | 13,128 | 23 | 8,000 | 8,000 |
| Wisconsin | ..... | 11,789 | 21 | ..... | ..... |
| Oregon | 930 | 20,742 | 21 | 15,000 | 15,000 |
| Iowa | 305 | 11,371 | 20 | 2,650 | 2,350 |
| South Carolina | ..... | 5,640 | 18 | ..... | ..... |
| Louisiana | ..... | 8,311 | 17 | ..... | ..... |
| North Dakota | ..... | 9,716 | 14 | ..... | ..... |
| MICHIGAN | 206 | 5,591 | 9 | 2,000 | 2,000 |
| Indiana | ..... | 3,041 | 8 | ..... | ..... |
| Minnesota | 434 | 5,572 | 6 | 10,362 | 10,000 |
| Mississippi | ..... | 1,889 | 4 | ..... | ..... |
| Florida | ..... | 2,080 | 4 | ..... | ..... |
| Total | 18,578 | 1,178,974 | 38.9 | $142,190 | $124,728 |

*From Thirty-fourth Annual Report of the Director of the U. S. Geological Survey.