BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA
VOL. 10, PP. 409-534, PLS. 49-54 JANUARY 19, 1900

PROCEEDINGS OF THE ELEVENTH ANNUAL MEETING, HELD AT NEW YORK CITY, DECEMBER 28, 29, AND 30, 1898

HERMAN LE ROY FAIRCHILD, *Secretary*

CONTENTS

Session of Wednesday, December 28

The Society convened in the assembly-room in Schermerhorn hall, Columbia University, at 10.15 o'clock a m. President J. J. Stevenson introduced the Honorable Seth Low, president of Columbia University, who gave the Society welcome in a few remarks expressing appreciation of the science of geology.

The President called for the Council report as the first administrative business, which report was submitted in print by the Secretary without reading, as follows:

REPORT OF THE COUNCIL

To the Geological Society of America,
in Eleventh Annual Meeting assembled:

The Council extends congratulations to the Fellows upon the excellent condition and prospects of the Society at the close of the first decade. Begun with misgivings as to the wisdom of the new organization, and amid prophecies of failure, it has more than justified the faith and work of its founders. The Society has united the geologists of the continent, produced harmony of feeling, thought, and labor, created and cemented friendships, and prevented the geology of America from becoming provincial. It has stimulated research and publication and has placed on record a great body of knowledge. The avowed purpose of the Society—" the promotion of the Science of Geology in North America "—has been carried out.

We may believe that the great success already achieved is but the beginning of a grander future. Already the Bulletin has given us a prominent place among the older geological societies of the world, and with the great advantages possessed by American students of earth-lore it may be expected that at a time not far distant our Society will occupy a foremost position.

We may well be proud of our Society and of our science, which, born so recently, has become a powerful factor in the intellectual uplifting of mankind. Let us sustain and cherish the Society as a noble means to a great end, and may every Fellow realize that he has a useful part, even though he be isolated in a distant field and unable to attend the meetings. To such Fellows the Council sends especial salutation.

During the past year the Council has held only one meeting, at Montreal, no quorum being present at Boston. The necessary business since the annual meeting has been transacted by correspondence.

The following reports of the officers contain all further matters of interest to the Society at large :

SECRETARY'S REPORT.

To the Council of the Geological Society of America :

Meetings.—The record of the Tenth Annual Meeting, held at Montreal December, 1897, is before the Society in print. The proceedings of the Tenth Summer Meeting are in type and will soon be distributed. Like the 1896 Summer Meeting, the Boston meeting occupied one day of the time of Section E, American Association for the Advancement of Science. This arrangement seems mutually satisfactory.

A list of the meetings of the Society held during the ten years is appended, with the number of Fellows and Fellows-elect in attendance, and the number of titles of papers presented (not including reports nor memorials).

	Summer meetings.	Papers.	Attendance.	Winter meetings.	Papers.	Attendance.
1888	....	......	....	1. Ithaca........	0	13
1889	1. Toronto........	11	53	2. New York ..	35	60
1890	2. Indianapolis ...	10	22 (?)	3. Washington..	55	66
1891	3. Washington....	34	83	4. Columbus....	27	23
1892	4. Rochester......	15	32	5. Ottawa.......	37	29
1893	5. Madison.......	20	38	6. Boston......	59	51
1894	6. Brooklyn.......	29	34	7. Baltimore ...	48	64
1895	7. Springfield.....	18	31	8. Philadelphia..	26	61
1896	8. Buffalo.	14	43	9. Washington..	50	79
1897	9. Detroit.........	12	21	10. Montreal.. ..	33	31
1898	10. Boston.........	18	46	11. New York....	—	—

Membership.—Since the last report. 1897, three Fellows have resigned and five have been dropped from the roll for non-payment of dues. Four Fellows elected at Montreal, added to the roll, made the last printed list (July, 1898) contain 238 names. The death of James Hall transfers one name to the list of deceased Fellows, leaving the present membership 237. Two resignations are pending and eight Fellows are delinquent in dues. Eleven persons are now candidates for election at the approaching meeting.

The Society began with 112 "Original" Fellows. The number of Fellows on the roll at the time of the annual meetings during the ten years is as follows: 1888, 98; 1889, 173; 1890, 197; 1891, 213; 1892, 219; 1893, 236; 1894, 226; 1895, 226; 1896, 233; 1897, 242; 1898, 237.

In 1893 the Society had secured the adhesion of nearly all the active geologists of the continent. Since that time the membership has remained quite uniform, the losses being balanced by elections. During the late years of financial stringency many Fellows have been forced unwillingly to relinquish membership. In all, 37 Fellows have been dropped from the rolls for non-payment of dues. Ten Fellows have resigned and 21 Fellows have died. The total number of persons who have been Fellows is 305, of whom two are women.

It is not expected that the membership of the Society will be much larger than at present. Accessions will be mainly from young men entering the profession, which will perhaps only balance the losses.

Following is a tabulation of the geographical distribution of the fellowship in 1888, 1894, and at the present time:

	Original Fellows, 1888.	*Fellows December, 1894.*	*Fellows December, 1898.*
District of Columbia	13	34	37
New York	21	27	29
Canada	..	23	20
Pennsylvania	10	17	15
Massachusetts	7	17	19
California	4	12	10
Ohio	6	12	7
Illinois	1	10	11
Iowa	4	7	8
Connecticut	4	7	6
Minnesota	3	6	5
Michigan	3	5	7
New Jersey	5	5	4
Kentucky	4	4	3
Wisconsin	3	3	6
Missouri	2	4	5
Texas	4	3	3
Alabama	1	3	4
Colorado	..	3	4
Kansas	2	3	2
Virginia	1	3	4
Maryland	2	2	3
Indiana	2	1	4
South Dakota	..	2	2
Vermont	..	2	1
West Virginia	1	2	2
Arizona	..	1	1
Georgia	1	1	1
Idaho	..	1	..

	Original Fellows, 1888.	*Fellows December, 1894.*	*Fellows December, 1898.*
Maine	..	1	1
Mississippi	1	1	..
North Carolina	1	1	2
New Hampshire	1	1	2
Nebraska	2	..	1
Tennessee	1	1	1
Arkansas	1	..	..
Rhode Island	1	1	..
Montana	..	..	1
Wyoming	..	..	1
New Mexico	..	..	1
Utah	..	..	1
Mexico	..	1	2
Brazil	..	1	1
Burma	..	1	..

OFFICERS OF THE SOCIETY, 1889–1898

	President	*First Vice-President*	*Second Vice-President*
1889	James Hall.	James D. Dana.	Alexander Winchell.
1890	James D. Dana.	John S. Newberry.	Alexander Winchell.
1891	Alexander Winchell.	G. K. Gilbert.	T. C. Chamberlin.
1892	G. K. Gilbert.	Sir J. W. Dawson.	T. C. Chamberlin.
1893	Sir J. W. Dawson.	T. C. Chamberlin.	J. J. Stevenson.
1894	T. C. Chamberlin.	N. S. Shaler.	George H. Williams.
1895	N. S. Shaler.	Joseph Le Conte.	C. H. Hitchcock.
1896	Joseph Le Conte.	C. H. Hitchcock.	Edward Orton.
1897	Edward Orton.	J. J. Stevenson.	B. K. Emerson.
1898	J. J. Stevenson.	B. K. Emerson.	G. M. Dawson.

Secretary

J. J. Stevenson	1889–1890
H. L. Fairchild	1891–

Treasurer

Henry S. Williams	1889–1891
I. C. White	1892–

Editor

W J McGee	1890–1892
Joseph Stanley-Brown	1893–

Librarian

H. P. Cushing	1898–

Councillors

John S. Newberry	1889	E. W. Claypole	1891–1892
J. W. Powell	1889–1890	John C. Branner	1891–1893
Chas. H. Hitchcock	1889–1892	Henry S. Williams	1892–1894
George M. Dawson	1890–1893	N. H. Winchell	1892–1894
I. C. White	1891	E. A. Smith	1893–1895
J. J. Stevenson	1891	C. D. Walcott	1893–1895

Councillors

F. D. Adams	1894–1896	J. S. Diller	1897–1899
I. C. Russell	1894–1896	W. B. Scott	1897–1899
R. W. Ells	1895–1897	W. M. Davis	1898–1900
C. R. Van Hise	1895–1897	Robert Bell	1898–1900
B. K. Emerson	1896–1897	M. E. Wadsworth	1898–1900
J. M. Safford	1896–1898		

Distribution of Bulletin.—The distribution for the year is included in the following table:

DISTRIBUTION OF BULLETIN FROM THE SECRETARY'S OFFICE DURING THE YEARS 1891–1898

Complete Volumes

	Vol. 1.	Vol. 2.	Vol. 3.	Vol. 4.	Vol. 5.	Vol. 6.	Vol. 7.	Vol. 8.	Vol. 9.
Distributed to Fellows	..	..	209	214	214	223	222	231	234
Donated to "exchanges"	91	91	89	89	89	87	85	85	84
Sold to libraries	89	89	91	87	83	89	82	79	77
Sold to Fellows	24	18	12	8	5	3	2	....	....
Sent to Fellows, deficient	2	1	1	....	....	....	....	1	....
Donated	4	4	3	3	3	3	2	2	1
Bound for offices and library	3	3	3	3	3	3	3	3	3
Volumes in reserve	51	300	342 (?)	346 (?)	337 (?)	92 (?)	104 (?)	99 (?)	101 (?)
Complete vols. received	264	506	750 (?)	750 (?)	734	500 (?)	500 (?)	500 (?)	500 (?)

Brochures

	Vol. 1.	Vol. 2.	Vol. 3.	Vol. 4.	Vol. 5.	Vol. 6.	Vol. 7.	Vol. 8.	Vol. 9.
Sent to Fellows, deficient	50	141	46	43	28	13	15	12	5
Sent to libraries, deficient	3	7	5	6	3	1	4	8	2
Sold to Fellows	19	22	11	13	19	8	2	3	....
Sold to public	13	15	17	13	7	11	6	6	1
Donated	3	3	3	3	2	....	....	....	....

Subscriptions.—The list of subscribers to the Bulletin remains the same as last year, one new subscriber, the John Crerar Library, Chicago, balancing the withdrawal of Cornell College, Mt. Vernon, Iowa. The Secretary has planned to again advertise the Bulletin among educational institutions and libraries, using pages out of volume 9.

Bulletin sales.—Receipts for the past year are $426.65. The reduction from last year is due to delay in the publication of volume 9. In former years the completed volume has been distributed in June or July, which allowed several months for collection of the bills. As the distribution of complete copies of volume 9 has been only within the past week' these sales appear under the item "Charged and uncollected." Moreover, the irregular sales which follow the publication of each volume have not been realized, but will appear in next year's report.

RECEIPTS FROM SALE OF BULLETIN DURING 1898

By Sale of Complete Volumes

	Vol. 1.	Vol. 2.	Vol. 3.	Vol. 4.	Vol. 5.
From Fellows	$18 00	$22 50	$20 00	$17 50	$16 00
From libraries	10 00	10 00	10 00	10 00	15 00
Total for 1898	28 00	32 50	30 00	27 50	31 00
By last report (1897)	534 10	508 50	488 50	452 50	422 00
Total to date	$562 10	$541 00	$518 50	$480 00	$453 00
	Vol. 6.	Vol. 7.	Vol. 8.	Vol. 9.	Total
From Fellows	$8 00	$8 00	$4 00	....	$114 00
From libraries	20 00	20 50	20 00	$125 00	240 50
Total for 1898	28 00	28 50	24 00	125 00	354 50
By last report (1897)	443 00	393 50	370 00	45 00	3,657 10
Total to date	$471 00	$422 00	$394 00	$170 00	$4,011 60

By Sale of Brochures

	Vol. 1.	Vol. 2.	Vol. 3.	Vol. 4.	Vol. 5.
From Fellows	$2 15	$0 50	$22 40	....	$0 60
From public	1 60	....	70	$1 20	....
Total for 1898	3 75	50	23 10	1 20	0 60
By last report (1897)	23 45	20 75	14 65	10 40	6 25
Total to date	$27 20	$21 25	$37 75	$11 60	$6 85
	Vol. 6.	Vol. 7.	Vol. 8.	Vol. 9.	Total.
From Fellows	$0 45	$1 50	$0 25	....	$27 85
From public	20	....	....	$0 60	4 30
Total for 1898	65	1 50	25	60	32 15
By last report (1897)	7 60	6 95	4 30	....	94 35
Total to date	$8 25	$8 45	$4 55	$0 60	$126 50

Grand total	$4,138 10
Received for volume 10 in advance	40 00
Total receipts to date	$4,178 10
Charged and uncollected	231 75
Total sales of Bulletin to date	$4,409 85

Exchanges.—The list of institutions to which the Bulletin is donated is one less than last year, 84 in number, Rassegna delle Scienze Geologische in Italia, Rome, having been reported defunct. This list appears on pages 443–449 of volume 9.

Expenses.—The following table covers the cost of administration for the last fiscal year:

EXPENDITURE OF SECRETARY'S OFFICE FOR THE FISCAL YEAR, NOVEMBER 30, 1897, TO NOVEMBER 30, 1898

Account of Administration

Postage	$16 55	
Expressage	2 75	
Printing (including stationery and records)	70 65	
Meetings (not included in printing)	4 65	
Total		$94 60

Account of Bulletin

Postage	$77 50	
Expressage and freight	35 12	
Wrapping material and labels	2 60	
Printing	2 00	
Collection of checks	2 25	
Total		$119 47
Total expenditure for year		$214 07

Respectfully submitted. H. L. FAIRCHILD,
Secretary.

ROCHESTER, N. Y., *December 20, 1898.*

TREASURER'S REPORT.

To the Council of the Geological Society of America:

The accompanying statement of receipts, disbursements, and investments for the current year (December 1, 1897, to December 1, 1898) exhibits in detail the present very satisfactory financial condition of the Society.

The chief points of interest may be noted as follows:

The names of five (5) Fellows (the same number as last year) have been dropped from the roll for non-payment of dues, each being three years in arrears.

The Fellows delinquent on dues for 1897 and 1898 number only eight (8), compared to fifteen (15) last year. Several of the eight have given notice of withdrawal, so that all but one, or possibly two, will drop out of our ranks early in the coming year, under the operation of section 3, chapter 1, of the By-Laws, since each will, after January 1, 1899, be more than two (2) years in arrears.

Thirty-one (31) Fellows are delinquent on dues for 1898, against thirty-four (34) at the same time last year.

Six (6) life commutations have been received, by payment of one hundred dollars ($100) each, so that the names of E. H. Barbour, J. P. Lesley, Arthur M. Miller, R. A. F. Penrose, J. W. Powell, and J. E. Talmage are now added to the previous list of twenty-nine, thus making thirty-five (35) in all who have secured life membership.

The invested funds of the Society have been increased two thousand dollars ($2,000) during the year, raising the total to five thousand dollars ($5,000), the cost of which to the Society has been $5,120.86.

The annual interest accruing upon these investments is two hundred and seventy-three dollars ($273), or five and one-third (5⅓) per centum upon the total cost, a very satisfactory rate considering the high character of the securities purchased.

The Council at its last meeting appointed the President, Treasurer, and Professor Scott a committee upon investments, with instructions to add fifteen hundred dollars ($1,500) to the invested fund. A most favorable time for purchase came in March, 1898, when war with Spain appeared certain, and securities of all kinds dropped in price. The committee concluded to exceed the limits advised by five hundred dollars ($500), and hence purchased two (2) one-thousand-dollar first-mortgage 5 per cent bonds of the Texas Pacific railroad, dated February 1, 1898, and maturing June 1, 2000 A. D., with accrued interest from December 1, 1897, for the sum of nineteen hundred and seventy-six dollars and twenty-five cents ($1,976.25). The interest upon these bonds is payable semi-annually, June 1 and December 1, and as their current market value is now $2,140, and the Society has already received one hundred dollars ($100) interest thereon during the year, the Treasurer is of the opinion that no mistake was made in exceeding the limit set by the Council, and is only sorry that our resources at the time would not permit the investment of an additional thousand.

The "interest" item of $32.98 has accrued to the treasury from the 4 per cent allowed upon monthly balances with the Security Trust Company of Rochester, N. Y., where the Secretary deposits all the proceeds from sales of publications. This sum added to the amount, $275.50, received during the year from investments, makes a total of $308.48, no inconsiderable sum, and largely offsetting the loss of revenue to the Society from those whose names (37) have been dropped from the roll for non-payment of dues during the entire history of the Society.

The receipts from interest have shown a steady increase since the first year of the Society's history, and the following summary exhibits their rate of growth:

Interest receipts	1888–1889..	$16 63	Interest receipts	1895–1896..	191 00
" "	1889–1890..	51 34	" "	1896–1897..	220 34
" "	1890–1891..	100 32	" "	1897–1898..	308 48
" "	1891–1892..	102 73			
" "	1892–1893..	150 15	Total receipts from interest,	1888–1898....	$1,470 01
" "	1893–1894..	158 96			
" "	1894–1895..	170 06			

The detailed operations of the treasury are shown by the following account of receipts and disbursements:

RECEIPTS.

Balance in treasury November 30, 1897			$2,043 08
Fellowship fees 1896 (10)	$100 00		
" " 1897 (37)	370 00		
" " 1898 (162)	1,620 00		
" " 1899 (1)	10 00		
		$2,100 00	
Initiation fees (6)		60 00	
Life commutation fees (6)		600 00	
Interest on investments:			
Tioga Township, Kansas, bonds	$70 00		
Cosmos Club bonds	87 50		
Tunnelton, Kingwood and Fairchance Railroad bonds	18 00		
Texas Pacific Railroad bonds	100 00		
On deposits in Security Trust Co., Rochester, N. Y., monthly balances	32 98		
		308 48	
Sales of publications by Secretary, deposited with Security Trust Co., Rochester, N. Y.		419 65	
			3,488 13
Total amount of receipts			$5,531 21

EXPENDITURES.

Total amount of receipts brought forward			$5,531 21
Expenses of Secretary's office:			
Account of administration	$91 10		
Account of Bulletin	112 16		
Allowance (to include ordinary traveling and clerical expenses)	300 00		
		$503 26	
Expenses of Editor's office:			
Account of administration, printing	$2 50		
Allowance (to include personal and office expenses)	160 00		
		162 50	
Expenses of Treasurer's office:			
Account of administration, printing	$4 40		
Account for postage, etc., for five years prior to 1898	100 00		
Account for postage for current year	20 00		
		124 40	
Publication of Bulletin:			
Printing	$1,112 99		
Engraving	231 91		
		1,344 90	
Photograph account:			
Geo. P. Merrill, expenses		12 50	
Expenses of Librarian		17 55	
Investment account:			
One Texas Pacific Railroad bond, No. 20892, 5 p. ct., $1,000, cost	$990 00		
One Texas Pacific Railroad bond, No. 11915, 5 p. ct., $1,000, cost	986 25		
		1,976 25	
Total amount of expenditures			4,141 36
Balance in treasury November 30, 1898			$1,389 85

The following summary exhibits the annual and total receipts and disbursements of the Society during the decade now closing:

RECEIPTS

	Annual dues.	Initiation fees.	Life commutations.	Interest.	Sales of publications.	Sundry acc'ts.	Total.
1888-'89	$1,820 00	....	....	$16 63	....	$0 50	$1,837 13
1889-'90	1,420 00	$40 00	$1,800 00	51 34	....	4 29	3,315 63
1890-'91	1,720 00	190 00	200 00	100 32	$157 35	106 95	2,474 62
1891-'92	2,160 00	160 00	100 00	119 22	426 85	200 94	3,167 01
1892-'93	1,840 00	80 00	....	150 15	598 05	2 00	2,670 20
1893-'94	1,880 00	150 00	100 00	158 96	576 80	10 00	2,875 76
1894-'95	1,910 00	150 00	200 00	170 06	491 50	77 50	2,999 06
1895-'96	1,880 00	120 00	....	191 00	638 45	90 80	2,920 25
1896-'97	1,840 00	140 00	300 00	220 34	821 35	....	3,321 69
1897-'98	2,100 00	60 00	600 00	308 48	419 65	....	3,488 13
Total..	$18,570 00	$1,090 00	$3,300 00	$1,486 50	$4,130 00	$492 98	$29,069 48

EXPENDITURES *

	Administration, Library, and Bulletin distribution.	Maps and photographs.	Publication, including editorial expenses.	Permanent investment.	Total.
1888-'89.........	$181 25	....	....	....	$181 25
1889-'90.........	368 87	$10 00	$1,763 46	....	2,142 33
1890-'91.........	323 58	....	2,691 25	$1,140 26	4,155 09
1891-'92.........	514 16	43 83	1,667 68	900 35	3,126 02
1892-'93.........	628 50	11 67	1,886 64	700 00	3,226 81
1893-'94.........	788 58	14 80	2,142 51	....	2,945 89
1894-'95.........	676 00	12 22	1,746 35	304 00	2,738 57
1895-'96.........	632 79	11 95	1,824 09	....	2,468 83
1896-'97.........	707 32	6 18	1,739 98	100 00	2,553 48
1897-'98.........	645 21	12 50	1,507 40	1,976 25	4,141 36
Total.........	$5,466 26	$123 15	$16,969 36	$5,120 86	$27,679 63

Balance on hand, uninvested $1,389 85

* The cost of distributing the Bulletin and the other expenses connected with the publication incurred by the Secretary's office are included under "Administration" expenses, in the second column. Since December, 1892, such expenditure for the Bulletin amounts to $1,104.72. For the earlier time the figures are not precise, but the total expense of this kind is about $1,300. Adding this amount to the total of column four would make the total cost of publication $18,269.36, and would reduce the cost of administration to $4,166.26.

The total expenses of the Library have been to date about $67.

The invested funds of the Society are as follows:

On account of publication fund:		
April 1, 1891, one Tioga township, Kansas, bond, cost $1,140.26	$1,000 00	
January 29, 1892, eight 5 per cent Cosmos Club bonds at par	800 00	
February 26, 1892, one 5 per cent Cosmos Club bond, with accrued interest, cost $100.35	100 00	
February 3, 1893, seven 5 per cent Cosmos Club bonds at par, cost $700	700 00	
May 1, 1895, two 10–20 gold bonds of Tunnelton, Kingwood and Fairchance railroad, bearing interest from January 1, 1895, cost $204	200 00	
September 27, 1895, one bond of Tunnelton, Kingwood and Fairchance railroad, with interest from July 1, 1895, cost $100	100 00	
January 27, 1897, one 5 per cent Cosmos Club bond, No. 56, first series, cost $100	100 00	
March 17, 1898, one Texas Pacific Railroad bond, No. 20892, 5 per cent, due June 1, 2000, interest payable semi-annually, cost $990	1,000 00	
March 25, 1898, one Texas Pacific Railroad bond, No. 11915, 5 per cent, due June 1, 2000, interest payable semi-annually, cost $986.25	1,000 00	
		$5,000 00

Respectfully submitted.

I. C. White,
Treasurer.

Morgantown, West Virginia, *December 10, 1898.*

Editor's Report.

To the Council of the Geological Society of America:

The publication of volume 9 has been attended with considerable delay and some annoyance to publishing members by reason of the absence of the Editor in Alaska from early March to the middle of October. Although the first brochure of the volume was issued at the usual time, December 30, the last one, owing to the absence above referred to, was not completed until December 1 (1898), instead of April 30, the usual close of the publication year. The delay would have been greater, but for the kindness of Mr J. S. Diller, who generously added to his other burdens that of carrying forward the editorial work, and pages 257 to 452 were printed under his direction.

Although, as just noted, the brochure containing the Proceedings of the Tenth Annual Meeting was not issued as a whole until December 1, 1898, it is due the authors appearing therein to state that "separates" of pages 401 to 452 were printed in July and distributed in September. It is not likely that delay will be again caused by similar conditions, and the attention of members is called to the desire and purpose of the Council to furnish the promptest medium of geological publication to be found in the United States, while the means now at the command of the Society insures the fullest illustration of papers.

Although volume 9 contains 460 pages and is copiously illustrated with 29 full-page half-tone plates and 49 line-work figures, it is the least expensive volume thus far issued by the Society, indicating that due regard has been paid to economy.

The printing of volume 10 is now well under way, and all material sent the Editor has been placed in the printer's hands. Attention is again called to the desirability of preparing an index of the ten volumes issued by the Society during its eleven years of existence. The making of such an index is no small task, and if the Council approves of such a step, plans should be perfected at the Winter Meeting in order that the work may be commenced before volume 10 is completed.

Although exact classification is not attempted, the contents of volumes 7, 8, and 9 are fairly well presented in the following comparative table:

Divisions.	*Vol. 7. Pages.*	*Vol. 8. Pages.*	*Vol. 9. Pages.*
Terminology	1	..	..
Dynamic geology	3	24	85
Economic geology	4	14	16
Relation of geology to pedagogy	12	..	..
Stratigraphic geology	21	67	28
Memoirs of deceased members	28	8	12
Areal geology	38	34	2
Petrology	40	43	44
Physiographic geology	53	5	..
Official matter	56	69	54
Rock decomposition	74	26	17
Glacial geology	105	98	138
Paleontology	123	58	64
Total	558	446	460

The cost of each of the nine volumes thus far issued by the Society is as follows:

	Vol. 1. (pp. 593; pls. 13)	Vol. 2. (pp. 662; pls. 23)	Vol. 3. (pp. 541; pls. 10)	Vol. 4. (pp. 458; pls. 10)	Vol. 5. (pp. 665: pls. 21)
Letter-press	$1,473 77	$1,992 52	$1,535 59	$1,286 39	$1,887 21
Illustrations	291 85	463 65	383 35	173 25	178 40
	$1,765 62	$2,456 17	$1,918 94	$1,459 64	$2,065 61

	Vol. 6. (pp. 528; pls. 27)	Vol 7. (pp. 558; pls. 24)	Vol. 8. (pp. 446; pls. 51)	Vol. 9. (pp. 460; pls. 29)
Letter-press	$1,341 93	$1,463 60	$1,262 22	$1,176 64
Illustrations	221 62	200 24	317 76	231 91
	$1,563 55*	$1,663 84*	$1,579 98	$1,408 55

*The actual cost to the Society was $77.50 less for volume 6, and $90.80 less for volume 7, those amounts being paid by authors for illustrations and correction charges.

Respectfully submitted. JOSEPH STANLEY-BROWN,
Editor.

WASHINGTON, D. C., *December 10, 1898.*

LIBRARIAN'S REPORT.

To the Council of the Geological Society of America:

The Library of the Society is housed on the third floor of the Case Library building, in Cleveland. The space allotted is at present sufficient, but more will be needed the coming year. The extra space and shelving required will no doubt be furnished, the Case Library authorities being disposed to allow us every facility in their power.

The contract with Case Library requires that they shall do all necessary binding; but prior to the appointment of your Librarian, one year ago, little had been done in this respect, the Library authorities not deeming themselves competent to determine what should or should not be bound. The amount of material needing binding was therefore great, amounting to between 350 and 400 volumes. It seemed neither just nor considerate to require the whole to be bound in one year. Of the whole number, 150 volumes have been cared for during the past year, and the whole will be completed within the next two years.

A careful inventory of the Library was made at the time of taking charge, showing nothing to be missing and everything in good order.

Some effort has been made during the past year to complete certain volumes of exchanges which were imperfect. The number was not great, and the immediate and cordial responses most gratifying.

The library comprises at the present time, in approximate numbers:

Bound volumes of Official Geological Surveys	290
Pamphlets of Official Geological Surveys	330
Proceedings of Scientific Societies, bound	223
Proceedings of Scientific Societies, unbound	200
Miscellaneous, mostly separate pamphlets	500

The use of the library is at present limited to those Fellows of the Society who reside in Cleveland, and to such patrons of the Case library as may wish to use it for reference. It is to be regretted that it is not of more service to the Fellows at large. It would seem that there must be a considerable number so situated that they lack access to a large library, and that to such it might be easily made a convenience. Quite possibly a complete list of at least the "foreign exchanges" of the library, in serviceable form, might facilitate such use. At present information concerning the contents of the library is only to be obtained from the lists of additions published annually in the Bulletin.

The Librarian would recommend that the Institute Geologico de Mexico be placed on the "exchange list" of the Society. Aside from the fact that the Society has no exchanges in Mexico, the number and character of the publications sent by that organization to the library of the Society would seem to warrant the procedure.

The expenses of the Librarian's office during the past year are as follows:

Stationery and printing.	$3 75
Postage and postal cards.	7 91
Rubber stamps.	2 75
Freight and expressage.	5 64
	$20 05

The last item represents the cost of transferring library material from Rochester to Cleveland. Nearly all such material now comes direct to Cleveland.

Respectfully submitted. H. P. CUSHING,
Librarian.

CLEVELAND, OHIO, *December 1, 1898.*

Upon motion of the Secretary, it was voted to defer consideration of the Council report until Thursday morning.

As the Auditing Committee, to examine the accounts of the Treasurer, the Society elected J. C. Smock and W. H. Holmes.

ELECTION OF OFFICERS

The result of the balloting for officers for 1899, as canvassed by the Council, was announced by the Secretary, and officers were declared elected as follows:

President:

BENJAMIN K. EMERSON, Amherst, Mass.

First Vice-President:

GEORGE M. DAWSON, Ottawa, Ont.

Second Vice-President:

CHARLES D. WALCOTT, Washington, D. C.

Secretary:

H. L. FAIRCHILD, Rochester, N. Y.

Treasurer:

I. C. WHITE, Morgantown, W. Va.

Editor:

J. STANLEY-BROWN, Washington, D. C.

Librarian:

H. P. CUSHING, Cleveland, Ohio.

Councilors (term expires in 1901):

W. M. DAVIS, Cambridge, Mass.
JOSEPH A. HOLMES, Chapel Hill, N. C.

ELECTION OF FELLOWS

The result of the balloting for Fellows, as canvassed by the Council, was announced, and the following persons were declared elected Fellows of the Society:

ALJA ROBINSON CROOK, A. B., Ph. D., Evanston, Illinois. Professor of Mineralogy and Petrography in Northwestern University.

NOAH FIELDS DRAKE, A. M., Ph. D., Tientsin, China. Professor of Geology and Mining in Imperial Tientsin University.

ARTHUR HUGO ELFTMAN, B. L., A. M., Ph. D., Grand Marais, Minnesota. Mining Engineer.

MYRON LESLIE FULLER, S. B., Boston, Massachusetts. Assistant in Geology, Massachusetts Institute of Technology.

AMADEUS WILLIAM GRABAU, S. B., M. S., Cambridge, Massachusetts. Fellow in Paleontology, Harvard University.

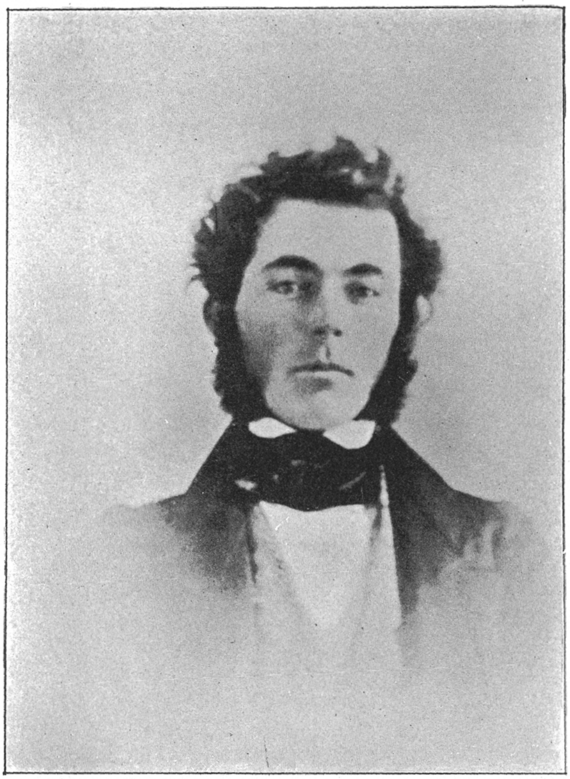
JOSEPH HYDE PRATT, Ph. B., Ph. D., Chapel Hill, North Carolina. Assistant Geologist, North Carolina Geological Survey.

FRANK CLEMES SMITH, B. S., E. M., Deadwood, South Dakota. Mining Engineer.

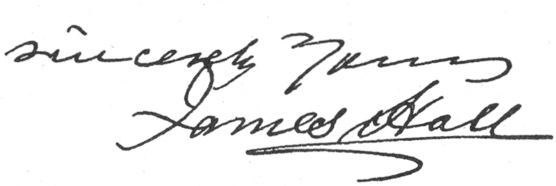
FRANK ROBERTSON VAN HORN, B. S., M. S., Ph. D., Cleveland, Ohio. Instructor in Geology and Mineralogy, Case School of Applied Science.

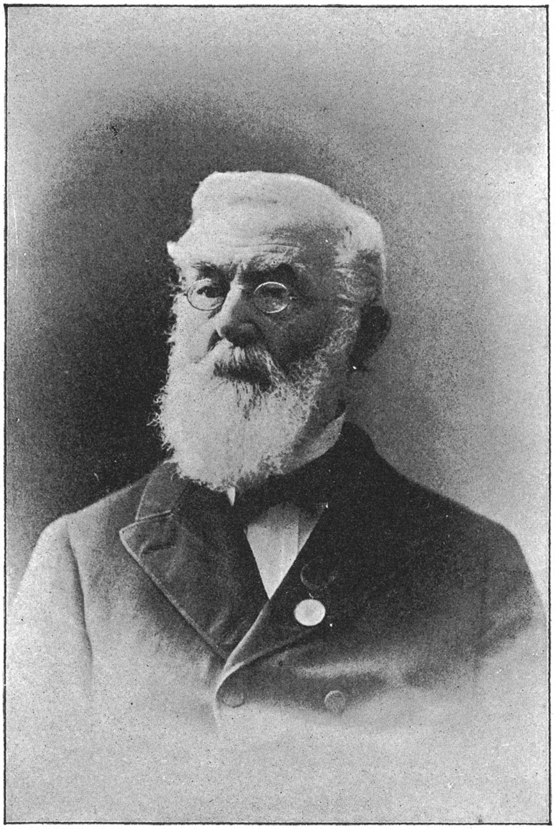
THEODORE GREELY WHITE, Ph. B., A. M., New York, New York. Assistant in Physics in Columbia University.

SAMUEL WENDELL WILLISTON, A. M., M. D., Ph. D., Lawrence, Kansas. Professor of Historical Geology in University of Kansas.



James Hall, 1847





James Hall, 1891

Sincerely Yours
James Hall

Announcements concerning certain details of the printed program and of the annual dinner were made by Professor J. F. Kemp and Mr E. O. Hovey.

The following memorial of the first President of the Society was read by the President from the Chair:

MEMOIR OF JAMES HALL

BY JOHN J. STEVENSON *

Professor James Hall, the first President of this Society, was born in Hingham, Massachusetts, September 12, 1811, and died in Echo Hill, Bethlehem, New Hampshire, August 7, 1898.

His father, James Hall, came from England, when only nineteen years old, to spend a year in travel through the United States. On the vessel he met a girl of his own age, Susan Dourdain, who, with her parents, was coming to reside in America. He married her soon after their arrival in Boston, and a rupture of friendly relations with his father followed, so that the young couple were compelled to make their way as best they might. Neither had been fitted by previous training for any such struggle, and poverty was always the lot of the family.

James Hall, the eldest son, was sent to the public school in Hingham, but lost much time, as his assistance was needed for support of the family. He succeeded, however, in obtaining private lessons in Latin and in securing books by doing, as he said, anything and everything. Nothing daunted him. When Silliman delivered the Lowell lectures in Boston, Hall attended them all, though on each occasion he had to walk from Hingham and back again.

His preparation for Rensselaer Institute having been completed, he hardly knew how, he went to Troy, where Eaton was imparting his own enthusiasm to nearly every pupil with whom he came into contact. It was soon discovered that the lad from Massachusetts had not merely a taste, but rather a passion, for natural history, and Eaton himself gained inspiration from him. Each summer was spent in fieldwork, under Eaton's direction, and often in company with Ebenezer Emmons, then an instructor in the Institute. Hall collected nearly nine hundred species of plants while a student and determined them. In geological excursions he reached as far south as the Coal Measures of the anthracite region, and had begun before his graduation that collection of fossil plants which afterwards proved so important.

*I am indebted to Mrs Thomas B. Bishop, of San Francisco, California, the daughter of Professor Hall, for information which has been used in preparing this memoir. The illustrations originally appeared in Science, and appear here through the courtesy of Professor J. M'K. Cattell, editor of that journal.

He received his degree in 1832. After a visit to the anthracite region of Pennsylvania he had still a little money in his pocket, with which he went to the Helderberg mountains, southwest from Albany, where he spent the summer in elaborating the section and in making collections. In September, when the money was almost gone, he returned on foot across the country to Troy to gather up his books, furniture, and collections, but without any definite notion as to what was to become of him or them. Until he reached his room in Troy the future had concerned him very little; the burdens of the present had sufficed; but as he sat there, with no plan for the future, the sense of absolute loneliness became so oppressive that he could not even pack.

Just then Eaton passed along the hallway and, looking in at the door, said, "Hall, what are you doing?" "Packing my property," was the reply. "Where are you going?" The answer was frank, "I do not know." Eaton urged him to remain, and, when Hall said that he had no money, replied simply, "We can arrange that." The result was that Hall was made librarian, with board and lodging as his compensation. As the library was small, the room assigned for it was very small, but it sufficed to accommodate the library and the librarian for several months. Before the close of the year he was made assistant professor at $600 a year and board, which gave him means for the prosecution of his work.

Eaton's attachment was very noteworthy. He brought his protégé to the attention of Stephen Van Rensselaer, the great patron of science, for whom Hall made explorations in Saint Lawrence county, his first systematic work in geology. This was done so well that when the State Geological Survey was organized, Van Rensselaer endeavored to obtain an independent appointment for Hall; but only four districts were made, and the best that could be secured was an appointment as assistant to Emmons, his colleague, who was thirteen years his senior.

There was little probability that this partnership would be pleasing to either, for each had done work in portions of the district and each held very positive views. Emmons in his annual report failed to make any reference to Hall or his work. Before the season of 1837 the state was redistricted, Mr Conrad withdrawing from the geological work to become the paleontologist. His district was taken by Mr Vanuxem, and Mr Hall succeeded to the fourth district, the level, uninteresting western portion of the state, which he was told was good enough for a young man of twenty-five. From that time his life was bound up in the official work for the state of New York, and after 1843 he was the survey. At the time of his appointment he was younger than any of his colleagues. Vanuxem had reached middle life, Emmons was thirty-eight, Conrad thirty-four, and Mather thirty-three; but some of them were still young enough to feel the importance of their years and to make the youngest member of the corps repent his aggressiveness.

The work in the fourth district was performed with characteristic energy. The region was not the western New York of today; roads were less numerous and less carefully made; exposures were rare and poor. It was necessary to wade along streams for miles to gain fragments which were to be pieced into tentative sections; the people were suspicious, fearing some new scheme for increasing the taxes; but none of these things moved him; as in later years, difficulties only increased his determination. So his is the only one of the four final reports which deals broadly with the problems of the young science, and, though upon the contemned fourth district, it is the only one which has endured with authority and become a classic in geological literature.

While the survey was in progress, Professor Hall, with his colleague, Professor Mather, and some gentlemen in Philadelphia, became interested in the mineral region of southeastern Ohio, where a large area was secured in 1838. Professor Mather soon afterward became a resident of Ohio, though retaining his position on the New York survey, and the property was allotted to the several purchasers, about 2,000 acres falling to Professor Hall. It was practically wilderness land, but studies by Hildreth and Briggs had shown that it lay within the best mineral region of the state, and, as afterward was discovered, Professor Hall's share was the best of the whole. When the fieldwork of the New York survey had been completed, Professor Hall made a journey to the Mississippi valley, partly to see his property, partly to trace the New York formations, and partly to make purchases of mineral lands for some gentlemen in New York. The banking system was uncertain then, and it was necessary to carry the whole sum to be invested sewed into the lining of his clothes.

While on this journey he remained for a few days in the house of Mr Henry Newberry, at Cuyahoga Falls, Ohio, where he became acquainted with John S. Newberry, then a lad of nineteen, who had become an enthusiastic collector of Coal Measures plants from his father's coal mine. He was able to give valuable information to Professor Hall respecting the distribution of the principal beds near Cleveland, which aided materially in determining plans for the journey, while he received in return the generic names of the plants which he had collected. This brief association had its influence on the lives of both. More than once Dr Newberry spoke to me of Hall's extraordinary gentleness and attractiveness, while Professor Hall's face always brightened as he spoke of the guileless boy whom he met at Cuyahoga Falls.

Upon returning to Albany, Professor Hall found Mr Conrad in a decided frame of mind. As paleontologist of the survey, he had found an accumulation of material that seemed too much for a lifetime. "To describe and figure the new species alone would require a great quarto volume with more than one hundred plates," was his moan. The prospect so terrified him that soon afterward he threw off the work and returned to Philadelphia. Mather was already in Ohio and Vanuxem had determined to retire to his farm. Hall and Emmons remained in Albany, desirous of retaining connection with state work that they might continue their studies. They were employed for a time in arranging the mass of material gathered during the survey work. While thus engaged, they discovered that the paleontology would prove even more important than Conrad had imagined. Each determined to be the paleontologist. The contest was hardly what might be termed friendly, but the outcome was that the paleontology was assigned to Hall, while Emmons was commissioned to write up the agriculture, and was appointed custodian or curator of the collections. But the new officials had hardly settled down to hard work when the legislature transferred the collections, or the cabinet of natural history, to the care of the Board of Regents of the University of the State of New York. The secretary of that board removed Doctor Emmons from the curatorship and thrust both of the geologists out of their quarters in the old State house. Soon afterward appropriations for the paleontology were cut off, except, curiously enough, those for the engraving, which were not opposed, but rather favored. At that time was begun a contest between Professor Hall and the board of regents which lasted for a number of years. When the executive officer of the board was changed the relations became friendly again, and so remained for many years.

Expelled from the State house, Professor Hall at once erected a building adjoining his residence, where his work was carried on until 1852, when he removed to a larger house. In 1857, after the state had begun appropriations for collecting fossils, he erected a very commodious brick building, in which the work was done until within a few years of his death. The first volume of the Paleontology was published in 1847 and made a notable impression, though the mechanical execution of the work, as well as the work itself, was far below the standard of later years. The second volume, published in 1852, was a great improvement upon the first, both in matter and manner, but prior to the appearance of the latter volume the state had abandoned further prosecution of the work. Its magnitude had not been foreseen at the beginning, but before the second volume was completed it was clear that the extent could hardly be foretold. This phase was emphasized so strongly by Professor Hall's chief opponent that frugal legislators were induced, in 1850, to cut off all appropriations for current expenses and salaries, though for some reason which does not appear on the surface the engraving contract was cared for and a small appropriation was made for drawings.

The state abandoned the work, but Professor Hall did not. Confident that it would be resumed, he retained his assistants for a time and continued the collecting and drawing until 1855, paying practically the whole cost. Despairing then of any assistance from the state, he accepted the proposition, made years before, by Sir William E. Logan, that he go to Canada as paleontologist with the expectation of becoming head of the survey upon Sir William's retirement in the near future. But, during the five years, Professor Hall had exhausted his cash resources and had incurred obligations which were pressing. A considerable sum of money was needed to pay his debts and to take him to Canada.

There was nothing available except the Ohio land, which he had kept, not to be sold until advancing years should render him unable to work. He always maintained that the property would be very valuable before his sixtieth birthday; but the sale had to be made, and he accepted an offer of $15,000, which enabled him to pay the obligations incurred to continue the work. Ten years afterward the property was valued at $200,000. Had it not been for this sacrifice, the "Paleontology of the State of New York" would have been closed with the second volume, in 1852.

In 1855 the Honorable Elias Leavenworth, then recently elected Secretary of State, learned that Professor Hall had determined to go to Canada. Realizing that to abandon the work in its incomplete condition would be discreditable to the state, he urged Professor Hall to delay, and called a meeting at his house to consider the matter. That meeting was attended by Professor J. D. Dana, Professor Agassiz, Sir William E. Logan, Mr Blatchford, and, among others, by Dr Beck, then, as for many years previously, Secretary of the Board of Regents. At this conference a plan for continuing the work was prepared, Professor Hall consenting to remain in case the legislature confirmed the agreement. The influence of Mr Leavenworth and Mr Blatchford prevailed with the legislature, and Professor Hall remained to carry on the work for 43 years.

I have thought well to dwell somewhat in detail upon these matters. Professor Hall was severely criticised because of the long intervals between the appearance of his second, third, and fourth volumes. Much of the criticism was due, no doubt, to the ignorance of the critics, who appear to have imagined that drawings of fossils can be made as rapidly as sketches of scenery; and that the writing of descriptions involves no more labor than the preparation of a report on a fire for a daily paper. The more intelligent criticism was due to ignorance of the conditions—that the state had abandoned the work, that the office staff had become broken, and that new hands as well as new minds had to be trained; that the work had, as it were, to be begun *de novo*. Even now it is not generally known that the great collections upon which much of the state paleontology is based were made by Professor Hall at his own expense prior to 1856 and very largely at his expense after 1866, the appropriations for collecting as such having continued practically only from 1856 to 1866.

The delay in beginning to publish the volumes after the third was due to exceedingly wise forethought. The work was published fragmentarily, so that results were made available to workers everywhere almost as soon as they were obtained, but the volumes did not appear promptly. Had they appeared promptly, had each division been finished in order, the work could have been stopped at any time; but the drawing and engraving went on for several volumes simultaneously, so that at no time for a number of years was any volume very near completion, but so much work had been done on all that continuation was necessary in order to save what had been expended already. More than once this argument prevailed with an unwilling committee, and the appropriations were ordered. On one occasion a very prominent citizen of New York city told me that there was no longer any use in trying to head off Professor Hall, for "he keeps so far ahead in his work that out of mere shame it is necessary to keep him at it."

The great mass of his publications appeared after he had reached three score years, an age when most men feel that the burdens of life should be lessened. He kept himself young by persistent work, and when eighty-six years old his mind was keen, more ready to accept new ideas and to reject erroneous, though cherished opinions, than when he was but thirty years old.

Professor Hall's energies, however, were not confined to the work in New York. Forty-seven years ago he contributed three important chapters to Foster and Whitney's report on the Lake Superior region; fifty-three years ago he prepared a discussion for Fremont's report, and soon afterward another for Stansbury's. His share of the Mexican Boundary report, published more than forty years ago, occupied 100 quarto pages. In the early fifties he sent Meek and Hayden to the Black Hills region to make collections of vertebrates and invertebrates, thus initiating the great work done afterward in the far west by those explorers. He was state geologist of Iowa and afterward of Wisconsin, meeting in each case with the degree of success which usually attends attempts to direct the survey of one commonwealth while residing in another, though he was able to publish important reports. He contributed an elaborate memoir to the Canada Survey publications. In later years his excursions into other states were confined to paleontological work, much of which was published jointly by himself and Professor R. P. Whitfield, the more important memoirs being those upon Ohio, Kentucky, and the Fortieth Parallel.

At the very outset of his career, when only 21 years old, he succeeded in determining the position of our Pennsylvania anthracites in the geological column. Eaton, in the second edition of his text-book, refers to proofs obtained at Carbondale by his pupils in 1832, showing the American coals, "bituminous and anasphalt," to be equivalent to those of Europe. The study of those fossils was by Hall, who made still further collections of coal plants, and determined 25 species. Eaton referred to this work in 1833 as the joint work of himself and Mr Hall. "It was the intention of Mr Hall and myself to have determined the names of all which had been determined by M. Brogniart, and to have given lithographic figures of the remainder, but we are prevented by other engagements."* At that time Hall was applying his knowledge of recent botany to paleobotany, so that he was enabled to give to Eaton the generalization which had escaped the Pennsylvania geologists, for, according to Lesley, even 3 years later, Taylor and others "drew a sharp distinction in age between Broad Top and Alleghany Mountain coal, and even Rogers expressed a doubt of their identity in an annual report."†

Professor Hall's influence upon American geology began with his reports. One must concede in all fairness that some of Professor Hall's friends in the earlier days gave him rather more credit for the New York state work than was properly his share, much more indeed than he ever claimed, the result being that in the minds of many he is thought to be entitled to the whole credit for the subdivision of the column. Conrad, Vanuxem, Eaton, and Emmons did good work; Conrad and Vanuxem on the survey did great work, which went far toward determining the section. Let us not fail to honor the men who were Hall's associates on that survey. Because they were not great in so many ways as Hall, they fall, as it were, deeply into shadow, and we are liable to overlook their excellence; the more so because nearly every one of them died before the younger generation of geologists were out of swaddling clothes, and to most of us they are but names.

Yet the credit for final, authoritative determination of the column must be given to Hall and to him alone. With the rest he had labored

* Amer. Jour. Science, vol. xxiii, p. 399.

† Second Geol. Surv. of Pennsylvania, Report A, p. 18.

to subdivide the column on physical grounds. The importance of paleontological confirmation was felt by all, and Conrad had tried to make the confirmation, but the examination of his list of fossils shows how defective his data were. The column thus divided was useful only for direct tracing and afforded nothing for general service. Professor Hall determined the fossils of each division, proved that the formations defined on physical grounds are practically coextensive with those defined on paleontological grounds, and so gave means for identification over broad areas. As this work was done within an offshore region, where changes in conditions were exceptionally numerous and positive, a too rigid application of the New York measuring line led at first to errors of correlation elsewhere; but those errors were inseparable from the times, when all the workers were self-trained and were becoming good geologists only by correcting their own errors.

Conrad was the first in our country to make extended study of Paleozoic fossils, but he soon abandoned the work. For a long time Professor Hall had the field so thoroughly to himself that he came to regard it as his own. For more than half a score of years he resented with great energy and no little acerbity any intrusion upon his domain. His great knowledge of forms, necessarily far beyond that of any other American student, rendered him not sufficiently tolerant of opposing opinions, and too frequently his criticisms had a scornful tone, which secured to him as an inalienable possession the implacable hatred of some of his contemporaries. But the systematic revision of his own work, begun almost two-thirds of a century ago, made its defects so manifest to him as absolutely to change his disposition toward fellow-students in paleontology. As the years went by ill-will toward scientific men who, as he believed, had done him injustice, disappeared; he sought friendship and cooperation where before he had repelled both. There were men for whom to the last he entertained certainly no affection. To have been indifferent toward them would have required him to be either more or less than man, and he was neither.

Professor Hall's thorough method of investigation was all his own, and the laboratory on the Albany hill was a training school for American paleontologists. One after another of his assistants having begun with him at the alphabet of the work went out to hew a special path for himself and to make American science respected. When we think of Meek, White, Whitfield, Walcott, Beecher, and Clarke, we think of American paleontology, for those men have given most of the literature on invertebrate paleontology, aside from that published by Hall himself. He impressed himself upon his assistants while he cultivated in them powers which he did not possess himself. He was a great teacher, for though we can not fail to see his impress in the method of every man who ever labored with him, yet we find the individuality of every man unchanged, so that his independent work is characteristically his own.

As a mere collector, Professor Hall could hardly be surpassed. He knew no duplicates; no two specimens of any species seemed precisely alike. He was one of the first to maintain the danger of mere species-making, and to insist on the gathering of abundant material. When he collected, he collected all there was. He believed in thorough work, whether in collecting or in studying. His first collection, on which was based much of his published work, went to the American Museum of Natural History in New York city, and much of the money obtained for it was expended in gathering another collection of immense bulk.

There is danger of forgetting that Professor Hall was preeminently a geologist. His quartos on the New York paleontology are his monument, and the casual observer is liable to see in him a biologist rather than a geologist; but until his later years he was a geologist. His studies were from the standpoint of one seeking to determine relations between the physical and biological conditions in order to solve problems of correlation. The great problems of geology, not those of biology, were uppermost in his mind until less than twenty years ago. His presidential address to the American Association for the Advancement of Science, in 1857, was so far in advance of the time as to be thought not merely absurd but mystical; yet today it is recognized as one of the most important contributions to one of the most difficult problems in physical geology. Even in his later years, when biological problems had assumed their proper importance for him, he would have resented an intimation that he was any less of geologist than before. When he succeeded in rehabilitating the New York survey, the economic side was not forgotten, and the annual reports presented to the legislature have been of late years as useful from the economic as from the scientific standpoint.

Professor Hall's work received recognition at home and abroad. He was foreign member of the London Geological Society, vice-president of the French Geological Society, correspondent of the Institute, foreign member of the Lincei, and of many other societies and academies. He had received the Wollaston medal and had been decorated by several monarchs. He was vice-president of the Geological Congresses at Paris and Bologna and honorary president of that at Washington. He was a charter member of the National Academy of Sciences and was president of the American Association in 1856. He received the degree of LL. D. from Hamilton College in 1863 and from McGill University in 1884.

As a youth, Professor Hall must have been merry and inclined to cast care to the winds. The old daguerreotype, reproduced here, suggests such a disposition, and Dr Newberry's description of him as a young man of sunny temperament, a delightful and absolutely irresistible companion, is such as one knowing him well in his later days would imagine. The contrast between the countenance of the young man at 35 and that of the old man at four score tells the story of a life filled with conflict. Burdens came early, but they belonged to the normal struggles of a New England youth, and had no effect except perhaps to make him more self-centered. Intimate association in the formative period with men like Eaton and Emmons, the incarnation of dogmatism, must have increased and confirmed a similar tendency in him, but could not have affected his disposition. Had matters run smoothly for half a score of years after the close of the survey, his life might have been an easier one; but he learned almost at once that a friend is a vain thing to lean upon, and soon afterward he was plunged into official conflicts, which lasted in one way or another until within three years of his death.

The fundamental feature of his character was childlike simplicity united to self-confidence and indomitable energy. Simplicity kept him from concealment of his purposes and self-confidence kept him from seeking easy modes of accomplishing them. Knowing what he wanted, he took a direct line, with little regard for anybody or anything which might be in the way to oppose. In early days the Albany officials did not understand him, believing his frankness to be but the cover for craftiness. He deceived his opponents by always telling the truth, something strange to politicians; but in time they came to understand him well, and strong men sought combat simply to measure strength, as in gladiatorial contests of olden time. Almost invariably he was victorious, but victory was often worse than defeat, for it converted into lifelong enemies men who before had been merely indifferent, and so it came about that, as a leading senator once said, "eternal vigilance is the price of Professor Hall's position." He held his place for almost two-thirds of a century through no favor of man, but solely because he refused to be displaced. His influence over governors, comptrollers, secretaries, and legislators was lost for little more than five years during the long period from 1843 to 1898. In bitter contest for years with a bureau of the state government and at times with prominent officials, he was pestered again and again with committees appointed too often not to investigate, but to condemn. With few exceptions, those committees appointed to curse returned to bless. Indeed, as Judge Draper once said, it is probable that Professor Hall drove more investigation committees up the stump than did any other man or group of men in our time.

Absolutely ignorant of the art of lobbying, unwilling or unable to conciliate an adversary, possessing pronounced political principles which he never concealed, this man by sheer force of will compelled men to rise superior to all party calls; so that throughout his career there were men of all shades of political opinion, inside and outside of the legislature, who held the preservation of his work to be a matter of supreme necessity for the welfare of the state.

But contests such as these, beginning in his early manhood, did not leave him unscarred. Surrounded by men hating him for his success, harassed by men anxious to reap the harvest which he had sowed, his life became one continuous anxiety. In later years his political and official foes were reinforced by others, who seemed to feel that he had done injustice to the world by living too long and thereby securing more than his share of profit. It is not strange that he was often stern and forbidding, carrying into scientific disputes the manner which was his wont when dealing with official adversaries; but it was easy to find the man if only one would, for in personal relations he gave his confidence as freely and affectionately as a child.

Take him all in all, Professor Hall was a great man. His excellencies were towering, his faults glaring. Transparent as crystal, his course was frank, open, and his word as good as a bond. His friends would do anything for him; his enemies would do anything against him. No one knowing him remained indifferent. For a friend he would sacrifice his own interests at any time. He was every read to crush an enemy in the abstract, but the enemy in the concrete, if needing assistance, could find no readier helper than he. Years of bitter aspersion were forgotten more than once when a slanderer became needy, and Professor Hall was quick to risk his own in rendering aid. He knew well how to distinguish between friend and flatterer. The wounds of a friend were never resented. He never desired his friends, in proof of friendship, to share in his enmities. He was a manly man, with a single aim throughout his life. Like a sturdy knight of medieval times, he kept his face toward the goal, turning neither to the right nor to the left—one of the grandest and most picturesque figures in the history of our science.

As he lived, so he died, self-reliant to the last. In 1897, at Saint Petersburg, he said that he intended to send his likeness to me in a gold frame, but not at once, as it would seem too much like the last farewell. During the winter of 1897–1898 he had several severe attacks of vertigo, and in the spring he wrote that there were evidences of giving way, such as to convince him that the work might not go on much longer. In July he must have felt that the end was approaching, for he sent the likeness on the plate of gold just as he left Albany for Echo Hill.

Though in good spirits and apparently in reasonably good physical condition when leaving Albany, he was stricken by vertigo soon after arriving at the hotel. This attack left him so enfeebled that the local physician urged his return to Albany. He refused, preferring to remain where he was and to await the end, which was likely to come suddenly. His letters gave no intimation of the conditions, but were written as calmly as though life were but beginning. Affairs of the survey received his attention in detail, and a long letter respecting them was written only two days before his death, when he was confined to his bed.

The end came as he appears to have expected. On Sunday afternoon, August 7, a servant carried a cup of beef tea to him and placed it near his bed. As she left the room she heard a crash, and, returning, found him lying on the floor beside the bed, dead. The effort to take the cup from the chair had brought on cerebral apoplexy, causing immediate and painless death. He lies buried in Albany, New York.

In 1843 Professor Hall married Susan, daughter of John Aiken, a lawyer of Troy, New York. She died April 25, 1895. Four children, two daughters and two sons, survive him.

BIBLIOGRAPHY OF JAMES HALL *

Books

1. Geology of New York: Part iv, comprising the survey of the Fourth Geological district. Albany, 1843, 682 pp., maps and plates.
2. Fremont's exploring expedition: Washington, 1845. Appendix A, Geological formations, pp. 295–303; B, Organic remains, pp. 304–310, 4 pls.
3. Palæontology of New York: Vol. 1, Albany, 1847, pp. xxiii, 338, 100 pls.
4. Report on the geology of the Lake Superior land district: By J. W. Foster and J. D. Whitney:
   Lower Silurian system: Washington, 1851, chapter 9, pp. 140–151.
   Upper Silurian and Devonian series: *Ibid.*, chapter 10, pp. 152–166.
   Description of new and rare species of fossils from the Palæozoic series: *Ibid.*, chapter 13, pp. 203–231.
   Parallelism of the Palæozoic deposits of Europe and America. *Ibid.*, chapter 18, pp. 285–318.
5. Stansbury's expedition to the Great Salt lake: Geology and Palæontology. Philadelphia, 1852, pp. 401–414.
6. Palæontology of New York: Vol. ii, Albany, 1852, pp. viii, 362, 104 pls.
7. United States and Mexican Boundary Survey (Emory). Geology and Palæontology of the boundary: Washington, 1857, pp. 103, 140, 20 pls. Also published in *American Journal of Science*, 2d ser.; see vol. 24, New Haven, 1857, pp. 72–86.

* This bibliography, to 1888, was published in the 42d Annual Report of the Trustees of the State Museum of Natural History. Professor J. M. Clarke brought the entries down to the close.

8. Geological Survey of the State of Iowa, vol. i, part i: Hall and Whitney. General geology, chapter ii, pp. 35–44; Geology of Iowa, general reconnoissance, chapter iii, pp. 45–46. Part ii: Palæontology of Iowa, chapter viii, pp. 473–724, 29 pls. Albany, 1858.
9. Contributions to the Palæontology of Iowa, being descriptions of new species of Crinoidea and other fossils (supplement to vol. i, part ii, of the Geological Report of Iowa): Albany, 1859, pp. 1–92, 3 pls.
10. Iowa Geological Survey: Supplement to vol. i, part ii, 1859, pp. 1–4.
11. Palæontology of New York: Vol. iii, part i, text, Albany, 1859, pp. xii, 522.
12. Supplement to vol. 1, published in Palæontology of New York, vol. iii, Albany, 1859, pp. 495–529.
13. Palæontology of New York: Vol. iii, part ii, plates, Albany, 1861, 141 pls. and explanations.
14. Report on the Geological Survey of the State of Wisconsin: Vol. i, James Hall and J. D. Whitney, Madison, 1862.
Chapter i, physical geography and general geology, pp. 1–72.
Chapter ix, palæontology of Wisconsin, pp. 425–448.
15. Geological Survey of Canada, figures and descriptions of Canadian organic remains: Decade ii, Graptolites of the Quebec group, Montreal, 1865, 151 pp., 23 pls.
16. Palæontology of New York: Vol. iv, part i, Albany, 1867, pp. xi, 428, 69 pls.
17. Geological Survey of the State of Wisconsin, 1859–1863: Palæontology, part iii, organic remains of the Niagara group and associated limestones, Albany, 1871, pp. 1–94, 18 pls.
(Same as published in 1864 in advance for *Eighteenth Report and Twentieth Report, New York State Museum of Natural History, 1867*, under title of "Account of some new or little-known species of fossils from rocks of the age of the Niagara group;" also in revised edition of same in 1870.)
18. Geological Survey of Ohio: Vol. ii, geology and palæontology; part ii, palæontology, Columbus, 1875.
Descriptions of Silurian fossils: James Hall and R. P. Whitfield. *Ibid.*, pp. 65–161.
19. Descriptions of Crinoidea from the Waverly group: James Hall and R. P. Whitfield. *Ibid.*, pp. 162–179.
20. Illustrations of Devonian fossils: Albany, 1876, 7 pp., 133 pls., with interleaved descriptions.
21. United States geological explorations of the fortieth parallel: Clarence King. Vol. iv, ornithology and palæontology; part ii, palæontology, James Hall and R. P. Whitfield, Washington, 1877, pp. 199–302, 7 pls.
22. Palæontology of New York: Vol. v, part ii, text, Albany, 1879, pp. xv, 492, 120 pls.
23. Palæontology of New York, vol. v, pt. i: Lamellibranchiata I. Text and plates, Albany, 1884, pp. xviii, 268, pls. 45.
24. Palæontology of New York, vol. v, pt. i: Lamellibranchiata II. Text and plates, Albany, 1885, pp. lxiv, 269–562, pls. 51.
25. Palæontology of New York, vol. v, pt. i: Lamellibranchiata, plates and explanations, Albany, 1883, pp. 20, pls. 78.
26. Palæontology of New York, vol. vi: Corals and Bryozoa. By James Hall, assisted by George B. Simpson, Albany, 1887, pp. xxvi, 298, pls. 66.

27. Palæontology of New York, vol. vii, pp. lxiv, 236, pls. 46. By James Hall, assisted by John M. Clarke; with supplement to vol. v, part ii, Albany, 1888, pp. 42, pls. 114–129.
28. Palæontology of New York, vol. vii: Text and plates. By James Hall, assisted by J. M. Clarke. Containing descriptions of the Trilobites and other crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung, and Catskill groups, pp. i–lxiii, 1–236, pls. i–xxxvi (49), 1888.
29. Palæontology of New York, vol. v, part ii: Supplement, containing descriptions and illustrations of Pteropoda, Cephalopoda, and Annelida, pp. 1–42, pls. cxiv–cxxxix, 1888.
30. Palæontology of New York, vol. viii: By James Hall, assisted by J. M. Clarke. An introduction to the study of the genera of the Palæozoic Brachiopoda, part 1, pp. i–xvi, 1–367, pls. 1, 2, i–xx (44), 1892.
31. Palæontology of New York, vol. viii, part 2, fascicle 1: By James Hall, assisted by J. M. Clarke, pp. 1–176, 1893.
32. Palæontology of New York, vol. viii, part 2, fascicle 2: By James Hall, assisted by J. M. Clarke, pp. 177–317, 1893.
33. Palæontology of New York, vol. viii: By James Hall, assisted by J. M. Clarke. An introduction to the study of the Palæozoic Brachiopoda. Part 2, pp. i–xvi, 1–394, pls. xxi–lxxxiv, 1894.
34. A memoir on the Palæozoic reticulate sponges constituting the family Dictyospongidæ: Part 1. By James Hall, in collaboration with J. M. Clarke. *Fifteenth Ann. Rept. State Geol.*, vol. 2, pp. 739–984, pls. i–xlvii. (In press.)
35. A memoir on the Palæozoic reticulate sponges constituting the family Dictyospongidæ: Part 2. By James Hall, in collaboration with J. M. Clarke. *Sixteenth Ann. Rept. New York State Geol.* (In press.)

Scientific Papers Published in Reports, Transactions of Societies, Journals, Magazines, etcetera *

1. Catalogue of plants growing without cultivation in the vicinity of Troy: By John Wright and James Hall, Troy, 1836, 42 pp.
2. Descriptions of two species of trilobites belonging to the genus *Paradoxides: American Journal of Science and Arts*, vol. xxxiii, New Haven, 1837, pp. 139–143.
3. Second Annual Report of the Fourth Geological District of New York: Assembly Doc. 200, Albany, 1838, pp. 287–373.
4. Third Annual Report of the Fourth Geological District of the State of New York: Assembly Doc. 275, Albany, 1839, pp. 287–339.
5. Fourth Annual Report of the Survey of the Fourth Geological District: Assembly Doc. 50, Albany, 1840, pp. 389–456.
6. Fifth Annual Report of the Fourth Geological District: Assembly Doc. 150, Albany, 1841, pp. 149–180.
7. Notes explanatory of a section from Cleveland, Ohio, to the Mississippi river, in a southwest direction, with remarks upon the identity of the western formations with those of New York: *Transactions of the Association of American Geologists and Naturalists*, Boston, 1842, pp. 267–293.

* The title or an abstract only was given of papers in the list marked with an asterisk (*), as full notes were not furnished for publication.

8. Remarks upon casts of mud furrows, wave lines, and other markings upon rocks of the New York system : *Ibid* , pp. 422–432.
9. Niagara Falls. Their physical changes and the geology and topography of the surrounding country : *Boston Journal of Natural History*, vol. iv, Boston, 1842, pp. 106–134.
10. Notes upon the geology of the western states : *Am. Jour. Science and Arts*, vol. xlii, New Haven, 1842, pp. 51–62.
11. * Geographical distribution of fossils of the Palæozoic strata of the United States : *Proc. Am. Assoc. Geol. and Naturalists* (published in) *Am. Jour. Sci. and Arts*, vol. 45, New Haven, 1843, pp. 157–160.
12. * Ripple marks and casts of furrows : *Ibid.*, vol. 45, New Haven, 1843, pp. 148, 149.
13. * Sections at Portage : *Ibid.*, vol. 45, New Haven, 1843, pp. 329, 330.
14. Address before the Society of Natural History of the Auburn Theological Seminary, 1843 : Auburn, 1844, pp. 1–20.
15. * Geographical distribution of fossils. *Am. Jour. Sci.*, vol. 47, New Haven, 1844, pp. 117, 118.
16. Description of some microscopic shells from the decomposing marl slate of Cincinnati : *Ibid.*, vol. 48, New Haven, 1845, pp. 292–295.
17. Notice of the geological position of the cranium of the *Castoroides ohioensis : Boston Journal of Natural History*, vol. v, Boston, 1846, pp. 385–391.
18. * On the supposed impression in shale of the soft parts of an Orthoceras : *Quar. Journal, Geological Society London*, vol. v, London, 1848, pp. 107–111.
19. On the parallelism of the Palæozoic deposits of North America with those of Europe, followed by a table of the species of fossils common to the two continents, with indication of the positions in which they occur, and terminated by a critical examination of each of these species, by Ed. de Verneuil (translated and condensed from the Bulletin of the Geological Society of France, 2d ser., vol. iv) : *Am. Jour. Sci. and Arts*, 2d ser., vol. v, New Haven, 1848, pp. 176–183, 359–370 ; *Ibid.*, 2d ser., vol. vii, New Haven, 1849, pp. 45–51, 218–231.
20. Remarks on the observations of S. S. Haldeman "on the supposed identity of *Atops trilineatus* with *Triarthrus beckii*" : *Am. Jour. Sci. and Arts*, 2d ser., vol. v, New Haven, 1848, pp. 322–327.
21. Catalogue of specimens in the geological department of the Geological Survey of New York : *First Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1848, 39 pp.
22. Catalogue of specimens in the Palæontological department of the Geological Survey of New York : *Ibid.*, 15 pp.
23. * Upon some of the results of the palæontological investigations in the state of New York : *Am. Jour. Sci.*, 2d ser., vol. v, New Haven, 1848, pp. 243–249.
24. List of minerals, geological specimens, and fossils added to the collections, 1847, 1848 : *Second Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1849, 4 pp.
25. On the trails and tracks in the sandstones of the Clinton group of New York ; their probable origin, etcetera, and a comparison of some of them with Nereites and Myrianites : *Proc. Am. Assoc. Adv. Sci.*, 2d meeting (Cambridge, 1849), Boston, 1850, pp. 256–260.
26. On the Brachiopoda of the Silurian period ; particularly the Leptænidæ : *Ibid.*, pp. 347–350.

27. On Graptolites, their duration in geological periods, and their value in the identification of strata: *Ibid.*, pp. 351–352.
28. Description of new species of fossils, and observations upon some other species previously not well known from the Trenton limestone: *Third Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1850, pp. 167–175, 5 pls.
29. * Remarks on the geology of Mackinac, Drummond, and Saint Josephs islands and the northern shores of lake Michigan: *Proc. Am. Assoc. Adv. Sci.*, 4th meeting (New Haven, 1850), Washington, 1851, p. 354.
30. * Report on the invertebrate fossils exhibited to the Association: *Proc. Am. Assoc. Adv. Sci.*, 5th meeting (Cincinnati, 1851), Washington, 1851, p. 180.
31. * Parallelism of the Palæozoic rocks of New York with those of the western states and of all those with the Palæozoic strata of Europe: *Ibid.*, p. 59.
32. * On the Silurian rocks of the Lake Superior land district: *Ibid.*, pp. 64–66.
33. * Catalogue of specimens of the rocks and fossils in the gray sandstone, Medina sandstone, Clinton group, Niagara group, Onondaga salt group, and a part of the Waterline group: *Fourth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1851, pp. 119–146.
34. On Drummonds island: *Proc. Am. Acad. Arts and Sci.*, vol. ii, Boston, 1852, pp. 253, 254.
35. * Comparison of the geological features of Tennessee with those of the State of New York: *Proc. Am. Assoc. Adv. Sci.*, 6th meeting (Albany, 1851), Washington, 1852, pp. 256–259.
36. * Remarks upon the fossil corals of the genus *Favosites* and allied fossil genera *Favistella*, *Astrocerium*, and others: *Ibid.*, p. 306.
37. * On the Palæozoic genera *Trematopora*, *Callopora*, etc.: *Ibid.*, p. 306.
38. * Tracks, trails, etc., in the shales and sandstones of the Clinton group from Green bay, with remarks on the thinning out and reappearing of this portion of the Clinton group: *Ibid.*, 306.
39. * Remarks on the trilobite of the Potsdam sandstone, named by Dr Owen *Dikellocephalus*, and its relations to Asaphus and Ogygia: *Ibid.*, p. 301.
40. * Remarks upon the fossils of the Potsdam sandstone: *Ibid.*, p. 304.
41. Notice of a geological map of the United States and the British provinces of North America, with explanatory text, geological sections and plates of the fossils which characterize the formations, by J. Marcou: *Am. Jour. Sci.*, 2d ser., vol. 17, New Haven, 1854, pp. 199–206.
42. Rapport sur la Partie Geologique de l'Exposition de New York. C. Lyell and J. Hall. Traduit par M. A. Langel: *Annales des Mines*, vol. vi, Paris, 1854, pp. 1–85.
43. Report on coal lands in Kentucky for the Kentucky Mining and Manufacturing Company: B. Silliman and J. Hall, New York, 1855, 16 pp.
44. * Observations upon the geology of the Mauvaises Terres, Nebraska, with notices of the geographical and geological range of some of the fossils of that region: *Proc. Am. Assoc. Adv. Sci.*, 8th meeting (Washington, 1854), Cambridge, 1855, p. 290.
45. * Remarks upon a collection of Cretaceous fossils from Nebraska, and the absence of species known in southern extension of same formation: *Ibid.*, p. 290.
46. * Remarks upon the results of extensive and continued collections of fossil species from a portion of the Silurian rocks of New York, showing the number of species and individuals of each species obtained from a limited locality during a period of ten years: *Ibid.*, p. 290.

47. *On the reproduction of similar types or representative species in successive geological formations, illustrated by a collection of species of the *Brachiopoda* from the Niagara and Lower Helderberg groups of the Palæozoic rocks of the United States: *Ibid.*, p. 290.
48. *Red sandstone of the Connecticut River valley and the proofs of its Oölitic or Liassic age: *Ibid.*, p. 290.
49. *Remarks upon the geological formation of the country along the line of the [Mexican] Boundary Survey, based upon the examinations of Dr Parry, made under the order of Major [W. H.] Emory: *Ibid.*, p. 291.
50. *The Silurian and Devonian systems and the nature of the evidence for drawing a line of separation between the two systems in the United States: *Ibid.*, p. 291.
51. *On the western limits of the Cretaceous formation on the northern continent of America as evidenced by the various collections that have been made by exploring expeditions under the direction of the government of the United States: *Ibid.*, p. 291.
52. *Contributions to our knowledge of the geology of Nebraska and the Mauvaises Terres: *Proc. Am. Assoc. Adv. Sci.*, ninth meeting (Providence, 1855), Cambridge, 1856, p. 277.
53. *Notes upon the genus *Graptolithus: Ibid.*, p. 277.
54. *On the development of the septa in the genus *Baculites* from the extreme young to the adult state: *Ibid.*, p. 277.
55. Descriptions of new species of fossils from the Cretaceous formations of Nebraska, with observations upon *Baculites ovatus* and *B. compressus*, and the progressive development of the septa in Baculites, Ammonites, and Scaphites: J. Hall and F. B. Meek. *Memoirs of the American Academy of Arts and Sciences*, vol. v, new series, Cambridge, 1856, pp. 379-411, 8 pls.
56.. On the genus *Tellinomya* and allied genera: *The Canad. Nat. and Geol.*, vol. 1, Montreal, 1856, pp. 390-395.
57. Observations on the genus *Archimedes* or *Fenestella*, with descriptions of species, etc.: *Proc. Am. Assoc. Adv. Sci.*, tenth meeting (Albany, 1856), Cambridge, 1857, pp. 176-180.
58. On the Carboniferous limestones of the Mississippi valley: *Ibid.*, pp. 51-69.
59. Opening address before the American Association: *Ibid.*, pp. 230-232.
60. *On some points in the geology of the upper Mississippi valley: *Ibid.*, p. 226.
61. *On the results of collections of fossils during a period of ten years in the limestones of the Lower Helderberg: *Ibid.*, p. 227.
62. Observations upon the Carboniferous limestones of the Mississippi valley. [Abstract.] *Am. Jour. Sci.*, 2d ser., vol. 23, New Haven, 1857, pp. 187-203.
63. Remarks upon the genus *Archimedes* or *Fenestella* from the Carboniferous limestones of the Mississippi valley: *Ibid.*, pp. 203, 204.
64. Observations upon the Cretaceous strata of the United States, with reference to relative position of fossils collected by the [Mexican] Boundary Commission: *Am. Jour. Sci. and Arts*, 2d ser., vol. 24, New Haven, 1857, pp. 72-86.
65. Descriptions of Palæozoic fossils: *Tenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Appendix C, Albany, 1857, pp. 41-180.
66. *On the Cretaceous formations of the United States and the North American continent: *Proc. Am. Assoc. Adv. Sci.*, 11th meeting (Montreal, 1857), Cambridge, 1858, p. 158.

67. * On the Carboniferous limestones and Coal Measures of the United States (published in the Geological Report of Iowa, 1858): *Ibid.*, p. 158.
68. * On the direction of ancient currents of deposition and the source of materials in the older Palæozoic rocks, with remarks on the origin of the Appalachian chain of mountains: *Ibid.*, p. 158.
69. Contributions to the geological history of the American continent (the address of the retiring president, delivered before the first Montreal meeting of the American Association for the Advancement of Science, August, 1857): Published in the *Proc. Am. Assoc. Adv. Sci.*, 2d Montreal meeting, 1882, Salem, 1883, pp. 29–71.
70. Notes upon the genus *Graptolithus* and description of some remarkable new forms from the shales of the Hudson River group discovered in the investigations of the Geological Survey of Canada, under the direction of Sir W. E. Logan, F. R. S.: *Canadian Naturalist and Geol.*, vol. 3, Montreal, 1858, pp. 139–150, and 161–177.
71. * Observations upon the genus *Graptolithus* and allied genera: *Proc. Am. Assoc. Adv. Sci.*, 12th meeting (Baltimore, 1858), Cambridge, 1859, p. 287.
72. * Observations upon the genus *Meganteris* and other Palæozoic Brachiopoda: *Ibid.*, p. 287. Contributions to the Palæontology of New York: *Twelfth Ann. Rept. Cab. Nat. of Hist.*, Albany, 1859.
73. Notice of the genera *Ambonychia*, *Palæarca*, and *Megambonia*: *Ibid.*, pp. 8–14.
74. Observations on the genera *Capulus*, *Pileopsis*, *Acroculia*, and *Platyceras*: *Ibid.*, pp. 15–22.
75. Observations on the genera *Platyostoma* and *Strophostylus*: *Ibid.*, pp. 20–22.
76. Observations on the genus *Nucleospira*: *Ibid.*, pp. 23–34.
77. Observations on the genus *Eatonia*: *Ibid.*, pp. 34–37.
78. Observations on the genus *Rensselaeria*: *Ibid.*, pp. 38–41.
79. Observations on the genus *Camarium*: *Ibid.*, pp. 42–44.
80. Notes upon the genus *Graptolithus*: *Ibid.*, pp. 45–58.
81. Trilobites of the shales of the Hudson River group: *Ibid.*, pp. 59–62.
82. Catalogue of the species of fossils described in volumes i, ii, iii of the Palæontology of New York, with the corrections on nomenclature as far as determined to the present time: *Ibid.*, pp. 63–87.
83. Corrected list of the fossils described in the Report of the Fourth Geological District of New York: *Ibid.*, pp. 87–92.
84. Catalogue of the species of fossils described in the third volume of the Palæontology of New York; *Ibid.*, pp. 93–96.
85. Supplementary note on the genus *Ambonychia*: *Ibid.*, p. 110.
86. New species of fossils from the Niagara group of Wisconsin: *Report of Progress for 1859*, Albany, 1860, pp. 1–4.
87. Descriptions of new species of fossils from the Silurian rocks of Nova Scotia: *Can. Nat. and Geol.*, vol. v, Montreal, 1860, pp. 144–158.
88. * Relations of the genus *Eurypterus*: *Proc. Am. Acad. Arts and Sci.*, 1859, vol. iv, Boston, 1860, p. 353.

Contributions to palæontology, 1858 and 1859: *Thirteenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Appendix F, Albany, 1860.

89. Notices of new forms of the genus *Graptolithus* and allied genera: *Ibid.*, pp. 55–64.

[From supplement to vol. i, Pal. N. Y., published in vol. iii.]

90. On Rhynchonella, etc.: *Ibid.*, pp. 65–69.
91. Observations on Orthis, Skenidium, Ambocœlia, etc.: *Ibid.*, pp. 69–73.
92. Observations on the genera *Athyris* (=*Spirigera*), *Merista* (= *Camarium*), *Meristella*, and *Leiorhynchus*: *Ibid.*, pp. 73–75.
93. Descriptions of new species of fossils from the Hamilton group of western New York, with notices of others from the same horizon in Iowa and Indiana: *Ibid.*, pp. 76–94.
94. Notes and observations upon the fossils of the Goniatite limestone in the Marcellus shale of the Hamilton group, in the eastern and central parts of the state of New York, and those of Goniatite beds of Rockford, Indiana, with some analogous forms from the Hamilton group proper: *Ibid.*, pp. 95–112.
95. Note upon the Trilobites of the shales of the Quebec group in the town of Georgia, Vermont: *Ibid.*, pp. 113–119.
96. New species of fossils from the Hudson river group of Ohio and other western states: *Ibid.*, pp. 119–121.
97. Observations upon a new genus of Crinoidea, *Cheirocrinus*: *Ibid.*, p. 121.
98. Descriptions of new species of Crinoidea, from investigations of the Iowa Geological Survey: Preliminary notice, Albany, 1861, p. 19.
99. Report of the superintendent of the Geological Survey, exhibiting the progress of the work; Geological Survey of Wisconsin; descriptions of new species of fossils from the investigations of the survey: Madison, 1861, 52 pp.
100. New species of Orthoceras: Geol. of Vermont, Claremont, N. H., 1861, p. 718.
Contributions to paleontology, being some of the results of investigations made during the years 1859 and 1860: *Fourteenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Appendix C. Albany, 1861.
101. Observations upon some new and other species of fossils from the rocks of the Hudson River group of Ohio and the western states, with descriptions: *Ibid.*, pp. 89–92.
102. Note on the genera *Bellerophon, Bucania, Carinaropsis*, and *Cyrtolites*: *Ibid.*, pp. 93–98.
103. Descriptions of new species of fossils from the Upper Helderberg, Hamilton, and Chemung groups, with observations upon previously described species: *Ibid.*, pp. 99–109.
104. Descriptions of new species of Crinoidea from the Carboniferous rocks of the Mississippi valley: *Jour. Bost. Soc. Nat. Hist.*, Boston, 1861, vol. 7, pp. 251–328; also published separate August, 1872, with 7 plates.
105. On the primordial fauna and Point Levis fossils: *Am. Jour. Sci. and Arts*, 2d ser., vol. 31, New Haven, 1861, pp. 220–226; also published in *Can. Nat. and Geol.*, vol. vi, Montreal, 1861, pp. 113–120.
106. On the Potsdam sandstone and Hudson River rocks in Vermont: *Am. Jour. Sci. and Arts*, vol. 33, New Haven, 1862, pp. 106, 107.
107. Rejoinder to criticisms on contributions to palæontology: *Ibid.*, pp. 127–132.
108. *On the formation of mountain chains: *Proc. Am. Acad. Arts and Sci.* [1861], vol. v, Boston, 1862, pp. 240–251.
Contributions to palæontology. (Continuation of Appendix C.) Descriptions of new species of fossils from the Upper Helderberg, Hamilton, and Chemung groups, continued from page 109 of the Fourteenth Annual Report of the Regents of the University upon the State Cabinet: *Fifteenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1862.

109. Contributions to palæontology: *Ibid.*, pp. 1–53.
110. Preliminary notice of the trilobites and other crustacea of the Upper Helderberg, Hamilton, and Chemung groups: *Ibid.*, pp. 54–86. (Published September, 1861.)
111. Preliminary notice of the species of Crinoidea known in the Upper Helderberg and Hamilton groups of New York: *Ibid.*, pp. 87–125.
112. Observations upon a new genus of Brachiopoda: *Ibid.*, pp. 126-127.
113. Observations on the genera *Athyris* = *Spirigera*, etc. (Reprinted from the Thirteenth Report, with explanation): *Ibid.*, pp. 148–163.
114. Note on the genus *Cypricardites: Ibid.*, pp. 164, 165.
115. Notes and corrections: *Ibid.*, pp. 167–169.
116. On a new crustacean from the Potsdam sandstone: *Can. Nat. and Geol.*, vol. 7, Montreal, 1863, pp. 443–445.

Contributions to palæontology, principally from investigation made during the years 1861 and 1862: *Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Appendix D, Albany, 1863.

117. Descriptions of new species of Brachiopoda from the Upper Helderberg, Hamilton, and Chemung groups: *Ibid.*, p. 19.
118. Observations upon some of the Brachiopoda, with reference to the characters of the genera *Cryptonella, Centronella, Meristella, Trematospira, Rhynchospira, Retzia, Leptocœlia*, and other allied forms: *Ibid.*, pp. 38–61.
119. Observations upon the genus *Streptorhynchus*, with remarks upon some species heretofore referred to the genera *Strophomena* and *Orthis: Ibid.*, pp. 61–66.
120. Note on the geological range of the genus *Receptaculites* in American Palæozoic strata: *Ibid.*, pp. 67–69.
121. Note on the occurrence of Astylospongia in the Lower Helderberg rocks: *Ibid.*, pp. 69–70.
122. On the occurrence of crustacean remains of the genera *Ceratiocaris* and *Dithyrocaris*, with a notice of some new species from the Hamilton group and Genesee slate [with a plate]: *Ibid.*, pp. 71–75.
123. Observations upon some spiral-growing fucoidal remains of the Palæozoic rocks of New York: *Ibid.*, pp. 76–83, 1 pl.
124. Observations upon the genera *Uphantænia* and *Dictyophyton*, with notices of some species from the Chemung group of New York and the Waverly sandstone of Ohio: *Ibid.*, pp. 84-91, 4 pls.
125. The flora of the Devonian period: *Ibid.*, pp. 92–109, 4 pls.
126. Preliminary notice of the fauna of the Potsdam sandstone, with remarks upon the previously known species of fossils, and descriptions of some new ones from the sandstone of the upper Mississippi valley: *Ibid.*, pp. 119–209, 6 pls.
127. Supplementary note on the Potsdam sandstone: *Ibid.*, pp. 210–222.
128. Notes and corrections: *Ibid.*, pp. 223-226.
129. Observations upon some of the Brachiopoda, with reference to the genera *Cryptonella, Centronella, Meristella*, and allied forms: *Trans. Albany Institute*, vol. iv, Albany, 1864, pp. 125–147 [1863]; also published in *Am. Jour. Sci.*, 2d ser., New Haven, 1863, vol. 35, pp. 396–406; vol. 36, pp. 11–15.
130. Preliminary notice of some species of Crinoidea from the Waverly sandstone series of Summit county, Ohio, supposed to be of the age of the Chemung group of New York: *Seventeenth Ann. Rept. N. Y. State Cab. Nat. Hist.*, published in advance, Albany, 1863, pp. 50–60.

131. Descriptions of new species of fossils from the Carboniferous limestones of Indiana and Illinois, read in 1856 and published separately: *Trans. Alb. Inst.*, vol. iv, 1864.
132. *On the genus *Eurypterus: Ibid.*, 1860, p. 280.
133. *On the formation of mountain chains: *Ibid.*, pp. 284, 285.
134. *On the geology of Wisconsin: *Ibid.*, 1864, pp. 288, 295.
135. *Remarks on oil springs: *Ibid.*, p. 303.
136. *Remarks on the Taconic system: *Ibid.*, pp. 289, 292, 293.
137. *On the Niagara group: *Ibid.*, p. 301.
138. Notice of some new species of fossils from a locality of the Niagara group in Indiana, with a list of identified species from the same place: *Ibid.*, Albany, 1864 [1862], pp. 195–228.
139. Notes upon the oil region of Canada West, and its geographical relations, 1865, 7 pp.
140. Report upon the property of the Empire State Iron and Coal Company of Georgia [giving some account of the geology of northwestern Georgia], Albany, 1866, 24 pp.
141. Descriptions of some new species of Crinoidea and other fossils from the lower Silurian strata of the age of the Hudson River group and Trenton limestone, 17 pp.; printed in advance from the Report of the State Cabinet for 1866, Albany, 1866; also published in the Twenty-fourth Report, 1872.
142. Observations upon some species of Spirifera, being the concluding remarks of the chapter on the descriptions of species of that genus from the Upper Helderberg, Hamilton, and Chemung groups: From the Palæontology of New York, vol. iv, pp. 252–257, unpublished; *Proc. Am. Phil. Soc.*, vol. x, Philadelphia, 1866, pp. 246–254.
143. On the occurrence of an internal convoluted plate within the body of certain species of Crinoidea: *Proc. Boston Soc. Nat. Hist.*, 1864, vol. x, Boston, 1866, pp. 33, 34.
144. Notes upon the geology of some portions of Minnesota, from St. Paul to the western part of the State: *Trans. Am. Phil. Soc.*, 1866, Philadelphia, 1867, pp. 329–340.
145. *On the structure of the mountains and valleys in Tennessee, northern Georgia, and Alabama: *Proc. Am. Assoc. Adv. Sci.*, fifteenth meeting (Buffalo, 1867), Cambridge, 1867, p. 105.
146. *Remarks on the geological structure of southern Minnesota: *Ibid.*, p. 105.
147. *Observations on the structure and mode of growth of the spines on the cardinal area of Chonetes, with remarks on the distribution of some species of the genus: *Ibid.*, p. 105.
148. *On the structure of the spires in the genera *Athyris*, *Meristella*, and other genera of Spiriferidæ: *Ibid.*, p. 105.
149. *On some characters of Spirifera and the geographical and geological distribution of some of the species: *Ibid.*, p. 106.
150. Notice of volume iv of the Palæontology of New York: *Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1867, pp. 145–167; also printed separately.
Contributions to Palæontology: *Ibid.*
151. Introduction to the study of the Grapolitidæ: *Ibid.*, pp. 169–240, 4 pls.
152. The genus *Chonetes: Ibid.*, pp. 242–244.
153. Reports on the genera *Productus*, *Strophalosia*, *Aulosteges*, and *Productella: Ibid.*, pp. 245–250.

154. On the genera *Spirifera*, *Cyrtina*, and allied genera: *Ibid.*, pp. 251-257.
155. On the genera *Athyris*, *Merista*, and *Meristella*: *Ibid.*, pp. 258-266.
156. Note upon the genus *Zygospira* and its relations to *Atrypa*: *Ibid.*, pp. 267-268.
157. Remarks upon the genera *Rhynchonella* and *Leiorhynchus*: *Ibid.*, pp. 269-273.
158. Note on the genus *Eichwaldia*: *Ibid.*, pp. 274-278.
159. On the genus *Tropidoleptus*: *Ibid.*, pp. 279-281.
160. Note on the genus *Palæaster*, with descriptions of some new species, and observations upon those previously described: *Ibid.*, pp. 282-303, 1 pl.
161. Account of some new or little-known species of fossils from rocks of the age of the Niagara group (originally printed in advance for the Eighteenth Report in the New York State Cabinet, 1864): *Ibid.*, pp. 305-401, 15 pls.
162. * Observations on the genus *Streptorhynchus*: *Ibid.*, p. 241.
163. * Observations on the genus *Strophodonta*: *Ibid.*, p. 241.
164. * On the genera *Pentamerus* and *Stricklandinia*, and their supposed relations with Rensselaeria: *Ibid.*, p. 273.
165. * On the genera *Terebratula*, *Centronella*, *Cryptonella*, etc.: *Ibid.*, p. 279.
166. * Descriptions of some new species of Crinoidea and other fossils from the Lower Silurian strata, principally of the age of the Hudson River group: *Ibid.*, p. 304.
167. * Descriptions of Bryozoa and corals from the Lower Helderberg group of New York: *Ibid.*, p. 304 (published in Twenty-sixth Report, 1874).
168. * Descriptions of Bryozoa, etc., from the Upper Helderberg and Hamilton groups of New York: *Ibid.*, p. 304 (published in *Trans. Alb. Inst.*, 1882).
169. * Miscellaneous notices: *Ibid.*, p. 304.
170. * On the geological relations of the mastodon and fossil elephant (see Twenty-first Report on the State Cabinet of Natural History, Albany, 1871): *Am. Assoc. Adv. Sci.*, 16th meeting (Burlington, 1867), Cambridge, 1868, p. 161.
171. * On the geographical distribution of the sediments and of the fossils in the Hamilton, Portage, and Chemung groups of New York: *Ibid.*, p. 161.
172. * On the value of the term Hudson River group in geological nomenclature (see also for printed notes Proceedings Nashville Meeting, Am. Assoc. Adv. Sci., 1877): *Ibid.*, p. 161.
173. * On the occurrence of fossil sponges in the successive groups of the Palæozoic series: *Ibid.*, p. 161.
174. Geological history of the North American continent; a lecture delivered before the American Institute in New York (Albany, 1869), 24 pp.
175. * Preliminary notice of the Lamellibranchiata of the Upper Helderberg, Hamilton, and Chemung groups: *Proc. Am. Assoc. Adv. Sci.*, 18th meeting (Salem, 1869), Cambridge, 1870, p. 282.
176. Preliminary notice of the Lamellibranchiate shells of the Upper Helderberg, Hamilton, and Chemung groups, with others from the Waverly sandstones. (Preparatory for the Palæontology of New York.) Part ii: *State Cab. Nat. Hist.* (December, 1869), Albany, 1870, 97 pp.
177. * Recent progress in geology: *Trans. Alb. Inst.*, 1865, vol. vi, Albany, 1870, pp. 291-294.
178. * Notice of the fossil plants of the Hamilton and Chemung groups, with reference to the source of the sediments of these formations: *Proc. Am. Assoc. Adv. Sci.*, 19th meeting (Troy, 1870), Cambridge, 1871, p. 362.

179. * On the relation of the Oneonta sandstone and Montrose sandstone of Vanuxem to the Hamilton and Chemung groups: *Ibid.*, p. 362.
180. * Note upon the rocks of the Huronian system on the peninsula of Michigan: *Ibid.*, p. 362.
181. * Remarks on the occurrence of the genus *Dithyrocaris* in the Hamilton and Chemung rocks of New York: *Ibid.*, p. 363.
182. Notes and observations on the Cohoes mastodon: *Twenty-first Ann. Rept. N. Y. State Cab. Nat. Hist.*, 1868, Albany, 1871, pp. 99–148 and maps.
183. * Remarks upon the Catskill red sandstone group as it occurs upon the borders of New York and Pennsylvania: *Proc. Am. Assoc. Adv. Sci.*, 20th meeting (Indianapolis, 1871), Cambridge, 1872, p. 418.
184. Reply to a "Note on a question of priority": *Am. Jour. Sci. and Arts.*, 3d ser., vol. iv, New Haven, 1872, pp. 105–109.
185. Report on the water supply of the city of Albany: *Trans. Alb. Inst.*, vol. viii, Albany, 1872, pp. 218–227. (J. Hall, G. W. Hough, T. Hun, L. C. Cooley.)
186. The New York State Museum of Natural History; its history and present condition; 4 pp.
Printed as a pamphlet; taken from Albany *Evening Times*, February 5, 1873.
187. Descriptions of new species of fossils from the Devonian rocks of Iowa. J. Hall and R. P. Whitfield: *Twenty-third Ann. Rept. N. Y. State Cab. Nat. Hist.*, Albany, 1873 (should be 1872), pp. 223–238.
188. Notice of three new species of fossil shells from the Devonian of Ohio. J. Hall and R. P. Whitfield: *Ibid.*, pp. 240, 241.
189. Notice of two new species of fossil shells from the Potsdam sandstone of New York. J. Hall and R. P. Whitfield: *Ibid.*, pp. 241, 242.
190. Notes on some new or imperfectly known forms among the Brachiopoda, etc. (published March, 1871; reprinted with explanation of figures March, 1873): *Ibid.*, pp. 244–247.
191. Descriptions of new species of fossils from the vicinity of Louisville, Kentucky, and the falls of the Ohio. J. Hall and R. P. Whitfield: *Twenty-fourth Ann. Rept. N. Y. State Mus. Nat. Hist.*, Albany, 1872, pp. 181–200 (6 plates for same in Twenty-seventh Report).
192. Report on fossil trees of Schoharie county: *Ibid.*, pp. 15, 16.
193. Remarks on some peculiar impressions on sandstone of the Chemung group, New York. J. Hall and R. P. Whitfield: *Ibid.*, pp. 201–204.
194. Descriptions of new species of Crinoidea and other fossils from strata of the age of the Hudson River group and Trenton limestone (in part previously published in 1866): *Ibid.*, pp. 205–224, 3 pls.
195. Descriptions of new species of fossils from the Hudson River group, in the vicinity of Cincinnati, Ohio: *Ibid.*, pp. 225–232, 1 pl. (published October, 1871, in advance of the State Cab. Rept.).
196. * On the occurrence of trunks of *Psaronius* in an erect position, resting on their original bed, in rocks of Devonian age in the state of New York, with some inferences regarding the condition of the sea bottom and shoreline during the deposition of the strata: Report of the *British Association for the Advancement of Science*, 42d meeting (Brighton, 1872), London, 1873, p. 103.
197. * On the relations of the Middle and Upper Silurian (Clinton, Niagara, and Lower Helderberg) rocks of the United States: *Ibid.*, pp. 103, 104 (published in full in the *Geological Magazine*, vol. ix, London, 1872, 4 pp.).

198. On the relations of the Niagara and Lower Helderberg formations, and their geographical distribution in the United States and Canada: *Proc. Am. Assoc. Adv. Sci.*, 22d meeting (Portland, 1873), Salem, 1874, pp. 321–335; (also published in *Twenty-seventh Ann. Rept. N. Y. State Mus. Nat. Hist.*, 1875, with map).

199. Descriptions of Bryozoa and corals of the Lower Helderberg group: *Twenty-sixth Ann. Rept N. Y. State Mus. Nat. Hist.*, Albany, 1874, pp. 93–115 (published in advance).

200. The Anderson School of Natural History and Geology of Penikese Island: Field meeting Albany Institute, Albany, 1874, 4 pp.

201. Descriptions of new species Goniatitidæ, with a list of previously described species: *Twenty-seventh Ann. Rept. N. Y. State Mus. Nat. Hist.*, Albany, 1875, pp. 132–136; (also published in advance, 1874).

202. On the geology of the southern counties of New York and adjacent parts of Pennsylvania, especially with reference to the age and structure of the Catskill mountain range: *Proc. Am. Assoc. Adv. Sci.*, 24th meeting (Detroit, 1875), Salem, 1876, pp. 80–84; also published in *American Journal*, 3d ser., vol. 12, New Haven, 1876, pp. 300–304.

203. The fauna of the Niagara group in central Indiana: *Twenty-eighth Ann. Rept. N. Y. State Mus. Nat. Hist.*, documentary edition, 32 plates and explanations, 1875, Albany, 1876.

204. *Note upon the geological position of the serpentine limestone of northern New York and an inquiry regarding the relations of this limestone to the Eozoön limestone of Canada: *Proc. Am. Assoc. Adv. Sci.*, 25th meeting (Buffalo, 1876), Salem, 1877, p. 385; published in *American Journal*, 3d ser., vol. 12, 1876, pp. 298–300.

205. Note upon the history and value of the term Hudson River group in American geological nomenclature: *Proc. Am. Assoc. Adv. Sci.*, 26th meeting (Nashville, 1877), Salem, 1878, pp. 259–265.

206. The hydraulic beds and associated limestones at the falls of the Ohio: *Trans. Alb. Inst.*, vol. ix, 1877, Albany, 1879, pp. 167–180; also published in *Pal. N. Y.*, vol. v, part ii, Albany, 1879, pp. 139–148.

207. Note on the genus *Plumalina*: *Thirtieth Rept. N. Y. State Mus. Nat. Hist.*, Albany, 1878, Museum edition, 1879, pp. 255, 256.

208. The fauna of the Niagara group in central Indiana: *Twenty-eighth Report*, State Museum edition, Albany, 1879, pp. 99, 203, 32 pls.

209. Notice of some remarkable crinoidal forms from the Lower Helderberg group: *Ibid.*, Albany, 1880, pp. 205–210, 3 pls.; also published in 4to.

210. De la nomenclature des terrains palæozoiques aux Etats-Unis: *Extrait du Cong. Internat. de Geologie*, 1878, Paris, 1880, pp. 1–8.

211. *The fauna of the Lower Helderberg group in relation to the corals, Bryozoa, and Echinodermata: *Proc. Am. Assoc. Adv. Sci.*, 28th meeting (Saratoga, 1879), Salem, 1880, p. 488.

212. *Notes upon the genera *Fenestella*, *Hemitrypa*, etc.: *Ibid.*, p. 488.

213. *On the present condition of the work upon the palæontology of New York: *Ibid.*, p. 488.

214. Corals and Bryozoans of the Lower Helderberg group: *Thirty-second Ann. Rept. N. Y. State Museum Nat. Hist.*, Albany, 1879, pp. 141–176; also published separately and distributed in 1880, Albany, 1880, 38 pp.

215. Notes upon the relations of the Oneonta and Montrose sandstones of Vanuxem and their relation to the sandstones of the Catskill mountains [read before the National Academy of Science, New York meeting (November, 1882)]: *Science*, vol. i, New York, 1880, p. 280.

216. Descriptions of new species of fossils from the Niagara formation at Waldron, Indiana: *Trans. Alb. Inst.*, vol. x, Albany, 1882, pp. 57–76 (read in 1879 and published separately in 1881).

217. Bryozoans of the Upper Helderberg group: *Trans. Alb. Inst.*, vol. x, Albany, 1882, 36 pp. (read in March, 1881, and published separately in 1881.)

218. Bryozoans of the Upper Helderberg and Hamilton groups: *Trans. Alb. Inst.*, vol. x, Albany, 1882, pp. 145–197 (same as 217, with the addition of the Hamilton Bryozoa, published as a separate pamphlet in 1882).

219. Fossil corals of the Niagara and Upper Helderberg groups: Published in advance of the Annual Report of the State Museum of Natural History, August, 1882, pamphlet, 59 pp.

220. Descriptions of the species of fossils found in the Niagara group at Waldron, Indiana. Indiana Department of Geology and Natural History: *Eleventh Ann. Report for 1881*, Indianapolis, 1882, pp. 217–345 (also bound separately).

221. Contributions to the geological history of the American continent: Address of the retiring president delivered before the first Montreal meeting of the American Association for the Advancement of Science, August, 1857 (see No. 59), with notes by James Hall and T. S. Hunt, Salem, 1882.

222. * Note upon the genus *Plumalina* [*Plumalites* in error]: *Proc. Am. Assoc. Adv. Sci.*, 31st meeting (Montreal, 1882), Salem, 1883, p. 419.

223. On the relation of Dictyophyton, Phragmodictyum, and similar forms with Uphantænia: *Ibid.*, p. 419.

224. Van Cleve's fossil corals. Indiana Department of Geology and Natural History: *Twelfth Annual Report for 1882*, Indianapolis, 1883, pp. 239–270, 14 pls.

225. Descriptions of fossil corals from the Niagara and Upper Helderberg groups of Indiana: *Ibid.*, pp. 271–318, 14 pls. (Same as 219, with some revision and the addition of the plates; also republished with lithographed plates in *Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist.*, 1884.)

226. Spergen Hill fossils: *Ibid.*, pp. 319–375, 4 pls. (Same as 131, with additional notes and the four plates which are reproduced from *Bull. No. 3, Am. Mus. Nat. Hist.*, 1882.)

227. Discussion upon the manner of growth, variation of form, and characters of the genus *Fenestella* and its relations to Hemitrypa, Polypora, Retepora, Cryptopora, etc.: *Second Rept. of the State Geologist for 1882*, Albany, 1883, pp. 5–16.

228. Fossil corals and Bryozoans of the Lower Helderberg group and fossil Bryozoans of the Upper Helderberg group: *Ibid.*, pls. 1–33 and interleaved explanations.

229. Brachiopoda, plates and explanations: *Ibid.*, pls. 34–61, inclusive, and interleaved explanations.

230. Preliminary notice of the Lamellibranchiate shells of the Upper Helderberg, Hamilton, and Chemung groups (preparatory for the Palæontology of New York). Part i (see No. 176): *Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist.*, Albany, 1884, pp. 215–406 G (also published separately, with 5 plates additional).

231. Descriptions of the species of fossil reticulate sponges constituting the family Dictyospongidæ: *Ibid.*, pp. 465–481, pls. 18–21 (also published in advance without plates).
232. Bryozoa (Fenestellidæ) of the Hamilton group: *Thirty-sixth Ann. Rept. N. Y. State Mus. Nat. Hist.*, Albany, 1884, pp. 57–72 (also published separately).
233. On the structure of the shell in the genus *Orthis: Ibid.*, pp. 73–75, pls. 3, 4 (also published separately).
234. Descriptions of a new species of *Stylonurus* from the Catskill group: *Ibid.*, pp. 76, 77, 1 pl. (also published separately).
235. Illustration of Cryptozoon: *Ibid.*, pl. 6 and explanation (also published separately).
236. Some new plant forms lately found in the Peach Bottom slates of southeastern York and southern Lancaster counties: *Trans. Am. Inst. of Mining Engineers*, Troy meeting, 1883, 2 pp., 3 pls., 1884.
237. Preliminary note on the microscopic shell structure of the Palæozoic Brachiopoda: *Proc. Am. Assoc. Adv. Sci.*, 32d meeting (Minneapolis, 1883), Salem, 1884, pp. 266–268.
238. Note on the Eurypteridæ of the Devonian and Carboniferous formations of Pennsylvania. Second Geological Survey of Pennsylvania: *Report of Progress*, PPP, Harrisburg, 1884, pp. 23–39, 6 pls. (also published separately).
239. Classification of the Lamellibranchiata: *First Report of the State Geologist for 1881*, Albany, 1884, pp. 8–15, 11 pls.
240. Descriptions of the Bryozoans of the Hamilton group (Fenestellidæ excepted): *Third Report of the State Geologist for 1883*, Albany, 1884, pp. 5–61.
241. * Note on the intimate relations of the Chemung group and Waverly sandstone in northwestern Pennsylvania and southwestern New York: *Proc. Am. Assoc. Adv. Sci.*, 33d meeting (Philadelphia, 1884), Salem, 1885, pp. 416–419.
242. Note on the Eurypteridæ of the Devonian and Carboniferous formations of Pennsylvania, with a supplementary note on *Stylonurus excelsior: Ibid.*, pp. 420–422.
243. On the mode of growth and relations of the Fenestellidæ (continuation of No. 226): *Fourth Report of the State Geologist for 1884*, Albany, 1885, pp. 35–45, 2 pls.
244. Note (on some Palæozoic pectenoid shells): *Report State Geologist for 1884*, Albany, 1885, pp. 47, 48; figs. 1–6, p. 46.
245. On the relations of the genera *Strictopora*, *Ptilodictya*, *Acrogenia*, and allied forms in the Palæozoic rocks of New York: *Report State Geologist for 1884*, Albany, 1885, p. 46, figs. 1–6.
246. Report on building stones (communicated to the commissioners of the new capitol, 1868): *Thirty-ninth Ann. Rept. N. Y. State Mus. Nat. Hist.*, pp. 186–285 (also published separately, pp. 1–44, 1886).
247. Plates and explanations, published in advance of Palæontology of New York, vol. vi, pls. xxv, xxvii, xxix, xxx–xxxii, xl, xli, xliv, xlv, xlviii, l, li, liii: *Fifth Ann. Rept. State Geologist*, 1886.
248. Plates and explanations of Cephalopoda, supplementary to Palæontology of New York, vol. v, part ii, pls. (cxvii) 1–(cxxix) 14: *Fifth Ann. Rept. State Geologist*, 1886.
249. Field-notes on the geology of the Mohawk valley, with a map: *Fifth Ann. Rept. State Geologist*, 1886, 89 pp.

250. Note on the Oneonta sandstone in the vicinity of Oxford, Chenango county, N. Y.: *Fifth Ann. Rept. State Geologisl*, 1886, p. 11.

251. Note on the discovery of a skeleton of an elk (*Elaphus canadensis*) in the town of Farmington, Ontario county, N. Y.: *Sixth Ann. Rept. State Geologtst*, 1880, p. 39.

252. Note on the occurrence of the Dictyospongidæ in the State of New York, pp. 36–38, with map: *Sixth Ann. Rept. State Geologist*, 1886.

253. Descriptions of Fenestellidæ of the Hamilton group of New York: *Sixth Ann. Rept. State Geologist*, 1886, pp. 41–70, pls. i–vii.

254. Palæontology of New York, vol. vii, extract from supplement (Pteropoda and Annelida): Albany, 1888, pp. 1–24, pls. cxiv–cxvi*a*.

255. Descriptions of new species of Fenestellidæ of the Lower Helderberg group, with explanations of plates illustrating species of the Hamilton group, described in the Report of the State Geologist for 1886, 1888: *Ann. Rept. State Geologist for 1887*, pp. 391, 392 (*Forty-first Mus. Rept.*), pls. viii–xv.

256. Crustacean tracks in the Potsdam sandstone: *Forty-second Ann. Rept. N. Y. State Mus.*, 1889, pp. 25–34, pl.

257. On the genus *Spirifera* and its interrelations with the genera *Spiriferina*, *Syringothyris*, *Cyrtia*, and *Cyvtina*: *Bull. Geol. Soc. Am.*, vol. 1, pp. 567, 568, 1889.

258. Some suggestions regarding the subdivision and grouping of the species usually included under the generic term *Orthis*, in accordance with external and internal characters and microscopic shell structure: *Ibid.*, pp. 19–21.

259. New forms of Dictyospongidæ from the rocks of the Chemung group: *Ninth Ann. Rept. State Geologist*, pp. 56–60; *Bull. Geol. Soc. Am.*, vol. 1, p. 22, 1890.

260. On the genus *Orbiculoidea*. James Hall, assisted by J. M. Clarke. (Published in advance): *Palæontology of New York*, vol. 8, part 1, pp. 120–160, pls. iv*e*, iv*f*, 1889.

261. Preliminary notice of *Newberria*, a new genus of Brachiopods, with remarks on its relations to Rensselaeria and Amphigenia: *Tenth Ann. Rept. New York State Geologist*, pp. 91–99, pls. v, vi, 1891.

262. A geological map of the state of New York: *Trans. Am. Inst. Mining Engineers*, Plattsburg meeting, October, 1892, pp. 1–7.

263. Review of "A catalogue of North American Crustacea confined to the non-trilobitic genera and species, by A. W. Vogdes": *The Financial and Mining Record*, February 22, 1890.

264. An introduction to the study of the Brachiopoda, intended as a handbook for the use of students. Part 1. James Hall, assisted by J. M. Clarke: *Eleventh Ann. Rept. New York State Geologist*, pp. 128–300, pls. 1–22, 1892.

265. An introduction to the study of the Brachiopoda, intended as a handbook for the use of students. Part 2. James Hall, assisted by J. M. Clarke: *Thirteenth Ann. Rept. New York State Geologist*, pp. 749–943, pls. 23–54, 1894.

266. Preliminary geologic map of New York, exhibiting the structure of the state so far as known. Prepared under the direction of James Hall, state geologist, by W J McGee, 1894.

267. The new species of Brachiopoda described in Palæontology of New York, vol. viii, parts 1 and 2. James Hall, assisted by J. M. Clarke: *Fourteenth Ann. Rept. State Geologist*, pp. 323–402, pls. 1–14, 1895.

The presentation of scientific papers was introduced by the annual address of the President, entitled :

OUR SOCIETY

BY THE PRESIDENT, JOHN J. STEVENSON

This address is printed as pages 83–98 of this volume; also in Science, volume ix, pages 41–52.

Following the President's address the second paper of the program was read :

ARCHEAN-POTSDAM CONTACT IN THE VICINITY OF MANITOU, COLORADO

BY W. O. CROSBY

This paper is printed as pages 141–164 of this volume.

The Society adjourned for lunch and reconvened at 2.15 o'clock p m. In the absence of President Stevenson, First Vice-President Emerson occupied the chair during the afternoon session. The first paper of this session was

OUTLINE OF THE GEOLOGY OF HUDSONS BAY AND STRAIT

BY ROBERT BELL

Remarks were made by the chairman and by J. B. Tyrrell, David White, and H. S. Williams.

The next paper was

UPPER ORDOVICIAN FAUNAS IN LAKE CHAMPLAIN VALLEY

BY THEODORE G. WHITE

Contents

INTRODUCTION

This paper is a preliminary study of the faunas contained in strata of the Black River, Trenton, and Utica formations in the valley in which lake Champlain lies.

Comparatively little attention has been given to the paleontology of the region until quite recently, but the field is one which affords unusually good opportunities for the study of the entire Ordovician series from the base of the Calciferous to an horizon which is at least well up toward the top of the Utica slates. The metamorphism which a short distance from the lake on the Vermont side nearly obliterated the fossil contents of the rocks did not extend to the edge of the lake in most cases. This is contrary to the impression which might be gained from the legend employed on the large wall-map of the state by Professor Hall and Mr McGee (1894). On both lake shores are numerous localities where the low-dipping strata abound in remains of organisms and afford excellent advantages for the study of a continuous section.

The results in the present paper represent the summary of a detailed laboratory examination of a mass of material, aggregating several tons in weight, collected at the localities described during the summers from 1893 to 1896, inclusive, and now deposited in the geological museum of Columbia University.

In the early period of the organization of the New York state geological survey but little attention was devoted to the details of stratigraphy or enumerations of the fossils contained in the formations which comprised the "Champlain division" of the New York system before that divisional designation was transferred to the upper portion of the geological column. Volume I of the Palæontology of New York mentions but 16 fossil species from the three formations under consideration, in the Champlain valley, 4 from the Black River zone, 12 from the Trenton, and none from the Utica or the Hudson. The 1861 report on the Geology of Vermont enumerates 32 Trenton and 5 Utica species. Our investigations to date, in the localities enumerated in the present contribution, show more than 100 species, exclusive of corals, bryozoa, and ostracods, of each of which groups there are many representatives, and which are now in the hands of Mr E. O. Ulrich for identification.

The close detailed work of Logan, published in the 1863 report on the geology of Canada, added much information regarding the stratigraphy of the northern end of the lake. The papers of Marcou,* in connection with the Cambrian and Taconic controversies, and the theory of precursory "colonies," have increased our knowledge of several of the Ordovician localities. More recently the papers of Walcott,† Whitfield,‡ Brainerd and Seely,§ Kemp,|| Cushing,¶ Ells,** and Ami †† have largely

*J. Marcou: Bull. Soc. Géol. France, 3d ser, vol. xi, 1883, pp. 407–435; Mem. Boston Soc. Nat. Hist., vol. iv, 1888, pp. 105–131; Proc. Amer. Acad., vol. xx, 1885, pp. 174–256.

†C. D. Walcott: Bull. 30, U. S. Geological Survey, 1886; Am. Jour. Sci., 3d ser., vol. xxxiii, 1888, pp. 229–242, 307–327, 394–401; Am. Jour. Sci., 3d ser., vol. xxxix, 1890, pp. 101–115; Bull. 81, U. S. Geological Survey, 1891.

‡R. P. Whitfield: Bull. Amer. Mus. Nat. Hist., vol. i, 1886, pp. 293–345; Ibid., vol. ii, 1889, pp. 41–63; Ibid., vol. iii, 1890, pp. 25–39; Bull. Geol. Soc. Am., vol. i, 1890, pp. 514, 515; Ibid., vol. ix, 1897, pp. 177–184.

§E. Brainerd and H. M. Seely: Am. Geologist, vol. ii, 1888, pp. 323–330; Bull. Geol. Soc. Am., vol. i, 1890, pp. 501–511: Ibid., vol. ii, 1891, pp. 293–300; Bull. Am. Mus. Nat. Hist., vol. iii, 1890, pp. 1–23; Ibid., vol. viii, 1896, pp. 305–315.

||J. F. Kemp: Bull. 107, U. S. Geological Survey, 1893; Rept. State Geologist N. Y. for 1893 (1894), pp. 433–472; Fifteenth Ann. Rept. New York State Geologist, 1895, pp. 576–614; Bull. N. Y. State Mus., vol. iii, 1895, pp. 322–355.

¶H. C. Cushing: Ann. Rept. New York State Geologist for 1893 (1894), pp. 473–489; Bull. Geol. Soc. Amer., vol. vi, 1895, pp. 285–296; Fifteenth Ann. Rept. New York State Geologist, 1895, pp. 499–573.

**R. W. Ells: Ann. Rept. Geol. Survey Canada, vol. vii, 1896, pp. 15J–37J.

††H. H. Ami: Ann Rept. Geol. Survey Canada, vol vii, 1896, pp. 113J–157J; Ottawa Naturalist, vol ix, 1896, pp. 215, 216.

added to our information of the distribution of each of the formations within the Champlain valley, and extended the detailed stratigraphic study of the lower members of the formations there so extensively developed.

Scope of the Investigation

As above cited, the detailed stratigraphy of the Cambrian, especially in the northern part of the Champlain valley, has been published by Mr Walcott, while similar work has been done in subdividing the zones of the Calciferous and Chazy in the region by Messrs Brainerd and Seely. My endeavor has been to prepare a similar preliminary study of the detailed stratigraphy of the Birdseye, Black River, and Utica formations overlying the latter.

The method of investigation employed was modeled on that developed by Professor H. S. Williams in his studies of the Devonian of western New York* and which has been described elsewhere by the writer.† Each stratigraphic zone which differed in anywise from those adjoining it was analyzed, on a faunal basis, and kept separate through all subsequent laboratory examination. The mass of the detailed work as thus analyzed will be published in volume xiii of the Annals of the New York Academy of Sciences, and the present contribution is but a summary of results therein set forth. In some cases as many as 96 distinctive beds were recognized and differentiated by reason of faunal or lithologic differences within the limits of a section having a total thickness of less than 200 feet.

General Relations of the sedimentary Rocks of the Region

From Fort Ticonderoga to the head of Missisquoi bay, lake Champlain is about 110 miles long, and its greatest width is 13 miles. The lower Cambrian is unknown on the western side of the lake, but on the eastern has a thickness of many thousand feet. The Calciferous has a thickness of possibly over 1,200 feet, and the Chazy perhaps half that. Following this very considerable mass of deposits, the upper Ordovician beds were laid down, more or less conformably, and all have subsequently undergone not only profound faulting into great blocks, but also local dislocation.

The Birdseye is not clearly recognizable in the Champlain valley itself. Most of the localities and fossils once referred to it in the district are now known to belong to the Calciferous and Chazy. In Benson an outcrop 6 feet thick occurs which contains true *Tetradium cellulosum* (Hall).

Outliers and embayments of the Potsdam and Calciferous are known at an altitude of over 1,000 feet above the lake level, in the midst of the Adirondacks, isolated from the main outcrops, and showing no higher strata above them.‡

Character of the Deposits

The lowest bed of the Black River, wherever a complete section is exposed, is a very compact and tough dove-gray limestone, having a conchoidal fracture, and in appearance somewhat resembling the true Birdseye, but usually containing no fossils other than ostracods. The capping bed of the underlying Chazy, where

* H. S. Williams: Bull. 41, U. S. Geological Survey, 1887.

† T. G. White and G. van Ingen: Trans. New York Acad. Sci., vol. xv, 1895, pp. 19-23.

‡ J. F. Kemp: Bull. Geol. Soc. Am., vol. 8, 1896, pp. 408-412.

well exposed, seems to be a very constant and characteristic layer of fine grained sandstone or quartzite. It is particularly well shown at Valcour and Crown point,* and seems to indicate a retreating sea at the close of the period immediately preceding the deposition of the Black River strata. The succeeding Black River beds are of heavy bedded black limestone having thin shaly partings, and ordinarily in the upper portion of each distinct thick layer a fossiliferous zone.

The change to beds carrying a true Trenton fauna is usually abrupt, the latter formation consisting of much more thinly bedded and usually softer black limestones and slates. A great variation in the character of these beds is observable, and in consequence the limits of particular conditions which favored the development of particular species is very much more marked than in the Trenton Falls paleontologic province, which was studied by the writer in connection with the present investigation.† In the Champlain Trenton, beds of tough and almost barren black limestone, or similar limestones containing fossils preserved almost entire, are succeeded by far softer beds in which all the contained fossils are entirely fragmentary.

The frequent lenticular character of the limestones is a marked characteristic. These lenses usually consist of a gray, finely crystalline, almost saccharoidal, limestone, usually very fossiliferous, within layers of black slate. The rich fauna of these granular layers is no doubt due to more numerous currents, and certain species, such as *Zygospira exigua* and *Z. recurvirostris*, *Tetradium fibratum*, *Platystrophia biforata*, *Bucania punctifrons*, *Conradella compressa*, *Holopea paludiniformis*, *Bathyurus spiniger*, and *Ceraurus pleurexanthemus*, seem to be almost wholly confined to deposits of this kind.

On the other hand, a large assemblage of linguloid species, *Parastrophia hemiplicata*, most of the lamellibranchs (as might be expected), *Protowarthia cancellata*, *Isotelus gigas*, and *Trinucleus concentricus*, were almost wholly denizens of the mud and are found principally in the shaly portions of the rock. Toward the upper portion of the series, the changes of the sea bottom evidently became a great deal more rapid and increasingly shaly layers appear, with attenuated fine crystalline lenses between.

In several instances, notably on Crown point (Fort Frederick), occur thin, tough, black, fine grained, highly carbonaceous layers, which appear to be the consolidated black mud of perhaps decaying organic remains. The upper surfaces of such layers are highly polished, but this may either have been the result of wear before subsequent deposition took place, or the result of the slip or "slickensides" from movement of the overlying layers on the more slippery surface. Such layers are constant over considerable areas. Many layers, especially those of gray crystalline limestone, are conglomeratic, containing rounded or elongated pebbles and masses of what was evidently thick black mud worn from neighboring land surfaces and entombed. Similar intraformational conglomerates are noted from the Galena series of Minnesota.‡

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* J. D. Dana: Discoveries of Reverend A. Wing; Am. Jour. Sci., 3d ser., vol. xiii, p. 415. E. Brainerd and H. M. Seely: Bull. Am. Mus. Nat. Hist., vol. viii, p. 315.

† See T. G. White: Trans. New York Acad. Sci., vol. xv, 1896, pp. 71-96, and Am. Jour. Sci., 3d ser., vol. ii, 1896, pp. 430-432; also C. S. Prosser and E. R. Cummings, Fifteenth Ann. Rept. New York State Geologist, 1898, pp. 615-659.

‡ F. W. Sardeson: American Geologist, vol. xxii, 1898, pp. 315-323.

The shales which formed the transition to the Utica must have been very soft and therefore have been eroded away very readily, for nowhere have the transi, tion beds between these two formations been found in position, whereas in several cases where the succession of the series would lead us to expect to find them a filled-in brook channel, beach, or fault will be found to intervene.

The Utica slates have a thickness of several hundred feet throughout the valley, and are quite uniformly of a rather soft friable character and the contained fauna composed of small sized individuals. These rocks have suffered more from dynamic metamorphism than those of the formations beneath.

The early reports were inclined to consider the Hudson River group as being largely represented in the region. Most of the strata once referred to the group are now known to be of Cambrian age. The islands in the lake referred to the Hudson by the Vermont survey have in several cases proved to belong to the Calciferous. We nowhere found fossils which might be considered typical of the Hudson, such as *Pterinea demissa* (Conrad), *Catazyga erratica* Hall, *Dalmanella emacerata* Hall, *Cyrtolites ornatus* Conrad, *Modiolopsis curta* Hall, nor any of the graptolites referred to that group by Lapworth,* while all the fossils found in the upper strata were of well known Utica facies. Professors Brainerd and Seely, at Shoreham, and Mr Walcott, at Highgate Springs, employed the term "Hudson" for the upper portion of the slates, simply because the thickness represented seemed to be greater than that usually assigned to the Utica alone, and no fossils were found by them. On Cumberland head and Grand isle, however, we found a thickness of strata probably fully as great, which contained scattered Utica fossils throughout. Erosion and glacial plowing has no doubt removed a great thickness of deposits, but even the elevated "outliers" already referred to give no indication that strata superior to the Utica were deposited in the district.

At numerous localities the rock is under stress and conchoidally fracturing chips of the tougher limestone fly off under a comparatively light blow of the hammer.

Summary of the Sections examined

In General

As already stated, the detailed faunal lists for each section will be published elsewhere. It is therefore only necessary here to give an idea of the completeness of the sections studied before summarizing the faunal lists.

Larrabee Point

The most southerly section is that at Larrabee point, Addison county, Vermont, nearly opposite historic fort Ticonderoga. A nearly continuous section is here presented in a small abandoned quarry and along the shore, with a general dip of 10 degrees north. Over 40 feet of Calciferous and Chazy limestones occur in proximity to the base of the section, but the transition beds to the base of the Black River are not shown. The section begins with 12 feet of compact black limestone, with shaly partings, the fossil contents of which indicate that it belongs to the top of the Black River or the lower Trenton.

The entire section is nearly 110 feet thick, and terminates in the Trenton, al-

* C. Lapworth: Trans. Roy. Soc. Canada, vol. iv, sec. iv, 1887, pp. 167–184.

though a separate outcrop of 15 feet of Utica strata occurs a short distance to the north; also on the opposite side of the lake at Addison Junction, New York.

SHOREHAM

East of Larrabee point there are no important outcrops until Shoreham is reached, about 3½ miles west of the lake. The ridges of strata here exposed embrace the entire lower Ordovician.* They are much sheared and crushed, although retaining remnants of a fauna which was very abundant and which corresponds in the upper portion to that of the base of the Larrabee Point section.

CROWN POINT

The extreme end of Crown point, Essex county, New York, 12½ miles north of Larrabee point, affords the next and for detailed study the most satisfactory section. All four divisions of the Calciferous, as classified by Messrs Brainerd and Seely, overlie the Cambrian with a thickness of 350 feet, followed by all three divisions of the Chazy, aggregating 305 feet thick. The latter terminates within the old French fort (Fort Frederick) near the end of the point, with a bed of silicious sandstone or quartzite, which is also seen at Valcour, at the upper end of the lake. The Black River here attains a thickness of 71 feet 3 inches and contains an abundant fauna. Following this series a beach covers 30 feet of horizontal distance and the transition beds to the Trenton proper, although if no fault occurs in the interval the missing thickness, as calculated on the dip of 8 degrees north 40 degrees west, is only 4 feet. Above the Black River a continuous series of 100 feet of alternating compact, sandy and shaly layers, all quite thin, is presented, which affords constant faunal variations and numerous interesting assemblages of forms. Nearly the entire middle and lower Trenton fauna of the region is represented in this section. After disappearing under the lake, which is very narrow at this point, the Trenton reappears, with beds belonging an unknown distance above the former, followed by the Utica slates, but separated from them, however, by superficial deposits. The Utica slates may be followed in outcrops at intervals for 8 miles along the Vermont shore north of this locality, to Arnold bay in Panton. A little over 2 miles north again on Button island, near Vergennes, Vermont, is a remarkable exposure of the Black River. In the lower portion of the section is a thin band containing myriads of *Leperditia fabulites* in perfect state of preservation, and near the top a sharply defined coral reef band made up entirely of *Columnaria alveolata* and *Stromatocerium rugosum.* The Trenton is exposed in small outcrops on the neighboring shore, and the Utica on Otter river, between the lake and Vergennes, but no continuous section is afforded.

PLATTSBURG AND CUMBERLAND HEAD

On Crab island, nearly opposite the hotel Champlain, beds of the middle Trenton, having a thickness of nearly 100 feet, are shown containing a fauna, among which *Isotelus gigas* and several species of *Endoceras* occur in prolific quantities and of large size. This series of beds, extending up into the Utica, reappears on the shore just south of Plattsburg, although on account of faulting no complete section can be obtained.

Beginning at the head of Cumberland bay, and extending all the way around Cumberland head and thence up the shore around Point-au-Roche is a series of

* E. Brainerd and H. M. Seely: Bull. Am. Mus. Nat. Hist., vol. iii, 1890, pp. 3-5.

thin bedded shales and limestones containing an interesting fauna, which seems to be transitionary between the Trenton and Utica formations, and also to commingle the fossil forms of the New York Trenton with those of the Canadian formations described by Billings.

The outcrops along the eastern shore occur on successive promontories which seem to be the result of a series of plications of the strata which curve on one side and on the outer side have fractured with more or less sharp faults. The beds differ greatly in hardness, and both differential erosion and differential shearing are seen in them in consequence.

Owing to the great variation of the dips and strikes following the plications of the strata, and owing also to the numerous faults, all of which have been followed out and plotted on the map, which will appear in the full report, it is yet impossible to arrive at the exact thickness and relations of these beds. On the northeastern side of Cumberland head a long, unfaulted, although considerably metamorphosed, continuous section occurs, which measures 457 feet in thickness, but this seems to be but the upper portion of the series. The latter series of beds reappears on Grand isle, exactly opposite this locality, but not so great a thickness is exposed there.

Long point and Short point, the two southern peninsulas of Point-au-Roche, are two north and south anticlinal folds of these same strata.

GRAND ISLE

At the southern end of South Hero, Grand isle, is an extensive, transversely eroded, north and south anticline, which exhibits in series, beginning with the top of the Calciferous, the entire section of the Chazy, 315 feet in thickness, followed, after an interval, by 35 feet of Black River strata, and, after another interval, by 23 feet of the lower Trenton beds.

CHAZY VILLAGE

Excellent exposures of the Black River are shown at two of the quarries in Chazy village, Clinton county, New York, and in the bed of the Chazy river. The lowest beds following the strata of the upper Chazy are of a dove-colored barren limestone, perhaps belonging to the Birdseye, followed by the distinctive Black River strata which here have a thickness of 34 feet. It is doubtful whether these beds extend into those of the Trenton proper. Characteristic Black River fossils occur throughout.

ISLE LA MOTTE

Several sections of the Black River and of the Trenton are shown on isle la Motte, but none of them are continuous. On the eastern side of the island an excellent example is afforded of the Utica shales faulted sharply down against the Trenton.

HIGHGATE SPRINGS

The Highgate Springs section is in the form of a steep north and south anticline, which at its southern end is curved sharply to the westward. The crest of this anticline has then suffered erosion, so that the whole series of faunas from the Chazy to the Utica is shown in consecutive thin bands, extending east and west on each side of the crest. It was this condition of affairs that gave to Professor Marcou the idea of the development of colonies or lenticles containing precursory faunas at this place.*

* J. Marcou: Bull. Soc. Geol. France, part iii, vol. ix, 1881, pp. 14, 15.

As this is the most northerly locality of the Trenton which we have so far observed within the Champlain valley, it is interesting to note that several of the same zones found in the extreme southern section at Larrabee point persist, although the apparent thickness of the layers is a great deal less than at points farther south, perhaps largely in consequence of squeezing and forcing of the layers out of their true position, as the result of the crumpling of the anticline.

On the opposite side of the lake at Rouse point, at Point-au-Fer, and on Alberg peninsula, the Utica formation occurs, in various outcrops, but containing few fossils.

Range of particular Faunas and Species

The Black River formation is characterized in the region, in its lower portion, by a zone composed almost exclusively of *Leperditia fabulites*, best shown on Button island, but also seen elsewhere.

The next well marked zone is that of *Stromatocerium rugosum*, *Columnaria alveolata*, *Tetradium fibratum*, and *Rhynchotrema inæquivalve*, which extends through over 60 feet of the top of the Black River, and with which fossils are associated *Strophomena billingsi* and *S. incurvata*, *Zygospira recurvirostris*, and *Z. exigua*, *Zaphrentis canadensis*, *Schizocrinus nodosus*, *Bumastus trentonensis*, and *Thaleops*, probably *ovata*.

Near the top of the Black River, in a zone particularly well marked at Chazy, New York, is a large species of *Maclurea*, which both in stratigraphic position and in specific characters is distinct from *Maclurea magna* of the Chazy, which occurs so abundantly in the neighborhood. It is a large species, more rounded than *M. magna*, and marked with concentric grooves around the periphery, and is probably identical with *M. logani* of Canada. Its associates are *Stromatocerium rugosum*, *Rafinesquina alternata*, *Rhynchotrema inæquivalve*, *Dalmanella testudinaria*, *Hormatoma gracilis*, *Lophospira bicincta*, *Lingula elongata*, *Calymmene senaria*, *Ceraurus pleurexanthemus*, etcetera.

Dalmanella testudinaria, *Rafinesquina alternata*, *Plectambonites sericeus*, *Protowarthia cancellata*, *Calymmene senaria*, *Ceraurus pleurexanthemus*, and *Trinucleus concentricus* are found universally through all the beds of lake Champlain valley.

Doctor Sardeson has recently attempted* to correlate by the employment of specific or varietal names the forms of *Plectambonites sericeus* and *Dalmanella testudinaria* of Minnesota, and a suite of the representatives of those species from our localities was sent him. He determines among them the varieties *P. sericeus aspera* James, a form related to *P. minnesotensis* Sardeson, *P. recedens* Sardeson, and *Dalmanella testudinaria meeki* Miller, *D. emacerata* Hall, a form related to *D. porrecta* Sardeson and *D. subæquata* var. *gibbosos* of Billings. A tabulation of the occurrences of these forms, as identified in the lake Champlain valley, does not indicate any rule of variation of one to another, but all appear to be irregularly distributed through the series, the variation being due more to changes in the character of the deposits and life conditions in particular beds than to any progressive order of evolution to established fixed types.

A short distance above the top of the Black River occurs a zone which may be traced the whole length of the lake by its abundance of *Parastrophia hemiplicata*. This fossil occurs scatteringly higher in the series, but is nowhere else abundant, and it appears in force without precursors below. The younger specimens very

* F. W. Sardeson: American Geologist, vol. xix, 1897, pp. 91-111 and 180-190.

often resemble those of *Triplesia extans*, a fossil which is frequent in a corresponding position above layers containing *Parastrophia hemiplicata* in central New York,* but which has not been found in the lake Champlain valley. Associated in the *Parastrophia hemiplicata* bed is what appears to be an undescribed variety of *Dalmanella*, of large size and marked by very strong plications. Still another new form of *Dalmanella* occurs higher in the series, and also a species which is perhaps identical with *Dalmanella delicatula* of Billings.

Murchisonia bellicincta appears in the tabulation prevailingly in the lower Trenton, associated with *Protowarthia cancellata*, *Liospira americana*, *Subulites elongatus*, *Bellerephon capex*, *Whitella ventricosa*, *Ctenodonta levata*, and *C. dubia*, *Dinorthis pectinella*, *Hormotoma gracilis*, and numerous trilobites, such as *Illænus americanus*, *Ceraurus pleurexanthemus*, *Bathyurus* sp., etcetera.

By coincidence two species laid aside as new in the preliminary field study very shortly afterward appeared in volume iii of the Paleontology of Minnesota. These are *Pterygometopus eboraceus* of Clarke, described from Rawlins Mills, New York, and found on lake Champlain, at Larrabee point at about 90 feet and on Crown point at about 80 feet above the base of the respective sections. Another *Pterygometopus*, probably *intermedius*, also occurs in neighboring layers. The other newly recognized species is *Schizambon dodgei*, which Winchell and Schuchert describe from the dark, compact limestone near the top of the Trenton, at Sandy Hill, New York, and which occurs, lower in the series, at Larrabee point.

The most notable fossil assemblage in the upper portion of the section is that of *Lingula vanhorni*, and *L. æqualis*, *Orbiculoidea lamellosa*, *Trematis terminalis*, various graptolites (seldom well preserved), *Leptobolus insignis*, *Ctenodonta dubia*, *Conularia trentonensis*, and *Holopea paludiniformis*.

The shaly masses toward the top of the Trenton abound in masses of *Munticuliporidæ*.

The most interesting fauna of all, however, is that of the very high Trenton or Utica of Cumberland head, which establishes a connection between the faunas of New York and Canada. Here we find associated *Leptobolus insignis*, *Lingula æqualis*, *L. curta* and *L. riciniformis* of the New York Trenton, with *L. cobourgensis* and *L. progne* (at Crown point), both being Canadian species of Billings, together with a new species, resembling *L. whitfieldi* of Ulrich. *Zygospira exigua* and *Z. recurvirostris*, *Trematis terminalis*, *Schizocrania filosa*, *Rafinesquina alternata*, *Ctenodonta gibbosa* and *C. levata*, *Calymmene senaria*, *Isotelus gigas*, *Ceraurus pleurexanthemus*, *Trinucleus concentricus*, and *Odontopleura parvula*, all of which are New York, and most of them also Illinois and Minnesota forms, are associated with *Trematis ottawensis*, *Illænus americanus*, and *Turrilepis canadensis*, all of Canada, the latter previously reported from the lower Utica formation, near Ottawa, with many of the same associates.† The lower portion of the series, which is so largely developed on Cumberland head, contains in all localities a fauna of numerous very small individuals of *Ceraurus pleurexanthemus* and *Triarthrus becki*, the latter, on account of their small size, resembling *T. fisheri* of Billings, but which do not show the series of minute but distinct pits along the front margin of the cephalon which occur in that species. Hall‡ notes *Phacops callicephalus* and *Ceraurus pleurexanthemus* in Wisconsin occur-

* T. G. White: Ann. Rept. Director New York State Mus., 1899, Appendix A, pr. 28.

† H. Woodward: Geol. Magazine, pl. iii, vol. vi, 1889, pp. 271-275; and H. M. Ami: Ibid., October, 1888.

‡ J. Hall: Foster and Whitney's Rept., vol. ii, 1851, p. 212.

ring, as the two trilobites mentioned do on lake Champlain, in association with crinoidal columns of unusually large size, while the trilobites are unusually small. He considers that the admixture of arenaceous matter, while it did not interfere with the production of the species, has diminished their size.

Conclusions

Messrs Matthew* and Ruedemann† have traced the Utica as a cold current from Europe invading the warm seas of the Trenton, and passing from the northeast around the southern slopes of the Adirondack island. There seems to be evidence pointing to the conclusion that the currents depositing limestone in the clear seas of the earlier period studied in this paper were from southwest to northeast, and that the currents gradually changed to a reverse direction over the soft muds which closed the period. Some of this evidence is found in the thinning of the Birdseye formation in the Champlain valley; in the luxuriant development of warm water corals and delicate bryozoa; in the developmental forms of the species common to the central New York and Champlain Trenton on the one hand and the Champlain and Canadian Trenton on the other.

The Black River zones are well marked and characteristic, and differ considerably from those of the western New York sections. The group is about 75 feet thick in the southern portion of the region.

The Trenton carries a very abundant fauna, the species not so strikingly limited to zones as in the adjacent groups, but commingling New York and Canadian types. Its thickness in the region is from 150 to 200 feet.

The Utica presents at least 475 feet in thickness of shales, carrying a "stunted" fauna for the most part, but a great variety of linguloid forms. No fossils characteristic of any higher formations are found in the region.

The localities afford a rich paleontological field of investigation and have furnished us to date 42 species of brachiopods, 14 of lamellibranchs, 23 of gastropods, 9 of cephalopods, and 16 of trilobites.

Remarks on the paper of Mr White were made by Henry M. Seely, H. P. Cushing, H. M. Ami, C. S. Prosser, the chairman, and the author.

Discussion

Dr H. M. Ami pointed out the excellent detailed stratigraphical as well as paleontological work for the lake Champlain valley. Many of the faunal zones and other peculiarities in the stratigraphical column, as pointed out by Doctor White, were identical with their Canadian equivalents. The beds holding *Leperditia fabulites* band, overlaid by the *Columnaria halli*, and these in turn capped by a *Maclurea* limestone, constituting the various members of the Birdseye and Black River formations in the Ottawa Paleozoic basin, agree well, as far as faunal succession and relation and also as regards their origin and lithological characters.

As regards the Trenton limestone, while the leading forms of fossil organic remains were identical, both in the Champlain valley and Ontario, there were a number of interesting points of difference in the vertical range and position assigned to certain species, as, for example, *Trematis ottawaensis*. This species is in-

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* G. F. Matthew: Bull. Nat. Hist. Soc. New Brunswick, vol. xi, 1893, pp. 3-18.

† R. Ruedemann: American Geologist, vol. xix, 1897, pp. 367-391.

variably characteristic of Lower Trenton in the Ottawa valley near Ottawa, and *Zygospira recurvirostra* was found abundantly in the uppermost beds of this formation. So also in the case of *Ceraruus plurexanthemus*, this trilobite occupies the basal beds of the Utica, at Ottawa; but occurs low down in the Trenton of the lake Champlain district.

The lacuna existing at the interval of transition from the Trenton to the Utica terranes along lake Champlain is unfortunate, as everywhere in the Ottawa and Saint Lawrence valleys, in Canada and in Ontario east of Toronto, these two formations pass imperceptibly one into the other. Along the Rideau river, at Ottawa, at Rochesterville, and in numerous other localities in the vicinity of Ottawa, the pyroschists of the Utica or bituminous shale follow directly upon the Trenton without any discordance of stratification whatever. The enormous thickness assigned to the Utica, of upward of 500 feet, was surprising, for the whole of the Utica formation at Ottawa is scarcely more than 75 feet in thickness.

In the absence of the authors, the next two papers were read by title.

STRATIGRAPHY OF THE POTTSVILLE SERIES IN KENTUCKY

BY MARIUS R. CAMPBELL

AMERICAN HOMOTAXIAL EQUIVALENTS OF THE ORIGINAL PERMIAN

BY CHARLES R. KEYES

The following paper was then read:

THE NEWARK SYSTEM IN NEW YORK AND NEW JERSEY

BY HENRY B. KÜMMEL

Remarks were made by the chairman, by N. S. Shaler, I. C. Russell, J. E. Wolff, A. Heilprin, J. B. Woodworth, and the author. The paper is published in the Journal of Geography, volume vii, 1899, pages 23–52.

The two following papers were read and, without discussion, closed the afternoon session:

JURASSIC FORMATIONS OF THE BLACK HILLS OF SOUTH DAKOTA

BY N. H. DARTON

This paper is printed as pages 383–396 of this volume, with description and illustrations of the fossils by Dr Charles R. Eastman, which also appears as pages 397–408 under the title "Jurassic Fishes from Black Hills of South Dakota."

MESOZOIC STRATIGRAPHY IN SOUTHEASTERN BLACK HILLS

BY N. H. DARTON

The Society adjourned. No evening session was held, the Fellows being invited to a reception tendered the several societies meeting at the same time in the city at the American Museum of Natural History, with an address by Professor H. F. Osborn.

SESSION OF THURSDAY, DECEMBER 29

The Society was called to order at 10 o'clock a m, President Stevenson in the chair.

Dr J. C. Smock reported that the Auditing Committee had found the accounts of the Treasurer correct, and the Society adopted the report.

The report of the Council was taken from the table and adopted without debate.

Following is the report of the Photograph Committee: *

NINTH ANNUAL REPORT OF COMMITTEE ON PHOTOGRAPHS

The committee report the addition of 320 views, bringing the full number in the collection up to 1,878. The donors are as below:

(1)	Second Geological Survey of Pennsylvania	144
(2)	U. S. Geological Survey	106
(3)	U. S. National Museum (George P. Merrill)	1
(4)	Professor J. F. Kemp	7
(5)	Geological Survey of Iowa	58
(6)	Mr T. C. Hopkins	4

The 144 views presented by the Second Geological Survey are prints made from selected negatives of the entire series presented, as noted in the Eighth Annual Report of your committee.

The committee asks a continuation of the appropriation of the sum of $15 for expenses during 1899.

Respectfully submitted. GEORGE P. MERRILL,
Chairman.

WASHINGTON, *December*, 1898

REGISTER OF PHOTOGRAPHS RECEIVED IN 1898

One hundred and forty-four (144) views (with negatives) presented by Mr E. V. D'Invilliers for the Second Geological Survey of Pennsylvania

Size, 5 by 7 inches. For prints, address Chairman Committee on Photographs

1559. *Pseudopecopteris macilenta* (L. and H.) Lx. Upper Pottsville series. Washington county, Arkansas. *Lepidocystis* (Polysporia) *salisburyi* Lx. Pottsville series. Days gap, Alabama.

* By a misunderstanding or inadvertence it was supposed that this report had not been received, and consequently it was not presented to the meeting. It was presented at the Washington meeting December 28, 1899, and adopted, and is here printed in its proper place.

1560. *Sphenopteris* (Hymenophyllites) *pendulata* Lx. MSS. (Fertile.) *Lepidophyllum alabamense* D. W. MSS. Pottsville series. Cordova, Alabama.
1561. *Pseudopecopteris obtusiloba* (Stb.) Lx., var. *dilatata* Lx. MSS. Kanawha series. West Virginia.
1562. *Pseudopecopteris obtusiloba* (Stb.) Lx. Kanawha series. West Virginia.
1563. *Dictyopteris sub-brongniartii* Gr. Ey. Coal Measures (Westphalien). France.
1564. Spirophyton. A probable Pseudophyte. Lower Carboniferous. Near Warren, Pennsylvania.
1565. *Asterophyllites gracilis* Lx. Fruiting spikes. Pottsville series. Dade county, Georgia.
1566. *Arthrophycus harlani* (Conr.) Hall. Medina sandstone. Locality unknown.
1567. *Arthrophycus harlani* (Conr.) Hall. Probably from Medina sandstone. Locality unknown.
1568. *Callipteridium tracyanum* Lx. Upper Pottsville (Walden SS). Tracy City, Tennessee.
1569. *Neuropteris clarksoni* Lx. High anthracite coal ("G"). Olyphant, Pennsylvania. (Photograph reduced.)
1570. Pseudophyte. Casts of trails of molluscs. Formation and locality unknown.
1571. *Eurypterus mansfieldi*, Hall. Figured in Second Geological Survey of Pennsylvania, page 3, plate 5, figure 3. Specimen from just below Darlington cannel coal, near Cannelton, Darlington county, Pennsylvania.
1572. Natural casts of Atrypa, Spinosa, Spirifer, Rhynchonella, Pelicypods, and Tantaculites. Horizon, Hamilton. A splendid illustration of associated Hamilton species.
1573. Natural sections of spire-bearing Brachiopods; also a few Tentaculites preserved. Horizon probably Lower Helderberg.
1574. Stripping at Hollywood colliery No. 1, looking east. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 52.
1575. Stripping at Hollywood colliery No. 1, looking east. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 51.
1576. Stripping at Hollywood colliery No. 1, looking east. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 51.
1577. Stripping at Hollywood colliery No. 1, looking east. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 51.
1578. Workings at Hollywood colliery, looking east. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 12.
1579. Workings at Hollywood colliery No. 1, looking south. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 53.
1580. Pottsville deep shaft. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 33.
1581. Breaker in process of construction, Kohinoor colliery. Report A. C., Second Geological Survey of Pennsylvania, page platé No. 45.
1582. Culm and rock heaps at Shenandoah. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 49.
1583. Kohinoor Colliery culm and rock dump. Report A. C., Second Geological Survey of Pennsylvania, page plate No. 50.
1584. No. 215. Anderson's tipple, Venetia, N. W.
1585. Black Diamond tipple. Report K 4, Second Geological Survey of Pennsylvania, plate iv.

1586. Gilmore's Slide tipple. Report K 4, Second Geological Survey of Pennsylvania, plate iii.
1587. Snow Hill tipple. Report K 4, Second Geological Survey of Pennsylvania, plate ii.
1588. Caledonia tipple. Report K 4, Second Geological Survey of Pennsylvania, plate i.
1589. Cornell and Werling Mine tipple, Youghiogheny river. Report K 4, Second Geological Survey of Pennsylvania, plate xii.
1590. Venetia Mine tipple, Peters creek. Report K 4, Second Geological Survey of Pennsylvania, plate xi.
1591. Little Saw-mill Run Railroad Company's tipple, South Pittsburgh. Report K 4, Second Geological Survey of Pennsylvania, plate x.
1592. Amity Mine tipple. Report K 4, Second Geological Survey of Pennsylvania, plate ix.
1593. Horner and Roberts' tipple. Report K 4, Second Geological Survey of Pennsylvania, plate viii.
1594. Walton's upper tipple. Report K 4, Second Geological Survey of Pennsylvania, plate vii.
1595. New Coal Bluff tipple. Report K 4, Second Geological Survey of Pennsylvania.
1596. Relief map of the rocky ridge and east broad top coal basins, in Huntington county, Pennsylvania. By Edward B. Harden.
1597. Relief map of Bald Eagle mountain and Nittany valley. By Edward B. Harden.
1598. Model of the Cornwall iron ore mines, looking north. Annual Report of Geological Survey of Pennsylvania, 1885.
1599. Compressed air locomotive, Old Eagle mine. Report K 4, Second Geological Survey of Pennsylvania, plate v.
1600. Avondale quarry, Delaware county, Pennsylvania.
1601. Deshong's quarry, near Chester, Pennsylvania.
1602. Ward's quarry, near Chester, Pennsylvania.
1603. Ward's quarry, near Chester, Pennsylvania.
1604. Figure 5, Ohlinger Dam quarry, showing both dip and cleavage in Laurentian gneiss, 3 miles northeast of Reading, Pennsylvania. Report D 3, volume 2, Second Geological Survey of Pennsylvania.
1605. Leiper quarry, Delaware county, Pennsylvania.
1606. Face of Deshong's quarry, near Chester, Pennsylvania.
1607. Leiper quarry, Delaware county, Pennsylvania.
1608. No. 156. Rocks exposed in railroad cut, Schuylkill Valley railroad, one-half mile above Lafayette station, P. and R. railroad.
1609. No. 155 (page 116). Old Quarry No. 2, at Slatington, Lehigh county, Pennsylvania, looking west. Report D 3, volume 1, Second Geological Survey of Pennsylvania, 1882, plate 1.
1610. No. 159 (page 117). American slate quarry No. 1, Slatington, Pennsylvania, looking southwest. Report D 3, volume 1, Second Geological Survey of Pennsylvania, 1883, plate 2.
1611. No. 159 (page 117). American quarry No. 2, at Slatington, Lehigh county, Pennsylvania. Report D 3, volume 1, Second Geological Survey of Pennsylvania, 1883, plate 3.

1612. Trap on the south side of the Cornwall big hill, where the spiral railroad enters the upper workings. Annual Report of Geological Survey of Pennsylvania, 1885.

1613. Feldspar quarry, Brandywine Summit kaolin works, Delaware county, looking north 20 degrees east, plate xxiii.

1614. American kaolin works, New Garden township, Chester county, looking north 5 degrees east. Report C 5, Second Geological Survey of Pennsylvania, plate xxvii.

1615. Kaolin mine at Hockessin, Delaware, looking north 60 degrees east. Report C 5, Second Geological Survey of Pennsylvania, plate xxviii.

1616. Figure 7, Potsdam sandstone of Neversink hills, exposed in the railway cut 3½ miles below Reading, Berks county, Pennsylvania, looking north. Report D 3, volume 2, Second Geological Survey of Pennsylvania, plate 3.

1617. Figure 6, Potsdam sandstone of Neversink hills, exposed in the railway cut at the Lover's Leap, 3 miles south of Reading, Berks county, Pennsylvania, looking south 45 degrees east. Report D 3, volume 2, Second Geological Survey of Pennsylvania.

1618. Contorted gneiss. Sckuylkill river, ¾ mile above Lafayette station, Schuylkill Valley railroad. No. 158.

1619. Duplicate of 1686.

1620. Kettle holes in the moraine in Cherry valley, Monroe county, Pennsylvania, looking north-northeast. Report Z, Second Geological Survey of Pennsylvania, plate vii.

1621. The terminal moraine crossing Cherry valley, Monroe county, Pennsylvania, looking southwest. Report Z, Second Geological Survey of Pennsylvania, plate viii.

1622. Long ridge, the terminal moraine on the Pocono plateau, 2,000 feet above tide. Monroe county, looking north-northeast. Report Z, Second Geological Survey of Pennsylvania, plate ix.

1623. Moraine kettle and kames in Cherry valley, Monroe county, Pennsylvania. Report Z, Second Geological Survey of Pennsylvania, plate x.

1624. Kames in Cherry valley, Monroe county, Pennsylvania. Report Z, Second Geological Survey of Pennsylvania, plate xi.

1625. Glacial scratches on Clinton red shale (No. 5), near Fox gap, Monroe county, Pennsylvania, plate xii.

1626. Great glacial grove on table rock, at the Delaware water gap. Report Z, Second Geological Survey of Pennsylvania, plate xv.

1627. The terminal moraine west of Coles creek, in Columbia county. Report Z, Second Geological Survey of Pennsylvania, plate xviii.

1628. Glacial till exposed at the Bangor slate quarry at Bangor, Northampton county. Report Z, Second Geological Survey of Pennsylvania, plate iv.

1629. A glaciated boulder at the Bangor slate quarry at Bangor, in Northampton county, Pennsylvania. Report Z, Second Geological Survey of Pennsylvania, plate v.

1630. Terminal moraine near Saylorsburg, Monroe county, Pennsylvania, looking north-northwest. Report Z, Second Geological Survey of Pennsylvania, plate vi.

1631. Boulder of Pottsville conglomerate on the crest of Penobscot mountain, Luzerne county, Pennsylvania, looking west. Report Z, Second Geological Survey of Pennsylvania, plate xvi.

1632. The terminal moraine crossing Fishing Creek valley, Columbia county, Pennsylvania, looking southwest. Report Z, Second Geological Survey of Pennsylvania, plate xvii.
1633. The Bryn Mawr gravel at Crawford's fireclay pit, Delaware county, looking north 34 degrees west. Report C 5, Second Geological Survey of Pennsylvania, plate xxii.
1634. Glacial striæ on the southern slope of Godfrey's ridge, in Monroe county, Pennsylvania. Report Z, Second Geological Survey of Pennsylvania, plate xiii.
1635. Front side of terminal moraine near Bangor, Northampton county, looking southeast. Report Z, Second Geological Survey of Pennsylvania, plate i.
1636. Inside view of terminal moraine near Bangor, Northampton county, looking northwest. Report Z, Second Geological Survey of Pennsylvania, plate 2.
1637. Moraine hummocks west of Bangor, Northampton county, looking southwest. Report Z, Second Geological Survey of Pennsylvania, plate 3.
1638 *to* 1643, *inclusive*. Castle rock, Edgemont township, Delaware county, Pennsylvania.
1644. Castle rock, eastern end, Edgemont township, looking north 80 degrees east. Report C 5, Second Geological Survey of Pennsylvania, plate xxiii.
1645. Castle rock, western end, Edgemont township, looking north 15 degrees east. Report C 5, Second Geological Survey of Pennsylvania, plate xxxii.
1646. Castle rock, Edgemont township, Delaware county, Pennsylvania, looking south 55 degrees east. Report C 5, Second Geological Survey of Pennsylvania, plate xxx.
1647. Limestone quarry, Port Kennedy, Pennsylvania. Phœnix Iron Company.
1648. Trap rocks at Gulf Mills, Pennsylvania.
1649. Lafayette soapstone quarry, Montgomery county, Pennsylvania.
1650. Lafayette soapstone quarry, Montgomery county, Pennsylvania.
1651. Trap rocks at Gulf Mills, Pennsylvania.
1652. Trap boulders, French Creek falls, Pennsylvania.
1653. Trap boulders, French Creek falls, Pennsylvania.
1654. Trap boulders, French Creek falls, Pennsylvania.
1655. Water Sheet narrows, Huntingdon county, Pennsylvania. Juniata river.
1656. Breaker at Hollywood colliery, showing stripping.
1657. Synclinal in mammoth bed, Hollywood colliery, Hazelton, Pennsylvania. Shows open-work mining after stripping.
1658. Synclinal in mammoth bed, Hollywood colliery, Hazelton, Pennsylvania. Shows open-work mining after stripping.
1659. Boring for oil. Sadsbury township, Chester county, Pennsylvania.
1660. Kennedy's syenite quarry, near Wayne.
1661. Gneiss peak on Harvey Thomas farm, L. Bethel township, Delaware county, Pennsylvania.
1662. Burned rocks, Fayette city, Monongahela river.
1663. Rausch's gravel quarry, Bethlehem, Pennsylvania.
1664. Limestone quarry, Bethlehem, Pennsylvania.
1665. Old Wheatley lead mine, near Phœnixville, Pennsylvania.
1666. Old Smelting Works mine, near Phœnixville, Pennsylvania.
1667. Old Wheatley lead mine, near Phœnixville, Pennsylvania.
1668. Pottsville from Sharp mountain.

1669. Head frame, Kaska William colliery, Schuylkill county, Pennsylvania.
1670. R. D. Lacoe's museum, Pittston, Pennsylvania. (R. D. L. and George B. Simpson.)
1671. Culm bank, Turkey Run colliery, Schuylkill county, Pennsylvania.
1672. Gap at Cumberland, Maryland.
1673. Gap at Cumberland, Maryland.
1674. Lower Helderberg limestone, near Mount Savage Junction, Maryland.
1675. Lower Helderberg limestone, near Mount Savage Junction, Maryland.
1676. Old marble quarry, Marble Hall, Montgomery county, Pennsylvania.
1677. Cut on Philadelphia and Reading railroad, near Reading, Potsdam quartzite (Neversink mountain).
1678. Cut through limestone, Schuylkill Valley railroad, below Norristown.
1679. Cut through limestone, Schuylkill Valley railroad, below Norristown.
1680. Delaware water gap.
1681. Avondale quarry, Delaware county, Pennsylvania.
1682. Avondale quarry, Delaware county, Pennsylvania.
1683. Contorted gneiss, Spring Mill, Montgomery county.
1684. Contorted gneiss, Spring Mill, Montgomery county.
1685. Anticlinal on Schuylkill river 2 miles above Port Clinton.
1686. Cut on Schuylkill Valley railroad showing "creep."
1687. Potts' limestone quarry, below Norristown.
1688. Syenitic gneiss near Spring Mill.
1689. Potts' limestone quarry, looking south 70 degrees west.
1690. Potts' limestone quarry, looking south 70 degrees west.
1691. Limestone in cuts on Schuylkill Valley railroad below Norristown.
1692. Limestone in cuts on Schuylkill Valley railroad below Norristown.
1693. Limestone quarry, Port Kennedy, Phœnix Iron Company.
1694. Old serpentine quarry near Devon, Montgomery county, Pennsylvania.
1695. Quartz vein in cut at Lafayette station, Montgomery county, Pennsylvania.
1696. Vein in Cornwall iron ore mine.
1697. Limestone in Schuylkill Valley railroad cut, near Mogeetown, Pennsylvania.
1698. Lower Avondale quarry, Nether Providence township, Delaware county, Pennsylvania. View taken looking south-southwest. Report C 5, plate viii, Geological Survey of Pennsylvania.
1699. Contorted gneiss of Wissahickon creek, near the Philadelphia and Reading railroad bridge. Report C 4, plate viii, Geological Survey of Pennsylvania.
1700. Creep striæ on roofing slate, Bangor, Northampton county, Pennsylvania. Report Z, plate 61, Geological Survey of Pennsylvania.
1701. Creep striæ on roofing slate, Bangor, Northampton county, Pennsylvania. Report Z, plate 61, Geological Survey of Pennsylvania.
1702. Glaciated boulder from moraine, base of Huntingdon mountain, near Jonestown, Columbia county, Pennsylvania. Report Z, plate 118, Geological Survey of Pennsylvania.

One hundred and six (106) views presented by the United States Geological Survey

Size, 5 by 7 inches. Thirty-one photographed by C. D. Walcott

1703. Missouri River beds, above railroad bridge, near Townsend, Montana. (523.) C. D. W., 1898.

1704. Hogback, formed by upturned basal Cambrian sandstone (Flathead), Indian creek, 4 miles west of Townsend, Montana. (525.) C. D. W., 1898.

1705. Hogback, formed by upturned basal Cambrian sandstone (Flathead), Indian creek, 4 miles west of Townsend, Montana. (525*a*.) C. D. W., 1898.

1706. Panoramic view of Paleozoic rocks at mouth of Indian creek, 4 to 6 miles west of Townsend, Montana. (526*a*.) C. D. W., 1898.

1707. Panoramic view of Paleozoic rocks at mouth of Indian creek, 4 to 6 miles west of Townsend, Montana. (526*b*.) C. D. W., 1898.

1708. Slaty shales in which pre-Cambrian fossils were found; mouth of Deep Creek canyon, 16 miles east of Townsend, Montana. (527*b*.) C. D. W., 1898.

1709. Paleozoic rocks near mouth of Avalanche canyon, west foot of Big Belt mountains, Montana, 12 miles east of Canyon Ferry. (529.) C. D. W., 1898.

1710. Eroded Carboniferous sandstones, in cliff 8 miles south of Livingston, Montana, west side of Yellowstone river. (534.) C. D. W., 1898.

1711. Eroded Carboniferous sandstones, in cliff 8 miles south of Livingston, Montana, west of Yellowstone river. (534*a*.) C. D. W., 1898.

1712. Eroded Carboniferous sandstones, in cliff 8 miles south of Livingston, Montana, west side of Yellowstone river. (534*b*.) C. D. W., 1898.

1713. Eroded Carboniferous sandstones, in cliff 8 miles south of Livingston, Montana, west side of Yellowstone river. (534*c*.) C. D. W., 1898.

1714. Eroded Carboniferous sandstones, in cliff 8 miles south of Livingston, Montana, west side of Yellowstone river. (535*c*.) C. D. W., 1898.

1715. View looking north from Point of Rocks down Yellowstone valley, about 34 miles south of Livingston, Montana. (539.) C. D. W., 1898.

1716. View of Carboniferous strata on north side of Beaver creek, above Missouri river, Big Belt mountains, Montana. (537.) C. D. W., 1898.

1717. Waterfall over Cambrian limestones, Sheep creek, toward summit of Teton range, southwest of Jackson lake, Wyoming. (541.) C. D. W., 1898.

1718. Big mud geyser shortly after eruption, Yellowstone National park. (545.) C. D. W., 1898.

1719. Brink of Upper falls of the Yellowstone, Yellowstone National park. (547.) C. D. W., 1898.

1720. Mouth of Fountain geyser shortly before eruption, Yellowstone National park. C. D. W., 1898.

1721. Siliceous deposits in the basin of the Great Fountain geyser, Yellowstone National park. (549.) C. D. W., 1898.

1722. Terrace pools on lower slopes of Angel terrace, Yellowstone National park. (550.) C. D. W., 1898.

1723. Calcareous points covering bottom of pool, Angel terrace, Mammoth hot springs, Yellowstone National park. (552.) C. D. W., 1898.

1724. Calcareous deposits in pool, summit of Angel terrace, Mammoth hot springs, Yellowstone National park. (553.) C. D. W., 1898.

1725. Calcareous (mushroom-like) concretionary deposits, Angel terrace, Mammoth hot springs, Yellowstone National park. (554.) C. D. W., 1898.

1726. Calcareous (mushroom-like) concretionary deposits, Angel terrace, Mammoth hot springs, Yellowstone National park. (554*a*.) C. D. W., 1898.

1727. Calcareous algæ in outlet of pools, summit of Angel terrace, Mammoth hot springs, Yellowstone National park. (555.) C. D. W., 1898.
1728. "Ox-bow" bend, Trout creek, Hayden valley, Yellowstone National park. (556.) C. D. W., 1898.
1729. North end of Teton range, northwest of Jackson lake, Wyoming. (557.) C. D. W., 1898.
1730. View of the Teton range from the east shore of Jackson lake, Wyoming. (558*a*.) C. D. W., 1898.
1731. Basal Cambrian sandstones of section at mouth of Two-mile canyon, 2 miles south of Malad City, Idaho. (562*a*.) C. D. W., 1898.
1732. Summit of ridge. View from the north, about 3 miles south of Malad City, Idaho. (563.) C. D. W., 1898.
1733. Boulders in Firehole river, Yellowstone National park. (565*a*.) C. D. W., 1898.

Size, 6 by 7½ inches. Nine photographed by H. W. Turner

1734. Crescent lake, in the Yosemite National park. The morainal dam which has formed the lake is shown, the outlet being in the middle, where the driftwood has accumulated. H. W. T.
1735. View from near Sentinel Dome, in the Yosemite National park, showing the canyon of Tenaya creek and the roches-moutonnees-like surface of the plateau north of Yosemite valley. H. W. T.
1736. Rock basin in biotite-granite. Ridge south of Morrison creek, in the Yosemite National park. The diameter of the basin is about 1 meter and its depth about 15 centimeters. These little basins are formed by atmospheric agency without aid of running water. H. W. T.
1737. Showing the weathering of biotite-granite on ridge south of Morrison creek, a branch of the Tuolumne river, in the Yosemite National park. On the boulder to the left may be seen several little rock basins which by growth have coalesced. H. W. T.
1738. Exfoliating granite east of Royal Arch lake, which drains into the South Merced river, in the Yosemite National park. H. W. T.
1739. Exfoliating granite on slope northwest of Grouse lake, in the Yosemite National park. The different steps formed by the layers are all glaciated, showing that the exfoliation took place before the final retreat of the ice. H. W. T.
1740. Exfoliating granite on slope northwest of Grouse lake, in the Yosemite National park. The large boulders in the foreground are polished on their upper surface and have been fractured and moved by frost and heat into their present position since the retreat of the ice. H. W. T.
1741. Boulder of an igneous pudding-stone on ridge north of Yosemite valley. It is composed of nodules of diorite cemented by biotite-granite. The measure is 25 centimeters long. H. W. T.
1742. Granite striated and polished by the ice, near Johnson lake, in the Yosemite National park. H. W. T.

Size, 4½ by 6½ inches. Thirty-seven photographed by G. K. Gilbert

1743. Shore of lake Ontario, Niagara county, New York. Illustrates mode of origin of beach shingle by showing rock in place and angular rocks recently detached. Gilbert, 1898.
1744. Beach of flat shingle. Shore of lake Ontario at Golden Hill creek, New York. Gilbert, 1898.
1745. Beach of well rounded shingle. Shore of lake Ontario at Golden Hill creek, New York. Gilbert, 1898.
1746. Cemented shingle in spit of glacial lake Iroquois at Lewiston, New York. Gilbert, 1898.
1747. Section of spit of glacial lake Iroquois at Lewiston, New York. The dip is landward, indicating growth on the inside of the spit. Gilbert, 1898.
1748. Section of spit of glacial lake Iroquois at Lewiston, New York. The dip is landward, indicating growth on the inside of the spit. Gilbert, 1898.
1749. Cut terrace of the Iroquois shore line, 2 miles west of Dickersonville, New York. Lacustrine plain, bed of lake Iroquois, near Jeddo, New York. The water edge was at base of cliff. The cliff is carved from Medina shale. Gilbert, 1898.
1750. Till plain, ½ mile south of Jeddo, Niagara county, New York. Gilbert, 1898.
1751. Cross-bedding and unconformity in sand kame, 3 miles east of Lockport, New York. Gilbert, 1898.
1752. Till. Shore of lake Ontario, Wilson, New York. Gilbert, 1898.
1753. Deposit by torrent of Erian water on the withdrawal of the ice-sheet from the escarpment at Lewiston, New York. Unassorted and unworn alluvium. Gilbert, 1898.
1754. Section of talus, Niagara gorge. Gilbert, 1898.
1755. Angular gravel in kame, south of Royalton, Niagara county, New York. Gilbert, 1898.
1756. Solitary gravel kame, 3 miles south of Middleport, New York. Gilbert, 1898.
1757. Escarpment of the Niagara limestone, looking west from a point on the talus near Lewiston, New York. Gilbert, 1898.
1758. Niagara escarpment capped by Niagara limestone, looking east from a point 5 miles west of Lockport, New York. Gilbert, 1898.
1759. Niagara escarpment without capping of Niagara limestone; looking west from a point near Middleport, New York. Gilbert, 1898.
1760. Drowned valley of Twelve-mile creek, near Wilson, Niagara county, New York. Water lilies grow on submerged alluvial plain. Gilbert, 1898.
1761. Head of estuary of Twelve-mile creek, Niagara county, New York. Submerged alluvial plain supports rushes. Gilbert, 1898.
1762. Estuary of Eighteen-mile creek, near Olcott, Niagara county, New York. Channel deep, current slow. Submerged alluvial plain supports rushes. Gilbert, 1898.
1763. Valley of Eighteen-mile creek, Niagara county, New York, above head of estuary. Channel shallow, current rapid; alluvial plain dry except during flood. Gilbert, 1898.

1764. Post-glacial anticline, Hopkins creek, Niagara county, New York. The displacement of the rocks is accompanied by a superficial ridge traversing an alluvial terrace. Gilbert, 1898.
1765. Section of Niagara limestone, Cook's quarry, near La Salle, Niagara county, New York. Shows structure described by James Hall, Geology of Fourth District of New York, pages 93 and 94. Gilbert, 1898.
1766. Section in cut of Erie railway, Niagara falls, New York. Shows structure described by James Hall, Geology of Fourth District of New York, pages 93 and 94. Gilbert, 1898.
1767. Weathering of Niagara limestone by solution. A joint face exposed in quarrying southwest of Middleport, New York. Gilbert, 1898.
1768. Weathering of Niagara limestone by solution; old quarry southwest of Middleport, New York. Gilbert, 1898.
1769. Unconformity by erosion. Sandstones and shales of the Medina formation, Niagara gorge. Gilbert, 1898.
1770. Isolated limestone mass at base of Niagara shale, containing "transition fauna" of Ringueberg. Gilbert, 1898.
1771. Section of ripple-mark on Medina sandstone, Lockport, New York. From crest to crest, 23 feet; depth of trough, 29 inches. Gilbert, 1898.
1772. Flagstone in court-house yard, Elyria, Ohio. Shows reticulated ripple-marks. Gilbert, 1898.
1773. Trough of large ripple-mark in Medina sandstone, Niagara gorge, New York. Gilbert, 1898.
1774. Crest of large ripple-mark in Medina sandstone. Quarry near Lewiston, New York. Gilbert, 1898.
1775. Crest of large ripple-mark in Medina sandstone. Quarry in Lockport, New York. Gilbert, 1898.
1776. Diverse cross-bedding associated with large ripple-marks in Medina sandstone. Quarry near Lewiston, New York. Gilbert, 1898.
1777. Quarry face in Medina sandstone. Lockport, New York. Gilbert, 1898.
1778. Quarry face in Niagara limestone. Lockport, New York. The joint face shows weather fracture. Gilbert, 1898.
1779. Shore of lake Ontario at Wilson, New York. Train of shore drift from right, being arrested by bew-pin, begins to accumulate and partly protects bluff from wave attack. Dearth of shore drift under lee of pier favors wave attack; bluff eaten back 45 feet. Bluff contains two tills and cover of laminated clay, a deposit from lake Iroquois. Boulder pavement at top of lower till, indicated by arrow. Gilbert, 1898.

Size, 6 by 7½ inches. Twenty-nine photographed by N. H. Darton, 1898

1780 (424). Triassic conglomerate-sandstone, Garden of the Gods, Colorado. By N. H. Darton, 1898.
1781 (429). Pikes peak through the gateway of the Garden of the Gods, showing Jura-Trias beds. By N. H. Darton, 1898.
1782 (430). Cathedral spires, Garden of the Gods, Colorado. By N. H. Darton, 1898.
1783 (434). Titanotherium sands east of Adelia, Sioux county, South Dakota. By N. H. Darton, 1898.

1784 (443). "Toadstool park," Bad lands near Adelia, Sioux county, South Dakota. By N. H. Darton, 1898.

1785 (444). "Toadstool park," Bad lands near Adelia station, Sioux county, Nebraska. By N. H. Darton, 1898.

1786 (445). Looking down North Platte river at the Wyoming-Nebraska line. By N. H. Darton, 1898.

1787 (465). Granite needles near Harney peak, Black hills, South Dakota. By N. H. Darton, 1898.

1788 (468). Granite needles near Harney peak, Black hills, South Dakota (southern group). By N. H. Darton, 1898.

1789 (472). Cone-in-cone concretion in Pierre shale, southeast of Hot Springs, South Dakota. By N. H. Darton, 1898.

1790 (473). Gypsum in red beds, Hot Springs, Black hills, South Dakota. By N. H. Darton, 1898.

1791 (474). Jurassic sandstone on supposed Triassic red beds, 7 miles south of Hot Springs, Black hills, South Dakota. By N. H. Darton, 1898.

1792 (479). Faulted Middle Jurassic sandstone near Buffalo gap, Black hills, South Dakota. By N. H. Darton, 1898.

1793 (519). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1794 (520). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1795 (522). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1796 (523). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1797 (524). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1798 (526). Natural bridge, Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1799 (531). Protoceras sandstone area, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1800 (480). Natural bridge in middle Jurassic sandstone near Buffalo gap, Black hills, South Dakota. By N. H. Darton, 1898.

1801 (506). Big Bad lands of South Dakota, in the vicinity of the Flour trail, looking north. By N. H. Darton, 1898.

1802 (507). Looking west over portion of Big Bad lands of South Dakota near Flour trail. By N. H. Darton, 1898.

1803 (509). Looking west over portion of Big Bad lands of South Dakota from near the Flour trail. By N. H. Darton, 1898.

1804 (510). Looking southwest over a portion of Big Bad lands of South Dakota near Flour trail. By N. H. Darton, 1898.

1805 (515). Sandstone lenses near Flour trail, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1806 (517). Columns of clay capped by sandstone near Flour trail, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1807 (532). Looking down head of South fork of Coral draw, Big Bad lands, South Dakota. By N. H. Darton, 1898.

1808 (536). Big Bad lands of South Dakota in the vicinity of the Flour trail, looking west. By N. H. Darton, 1898.

One (1) view presented by the United States National Museum (George P. Merrill)

Size, 6 by 8½ inches

1809. Polished slab of Orbicular granite in the collection of the United States National Museum. From Slattemösse, Smaländ, Sweden. Dimensions, 22 by 30 inches.

Seven (7) views presented by J. F. Kemp

Size, 5 by 7 inches

1810 (1). Arch of Upper Silurian quartzite forming the "Rainbow," at Iron gate, near Clifton forge, Virginia. The arch is exposed in the valley of the James river. Another stratum of quartzite forms a parallel arch higher up, which does not appear, from lack of distance in taking the view. J. F. K., 1898.

1811 (2). Overthrown fold of Upper Silurian quartzite in Eagle mountain, in the valley of the James river, Virginia. J. F. K., 1898.

1812 (3). One limb of fold of Upper Silurian quartzite forming Rathole mountain, just across the James river from number 2. J. F. K., 1898.

1813 (4). Iron ore mine based on the "gossan" of a pyrrhotite vein, Isabella mine, Ducktown, Tennessee. J. F. K., 1898.

1814 (5). The Mary copper mine, based on a great vein of copper-bearing pyrrhotite, at Ducktown, Tennessee. The vein outcrops in a marked peneplain of mica schists, which is surrounded by a rim of high hills. J. F. K., 1898.

1815 (6). Rocking stone in Bronx park, New York city. By timing the effort to the period of the stone a man can make the top of the stone describe an arc of about 3 inches. J. F. K., 1898.

1816 (7). Glacial furrows, Bronx park, New York city. The furrows are not far from the rocking stone, but they have no connection with it. They strike in a northwesterly direction across the foliation of the gneisses. J. F. K., 1898.

Fifty-eight (58) views presented by Geological Survey of Iowa

Size, 4½ by 7½ inches

1817 (1). South of Cedar river, Linn county, Iowa. Ultimate ramification of dendritic drainage on loess mantle of Kansan drift sheet. Cedar Rapids sheet, topographical atlas, United States Geological Survey.

1818 (2). Topography of Kansan drift sheet, showing slopes of larger ravines. South of Cedar river, Linn county, Iowa. Cedar Rapids sheet, topographical atlas, United States Geological Survey.

1819 (3). Topography of Kansan drift sheet loess-mantled spatulate gullies. South of London, Cedar county, Iowa.

1820 (4). On Walnut creek, Scott county, Iowa. In Kansan drift sheet with loess mantle. Iowa Geological Survey, volume ix.

1821 (5). Kansan-loess topography, showing even sky line and spatulate valleys. Dixon, Scott county, Iowa. On farm of Ketelson. Iowa Geological Survey, volume ix.

1822 (6). Steffen's quarry, Cleona township, Scott county, Iowa. Pitted rock surface beneath Kansan drift. False bedding of Leclaire limestone. Iowa Geological Survey, volume ix.

1823 (7). Illinoian topography. North of Buffalo, Scott county, Iowa. Showing tabular divides on initial drift plain and miners sinking shaft for coal. Iowa Geological Survey, volume ix.

1824 (8). Topography of Iowan drift sheet. Drift plain with boulder and paha hills, near Lowden, Cedar county, Iowa.

1825 (9). From chapel tower of Cornell College, looking north-northeast. Iowan drift plain with paha ridges in distance. Mechanicsville sheet, topographical atlas, United States Geological Survey.

1826 (10). Paha north of Allens Grove, Scott county, Iowa, looking north. Davenport sheet, topographical atlas, United States Geological Survey; Iowa Geological Survey, volume ix.

1827 (11). The Stanwood paha, showing marshy ground which surrounds it. Eleventh Annual Report, United States Geological Survey, page 404; Tipton sheet, topographical atlas, United States Geological Survey.

1828 (11*a*). Stanwood paha, looking north. Eleventh Annual Report, United States Geological Survey, page 404; Tipton sheet, topographical atlas, United States Geological Survey.

1829 (12). Mount Vernon paha from south. Iowa Geological Survey, volume iv, pages 181-184.

1830 (13). Paha between Mount Vernon and Lisbon, Iowa.

1831 (14). Gallegher paha, northeast of Long Grove, Iowan frontier, Scott county. Hummocks of loess and sand, with pahoid orientation. Iowa Geological Survey, volume ix; Davenport sheet, topographical atlas, United States Geological Survey.

1832 (15). Sandhills, Iowan frontier, northwest of Princeton, Scott county, Iowa. Iowa Geological Survey, volume ix.

1833 (16). Pond among sandhills of Iowan frontier, Princeton township, Scott county. Iowa Geological Survey, volume ix.

1834 (17). Erosion gullies in loess mantle on Illinoian drift sheet, Princeton township, Scott county. Iowa Geological Survey, volume ix.

1835 (18). Vertical cleavage of loess, Bielers quarry, Cedar valley, Iowa.

1836 (19). Swallows' nests in loess, Clinton, Iowa.

1837 (20). Lingulate lobes of heavy loess near Iowan frontier, northwest of Princeton, Scott county, Iowa. Iowa Geological Survey, volume ix.

1838 (21). Gorge of Wapsipinicon, northeast of Dixon, Scott county, Iowa. Iowa Geological Survey, volume ix.

1839 (22). Gorge of Wapsipinicon, southeast of Big Rock, Scott county. Iowa Geological Survey, volume ix.

1840 (23). View across wide floodplain of Wapsipinicon valley below gorge shown in No. —, looking north. Leclaire atlas sheet, United States Geological Survey. Geology of Scott county, volume ix, Iowa Geological Survey.

1841 (24). Wide floodplain of Wapsipinicon river, Scott county, Iowa; seen from roadway cut in loess-mantled hills of Iowan frontier. Leclaire sheet, topographical atlas, United States Geological Survey; Iowa Geological Survey, volume ix.

1842 (25). View down Cedar river from below Cedar springs (Palisades). At head of gorge of Cedar river, cut in Leclaire limestone, near Mount Vernon, Iowa.

1843 (26). Broad valley of Cedar river below gorge south of Mount Vernon, Iowa. Mechanicsville sheet, topographical atlas, United States Geological Survey.

1844 (27). Gorge in Cedar river, Cedar bluff, Iowa. The rock hill at left parted from the rocky ridge at right by present channel of river rises from an ancient and wide floodplain so low that loess have been built to protect it from floods. Mechanicsville sheet, topographical atlas, United States Geological Survey.

1845 (28). Valley of Mud creek near mouth, Scott county, Iowa. Channel of "Wilton river," an ancient waterway probably occupied by the Mississippi during Illinoian invasion. Iowa Geological Survey, volume ix; Durant sheet, topographical atlas, United States Geological Survey.

1846 (29). Channel of "Wilton river," an ancient waterway to which the Mississippi is supposed to have been deflected during the Illinoian invasion. Now occupied in Scott county by Mud creek and Elkhorn creek. View at divide between the creeks which is constituted at marshy ground with a few small ponds lying but slightly above general level of channel. Iowa Geological Survey, volume ix; Durant sheet, topographical atlas, United States Geological Survey.

1847 (30). Contact of Niagara limestone (Silurian) and Hudson River shales (Ordovician). Above Lyons, Iowa.

1848 (31). Contact of Niagara limestone and Maquoketa shales (Silurian and Ordovician). Lyons, Iowa. Showing parallelism of the Silurian and Ordovician strata and the spheroidal weathering of the latter.

1849 (32). Chert layers in Delaware beds. Niagara limestone, Lyons, Iowa. Banks of Mississippi river.

1850 (33). "Massif," 90 feet high, of Leclaire limestone (Viola type), Niagara. Cedar river near Mount Vernon, Iowa. Iowa Geological Survey, volume 4, pages 129, 130.

1851 (34). "Massif" of Leclaire limestone (Viola type). Palisades below Minots, Cedar river, Mount Vernon, Iowa.

1852 (35). "Massif" of Le Claire (Viola) limestone quarried for lime. Schmidt's quarry. Southwest of Dixon, Scott county, Iowa. Reference, Geology of Scott county, Geological Survey, volume ix. Obscure false bedding appears on right of mound.

1853 (36). Dips of Leclaire (Viola type), Upper Palisades, Cedar river, near Mount Vernon, Iowa. Supposed examples of false bedding.

1854 (37). "Massif" of Leclaire limestone (Viola type) on left, into which run planes of false bedding from right. Cedar Valley lime quarries, Cedar county, Iowa.

1855 (38). Unstratified mound in Leclaire limestone (Anamosa type), near Lowden, Iowa.

1856 (39). Leclaire limestone near Massillon, Iowa. Illustrating the breaking down of cliffs along joint planes.

1857 (40). Ferruginous stains. Slab of Anamosa limestone, Leclaire stage of Niagara, from Mount Vernon quarry, Iowa.

1858 (41). Bieler's quarry, Cedar Valley, Iowa, showing horizontal and even bedding of Anamosa stone. Leclaire stage of the Niagara.

1859 (42). Cliff at Kenwood, Iowa. The lower 8 of feet Otis limestone, the basal member of the Devonian series in Iowa. Above the Otis is seen the Independence shale with associated limestones. Iowa Geological Survey, volume iv, pages 142, 143.

1860 (43). Kenwood bluff on Indian creek, Kenwood, Iowa. Fayette breccia at highest point. Otis limestone. Iowa Geological Survey, volume iv, pages 142, 143.

1861 (44). Independence shale. Linn, Linn county, Iowa. The light-colored clay shown in this landslip is the only known fossiliferous outcrop of these shales. Fayette breccia on either side.

1862 (45). The Lower Davenport beds. Devonian. Mouth of Duck creek, Scott county, Iowa. Reference, Geology of Scott county, Iowa Geological Survey, volume ix.

1863 (46). Brecciated beds of Lower Davenport limestone, Rock Island, northwest shore, Illinois. A flexed and broken fragment.

1864 (47). Breccia in Lower Davenport beds, Rock Island, Illinois.

1865 (48). Breccia in Lower Davenport beds, Rock Island, Illinois. Initial flexures.

1866 (49). Breccia, Linn, Linn county, Iowa. General view. This brecciated horizon, known as "the Fayette breccias," involves the following members of the Devonian series: Cedar Valley stage, *Spirifer pennatus* beds; Wapsipinicon stage, Upper Devonian beds, Lower Davenport beds; Independence shales. Iowa Geological Survey, volume iv, pages 157-166.

1867 (50). Breccia, Linn, Linn county, Iowa. Lowest phase, natural size. Iowa Geological Survey, volume iv, pages 157-166.

1868 (51). Breccia, Linn, Linn county, Iowa. Second phase. Chiefly fragments of Lower Davenport limestone. Iowa Geological Survey, volume iv, pages 157-166.

1869 (52). Breccia, Linn, Linn county, Iowa. Close view. Complex brecciation in large fragments. Iowa Geological Survey, volume iv, pages 157-166.

1870 (53). Breccia, Linn, Linn county, Iowa. Illustrating differential weathering of breccia, largely made up of Independence shales (buff, Kenwood phase), forming abundant talus and breccia formed of numerous fragments of Lower Davenport limestone, with sparse matrix. Iowa Geological Survey, volume iv, pages 157-166.

1871 (54). Breccia, Linn, south end of cut. Showing tilting.

1872 (55). Breccia, Linn, Iowa. Showing large blocks of Upper Davenport limestone retaining approximately their plane of deposition. The sides of these tilted blocks are usually affected with slickensides.

1873 (56). Breccia, Linn, Linn county, Iowa. Close view. Iowa Geological Survey, volume iv, pages 157-166.

1874 (57). Coal Measures shales in Lower Davenport limestone, Davenport, Iowa. Roof of cavern partially preserved. Iowa Geological Survey, volume ix; Geology of Scott county, Iowa.

Four (4) views presented by T. C. Hopkins

Size, 3½ by 4½ inches

1875 (1). View on the Ohio River bluff opposite Beaver, showing concentric weathering in shale. The weathering from the joints shows concentric peeling off on a large scale, with smaller concretionary masses inside. T. C. Hopkins, State College, Pennsylvania, August, 1897.

1876 (2). View on the Ohio River bluff opposite Beaver, Pennsylvania, showing concentric weathering in shale (Coal Measures). T. C. Hopkins, State College, Pennsylvania, August, 1897.

1877 (3). View of a shale bluff on Block House run, New Brighton, Pennsylvania, showing concentric weathering. Shale of lower Coal Measures. T. C. Hopkins, State college, Pennsylvania, August, 1897.

1878 (4). View showing concentric weathering in shale (Coal Measures) on the Ohio River bluff at Rochester, Pennsylvania. T. C. Hopkins, State College, Pennsylvania, August, 1897.

Announcements regarding the annual dinner were made by Dr E. O. Hovey and concerning mail and railroad certificates by Professor J. F. Kemp.

The first two papers of the morning session were read by the author and discussed together.

RELATIONS OF TERTIARY FORMATIONS IN THE WESTERN NEBRASKA REGION

BY N. H. DARTON

SHORELINES OF TERTIARY LAKES ON THE SHORES OF THE BLACK HILLS

BY N. H. DARTON

In discussion of the two papers remarks were made by G. K. Gilbert, G. M. Dawson, and A. C. Gill.

The following paper was read:

GENERAL GEOLOGY OF THE CASCADE MOUNTAINS IN NORTHERN WASHINGTON

BY I. C. RUSSELL

Remarks were made by Bailey Willis, S. F. Emmons, G. M. Dawson, and the author.

The Society then adjourned for the noonday recess and lunch and reconvened at one o'clock p m.

As introductory to the paper by Mr McGee, an address was made on the archeology of California by Mr W. H. Holmes, expressing strong doubts of the credibility or genuineness of the reputed evidences of man in the Tertiary of California. This was followed by

GEOLOGY AND ARCHEOLOGY OF THE CALIFORNIA GOLD BELT

BY W J MC GEE

The paper was discussed by S. F. Emmons, J.W. Powell, J. A. Holmes, H. T. Fuller, Angelo Heilprin, the author, and Professor William H. Brewer, of New Haven, Connecticut, a visitor. A portion of the matter of the paper and the address by Professor Holmes is published in the American Anthropologist (new series), volume 1, 1899, pages 107–121.

Vice-President Emerson assumed the chair, and, in the absence of its author, the next paper was read by title.

GEOLOGY AND PHYSIOGRAPHY OF THE WEST INDIES

BY ROBERT T. HILL

In place of the above paper the following paper was given place:

PHYSIOGRAPHY AND GEOLOGY OF REGION ADJACENT TO THE NICARAGUA CANAL ROUTE

BY C. W. HAYES

Remarks were made by G. K. Gilbert and Professor William H. Brewer. The paper is printed as pages 285–348 of this volume.

The next paper was read by title:

SURFACE FEATURES OF NORTHERN KENTUCKY

BY MARIUS R. CAMPBELL

The two following papers were then read:

AN UNRECOGNIZED PROCESS IN GLACIAL EROSION

BY WILLARD D. JOHNSON

GEOLOGY OF THE YOSEMITE NATIONAL PARK

BY H. W. TURNER

President Stevenson at this point resumed the chair. The discussion of the last two papers was begun, but was soon postponed until the afternoon of Friday (see page 491).

The following three papers were read without discussion:

GOLD MINING IN THE KLONDIKE DISTRICT

BY J. B. TYRRELL

GLACIAL PHENOMENA IN THE CANADIAN YUKON DISTRICT

BY J. B. TYRRELL

The paper is printed as pages 193–198 of this volume.

THE NASHUA VALLEY GLACIAL LAKE

BY W. O. CROSBY

No evening session was held, but the Fellows of the Society with a few guests had the annual dinner at the hotel Logerot.

Session of Friday, December 30

The Society met at 10 o'clock a m, President Stevenson in the chair.

The Secretary announced that the Council had selected Washington as the place of meeting for December, 1899.

The scientific program was resumed with the following paper:

ORIGIN OF THE GRAHAMITE IN RITCHIE COUNTY, WEST VIRGINIA

BY I. C. WHITE

Remarks were made by A. P. Coleman, J. S. Diller, J. F. Kemp, M. A. Wadsworth, J. A. Holmes, and the author. The paper is printed as pages 277–284 of this volume, under the title "Origin of Grahamite."

The next paper was

GEOLOGICAL STRUCTURE OF THE IOLA GAS FIELD

BY EDWARD ORTON

Remarks were made by the President, J. F. Kemp, and I. C. White. The paper is printed as pages 99–106 of this volume.

The following paper was then read:

CONSHOHOCKEN PLASTIC CLAYS

BY T. C. HOPKINS

On the hill near Conshohocken is one of the most interesting clay deposits in the state of Pennsylvania—interesting to the geologist because, with possibly one exception, it is unlike any other deposit in the state, and, further, for its remarkable resemblance to clay beds in other states. It was a matter of great surprise to the writer to find that there was no description nor even mention of these clays in any of the state geological reports, nor in fact in geological literature anywhere, and this despite the fact that they have had an important economic usage for 50 years.

The clays occur on the hill north of Conshohocken, north of the Schuylkill river, about 13 miles above Philadelphia. The clay has been exploited about the little village of Harmarville, along the pike between Conshohocken and Plymouth, and at several points eastward along the ridge to and beyond Barren or Lafayette hill, covering an area several square miles in extent.

The clay rests upon a blue (in places white and blue) limestone supposed to be of the age of the Trenton period. The limestone outcrops in several places in the proximity of the clay and has been quarried as marble quite extensively. A trap dike crosses the area, and the trap rock is exposed in several places. Iron ore and sand are still more intimately associated with the clay, and both have been mined quite extensively.

The clay, which is a tough, plastic, refractory one, lies in inequalities on the limestone. It is quite variable in color and character at different points. One pit may show clay, while another close by will contain nothing but sand, and from the same pit is taken bright red clay, variegated red and gray, white, black, and yellow clays, the colors not regularly banded, but quite irregularly mixed. In some places there are considerable bodies of uniform color, while at other points the colors are quite intricately mixed.

The variation in color and character of the materials probably may be best shown by comparing the following detailed sections, the location of which is shown on the accompanying plan, drawn to scale, on which the elevation above tide is shown.

Numbers 1, 2, and 3, the openings farthest southwest, are sand pits from which foundry sand has been mined. The upper part, 2 to 3 feet thick, consists of yellow sand, containing many quartz fragments and fragments of iron ore, which apparently rests unconformably upon a light, yellow-colored, clean, quartz sand with rounded grains, like beach sand. In one opening thin, irregular layers of fine gravel occur in this sand 10 feet and 15 feet from the top along with a few small pockets of white clay. The sand shows false bedding in places, and in one of the openings the sand is a light, feathery, micaceous variety.

Number 4 is a clay pit worked to a depth varying from 50 to 60 feet. There is at the surface a layer 3 to 6 feet thick of yellow sand, in a few places running to a depth of 15 feet. This is underlain by red variegated clay, a brilliant red clay, a black clay containing much charcoal or lignite, and a dove-colored clay. Both the dove-colored and the black clays turn lighter on exposure. These clays are not regularly bedded, but quite irregular in their occurrence. Thus the red clay runs more than half way down the pit on one side, while on the other the black clay extends nearly to the surface.

Number 5 is an abandoned iron mine which shows a white clay containing large quantities of iron ore and numerous pebbles and cobblestones—some rounded, some angular, and some subangular—the whole mass resembling in a striking manner beds of glacial drift. This mass of material shows a coarse lamination in places, a lamination strikingly unconformable with a finely laminated sandy clay that underlies it in one place.

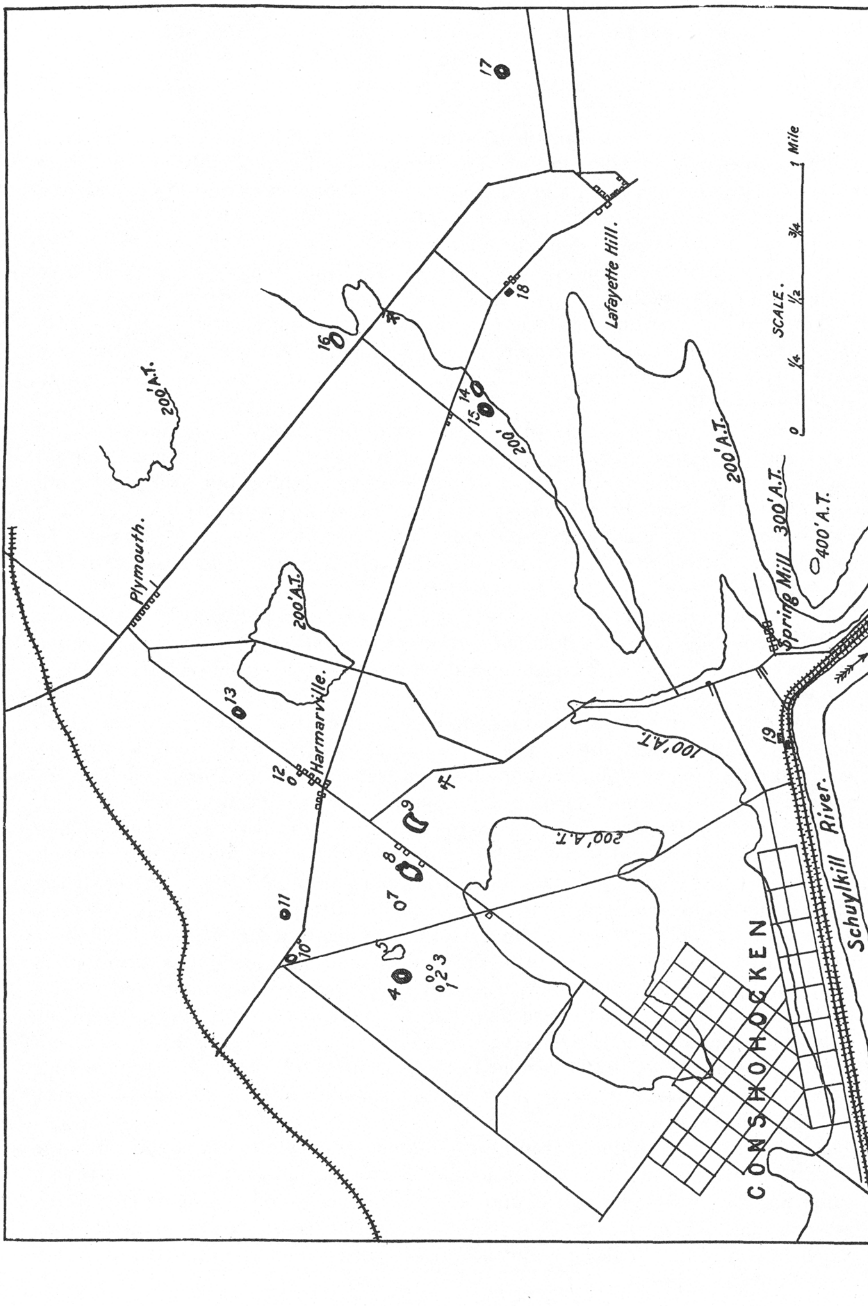

FIGURE 1.—*Location of the Conshohocken plastic Clays of Montgomery County, Pennsylvania*

Number 6 is an abandoned iron mine, overgrown.

Number 7 is a sand pit apparently about 20 feet deep.

Number 8 is a large clay pit, where several shafts have been sunk recently around the border of the pit, showing fresh exposures. These show a layer of yellow sand, clay, and pebbles at the top, varying from two to eight feet, underlying which is a bed of varying thickness consisting of variegated, red, red and gray mixed, and black clay, containing many pebbles. Beneath this is a clay, red, gray, black, and dove-colored, running to a depth of 40 to 50 feet. The clays are not regularly banded, but the colors are irregularly intermixed. The black clay which predominates toward the bottom contains large quantities of charcoal or lignite, fragments of limbs and twigs varying in size from a fraction of an inch to several inches in diameter. No leaves nor bark were observed.

Number 9 is a large pit containing clay, sand, and gravel in different portions. Large quantities of iron ore were removed from this opening a number of years ago. At the west end is a deposit of clean, sharp sand about 20 feet deep that has been quarried for foundry purposes. Near the middle of the opening is a shaft about 25 feet deep showing alternating layers of sand and light-colored clay; east of that a few yards the clay disappears, and the material is coarse sand and fine gravel; a few yards farther on is an opening in the variegated red clay. All of these sections are at about the same level, but none of them go through either the sand or clay, so the thickness is not known. About 50 yards south is a large marble quarry, where the limestone extends to the surface and has been quarried to a depth of 100 feet or more.

Number 10 is an abandoned brick yard where variegated and white clays were worked. It is now overgrown.

Number 11 is a small pit where white clay and white sand occur together. The white clay is overlain by five to eight feet of yellow sandy loam which contains fragments of quartz and pieces of red and brown hematite. The shaft penetrates about 15 feet into the white clay, but how much thicker it is could not be ascertained. Between number 11 and number 12 a thick deposit of white clay is reported.

Numbers 12 and 13 are old iron mines, from both of which considerable red and red variegated clay has been removed, but both mines are now abandoned.

Number 14 is an old iron mine from which white sand has been removed.

Number 15, a few yards farther south, shows two to five feet of brownish sandy clay at the top, banded blue and gray clay underneath, 20 feet or more in thickness. It shows a faint schistose structure in places as though it was decayed schist. About a quarter of a mile north of the last mentioned opening is a large iron mine.

Number 16, one of the largest openings on the hill is an ore pit, from which large quantities of clay were taken, and between the iron mine and the clay bank, number 14, there is an old marble quarry.

Number 17 is a short distance northeast of Lafayette hill, on the farm of Mr George Rapine. It is a shaft in the light and red variegated plastic clay which has been mined to some extent for use in the Barren Hill terra-cotta works. Some exploitation has been done here, but the report of it is too indefinite to give a correct estimate of the extent of the bed. The owner states that the clay follows a narrow east-and-west belt, and a short distance north exploitation pits showed nothing but sand.

Number 18 is the Barren Hill terra-cotta works, where these plastic clays have been used for nearly 50 years.

These are all the openings that had been made in the clay as late as August, 1898, although there is little doubt that many of the wells in this vicinity have been sunk into it. The area of the clays is probably not much larger than that outlined by the pits shown on the plat. Inquiry and a hasty examination failed to discover any similar deposits of red and variegated plastic clay in Pennsylvania except the deposit at Turkey Hill, a few miles southwest from Trenton, in the extreme eastern part of Pennsylvania, and 25 or 30 miles from Conshohocken, at which point red and variegated clays were mined several years ago and shipped to the Trenton potteries. The mines have not been operated for several years, as they are two far from the railroad to compete with the New Jersey clays.

The Conshohocken clays resemble the plastic clays of New Jersey, Long Island, and Marthas Vineyard. The similarity in appearance is sufficient to suggest that they may have been formed at the same time, at least under similar if not the same conditions and from materials having probably the same source.

To the best of my knowledge, no fossils have been found in these clays except the lignite, consisting of fragments of branches, which are fairly well preserved, but which rapidly crumble on exposure, and until further paleontologic evidence is found any correlation of these clays with deposits elsewhere will no doubt be attended with uncertainty.

The clays have been used in the terra-cotta works at Barren hill and Spring mill for making sewer pipe; they have been shipped to Reading and Royersford for making firebrick and stove linings. They have been used at Norristown for furnace lining, and to some extent for making glass pots. They are quite plastic and highly refractory, and the wonder is that they have not been used more extensively. The reason for their limited usage may be that they are little known outside of the immediate locality, and they are too remote from the railroad to compete successfully with the New Jersey clays.*

The next paper was:

REMARKABLE LANDSLIP IN PORTNEUF COUNTY, QUEBEC

BY GEORGE M. DAWSON

Contents

Locality and Consequences of the Landslip

On May 7, 1898, a landslip occurred on the Rivière Blanche, a tributary of the Sainte Anne de la Pérade, parish of Saint Thuribe, Portneuf county, Quebec. The

*More extended field observations carried on since the above was in type throw considerable light on the origin of these clays. The results will be incorporated in reports by the writer on the clays of eastern Pennsylvania in the annual reports of Pennsylvania State College.

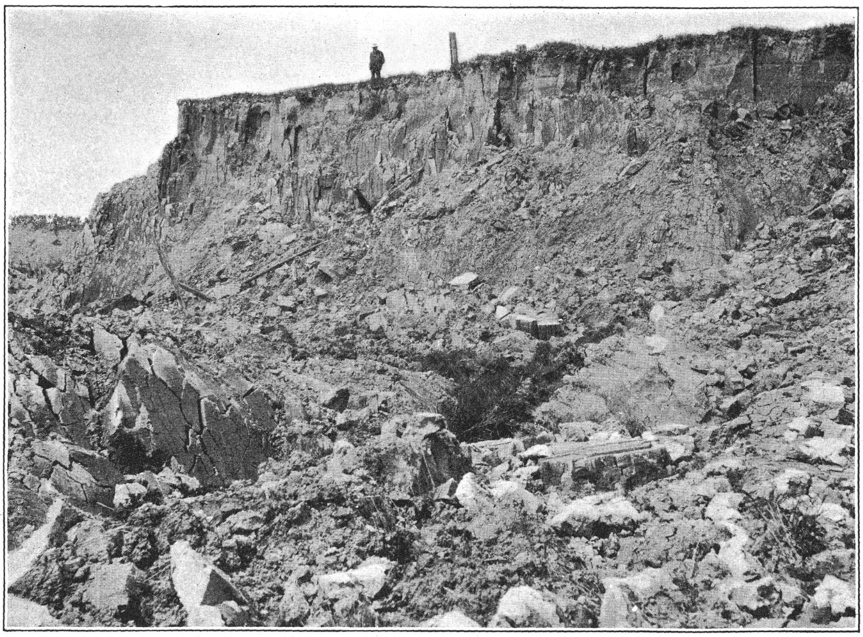

Figure 1.—Clay Cliffs at eastern End of Landslip Area

Figure 2.—Blanche Valley opposite Landslip, with Landslip Outlet in Distance

RIVIÈRE BLANCHE LANDSLIP

slip took place on the east side of the river, at a distance of 3 miles from the village of Saint Casimir. The results were disastrous to the farmers whose property was affected, one life was lost, two inhabited houses, a school-house, two barns, and several outbuildings were destroyed or engulfed, and cattle, horses, and other live stock perished.

Examination made

On May 29 I visited and examined the locality, taking some photographs of the scene, and a few days later, at my request, Mr R. Chalmers, of the Geological Survey, accompanied by Mr J. Keele, made a closer study of the circumstances as well as an approximate survey of the place, and procured additional photographs. The following brief description is based partly on my own observations, in part on those of Mr Chalmers, and is intended merely to outline the chief facts of interest, from a geological standpoint, respecting a mode of denudation that appears to have been not uncommon in the clay-floored plain of some parts of the Saint Lawrence valley.

Character of the Country

At the place in question, the Rivière Blanche, a small stream, occupies a valley running from north to south, about 1,000 feet wide, between sloping banks, 25 to 35 feet high, and nearly uniform in this respect. The surface of the country in the vicinity is for the most part under tillage, and is practically level to the eye, being a terrace-flat or plain composed of the marine Pleistocene deposit known as Leda clay, the whole thickness of which is not here anywhere shown. The clay is occasionally covered by arenaceous deposits a few feet thick and referable to the Saxicava sands.

To the north of and adjoining the wide crater-like depression produced by the landslip here particularly described there is, however, an irregular depressed area of nearly the same size, now under tillage, that evidently represents the site of a much earlier slip of the same character. Still farther to the north, and at a distance of 50 chains from the recent slip, the road, which runs parallel to the river valley and near it, crosses a low ridge of boulder clay. This material may be presumed to underlie the Leda clay elsewhere, but the subjacent rock is nowhere seen in the vicinity.

Mode and Extent of the Movement

A small runnel of water appears to have entered the Blanche valley at the point where the material of the landslip subsequently found issue, and I was informed that previous to the main slip a small slide had been noted to occur at this spot. At half past five in the morning the inhabitants were alarmed by the movement of the soil, which then suddenly began and continued for three or four hours. The immediate bank of the river valley appears in the first place to have given way along a front of about 200 feet in width, and the gap thus made rapidly extended inland, forming an opening through which a great body of clay behind rushed tumultuously out into the Blanche valley. At a short distance from the bank of the valley the width of the area affected greatly enlarged, the sides of the depression collapsing and falling into the gulf, until a crater-like hollow of bottle-shaped outline and opening on the valley by a narrow neck was produced.

The inhabitants on the spot were so much alarmed that they naturally did not observe the actual progress of the landslip with great precision, but eye-witnesses describe the passage of blocks and pyramids of clay through the orifice to the river valley as being very swift and resembling steamers in motion on a river. The occurrence, in fact, may be said to have resembled the bursting out into the valley of a lake of liquid mud, bearing with it outstanding and unbroken blocks of clay detached from the sides of the collapsing area.

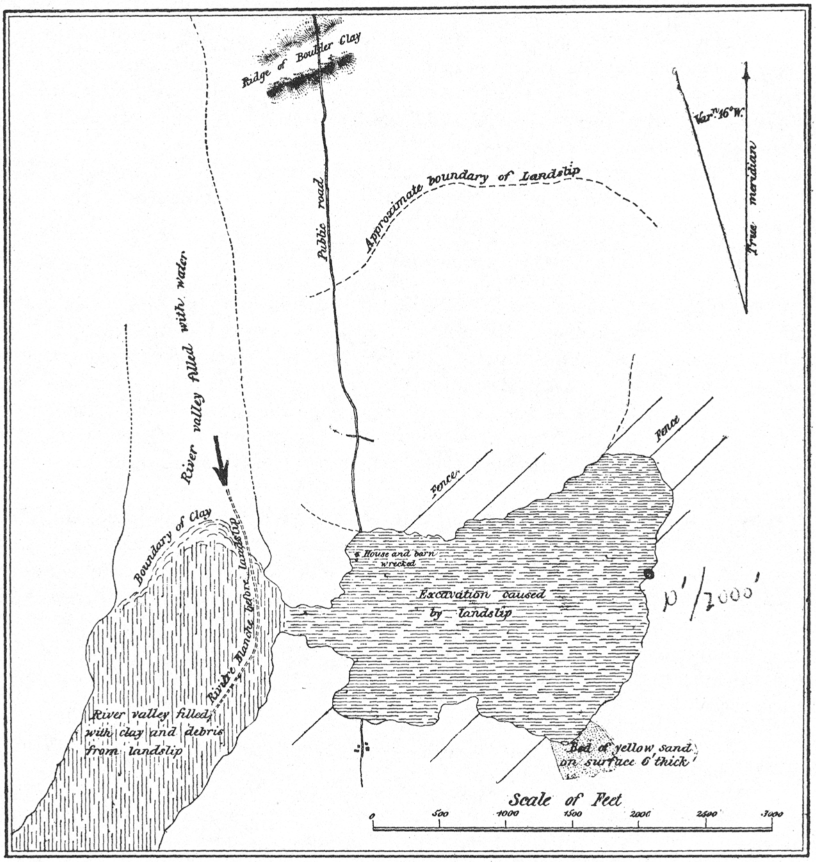

FIGURE 1.—*Sketch-plan showing Area of Landslip (horizontal lining), Part of Clay-filled River-valley (vertical lining), and approximate Boundary of an ancient Landslip of the same Kind*

On entering the Blanche valley the flood of clay spread upstream for some 500 or 600 feet, ponding back the river water, but the greater part, descending the valley for nearly two miles, filled it for that distance to a maximum depth of fully 25 feet, causing the destruction of the rich meadows along the valley, besides that of the agricultural lands immediately affected by the collapse.

When examined by me, the actual landslip was represented by a depressed area bordered by clay cliffs from 15 to 30 feet high, 1,700 feet in maximum width, with a greatest length of 3,000 feet and an area of 86 acres. The floor of this depression was formed by irregular mounds, pyramids, and blocks of clay, with trees, portions of fences, and other debris and small pools of water here and there; although it is stated that very little water was seen during the actual movement of the mass. The wrecks of trees coming from a wood-lot, part of which still remains near the head of the crater, showed very clearly the direction of flow of the mass. The channel of the Blanche below the orifice of the slip was entirely filled, and the water spread from bank to bank of the valley amid mounds and blocks of clay and debris that stood above it.

Amount of Material involved

The quantity of material which thus poured suddenly out into the Blanche valley is approximately estimated at 93,654,000 cubic feet, with a total weight, according to the specific gravity determined, of about 5,572,413 tons of 2,000 pounds.

The slope of the original surface from the head of the collapsed area to the point at which the road formerly passed, near the entrance to the narrow outlet, was, according to barometric observations by Mr Chalmers, about 10 feet only. The approximate difference between the average level of the bottom from the head to the present water level in the Blanche valley, according to the same authority, is between 20 and 25 feet, while the slope of that part of the Blanche valley from the orifice of the slip to the extremity of the flood of clay is not much more than 30 feet.

Explanation of the Catastrophe

The light slopes indicated by the above figures show that the mass of clay must have simulated a liquid body when in motion. Mr Chalmers suggests that a lower bed of the clay, in consequence of the impermeability of the subjacent boulder clay, became exceptionally saturated, forming a sliding plane upon which the more coherent overlying masses moved down. This would be in conformity with the explanation usually (and probably in most cases correctly) given for landslips, and it seems very likely that something of the kind may have been concerned in the initiation of the slip here described where it began on the bank of the Blanche valley. It appears to me, however, that the great and sudden discharge of clay in this case should rather be attributed to the character of the water-saturated mass as a whole, particularly as no evidence was found of any specially permeable or fluent bed and no underlying surface either of boulder clay or rock is anywhere exposed. It will be noted that this landslip differs very markedly in character from the ordinary form, in which the subsidence occurs along an extended front.

Three representative specimens of the clay, collected by Mr Chalmers while still in a nearly saturated condition were submitted to a careful examination in the laboratory of the Survey under Doctor Hoffmann's supervision. A mean of the results obtained shows the specific gravity of the clay as received to have been 1.912, equivalent to a weight of 119.5 pounds to the cubic foot. The clay as received was found capable of absorbing a small additional amount of water, varying from 7.0 to 0.2 per cent by weight. Apart from the water, it consisted of 35.5 per cent of argillaceous matter and 43.3 per cent of silt. When fully saturated it contained on the average, which varied little in the three samples, 23.5 per cent of water by weight or nearly 50 per cent by volume.

It will be noted that the Leda clay here contains a considerable proportion of silt as compared with the argillaceous matter proper, bearing out an observation made to the same effect on inspection of the locality. The large amount of silty matter present would render the clay unusually permeable, and it seems, therefore, to be probable that the water saturated the mass by descending directly through it from the surface, in a manner which would not have been possible in the case of the more purely argillaceous clays of the same age usually found.

In Rankine's Civil Engineering it is stated that "the presence of moisture in earth to an extent just sufficient to expel air from its crevices seems to increase its coefficient of friction slightly; but any additional moisture acts like an unguent in diminishing friction and tends to reduce the earth to a semifluid condition, or to the state of mud." It appears probable that in this particular instance the silty clay, surcharged with water, stood in a condition of unstable equilibrium, retaining its solidity merely by virtue of its unbroken molecular texture, and that at the moment in which it became subject to internal movement this texture gave way and it lapsed into a nearly liquid mass, the particles rearranging themselves with some freedom in the water previously locked up in its pores.

The fact that many clays when once completely dried and then immersed in water lose their plastic character and crumble down into an incoherent mud, shows that the natural texture is an important element in their coherence and plasticity, and one which does not appear to have been fully recognized in connection with experiments on clays and soils.

The high specific gravity of the fluent portion of the mass in this case, no doubt enabled it to carry the unbroken blocks of clay along that were supplied by the collapsing sides of the crater-like depression which was immediately formed, and when not subjected to stress these blocks continued to retain their original firmness and form.

The fact that the great mass of moving material was discharged through a comparatively narrow orifice, shows that the bank of the valley through which it passed was much firmer in character than the clay forming the subsoil of the plain behind. This no doubt arose from the natural drainage of the clay along the bank preventing its complete saturation. The same explanation no doubt accounts for the northern limit of the collapsed area occurring along the line where the surface begins to slope down toward the hollow of the old landslip already mentioned, but the limiting causes on the east and south are not clearly apparent.

Inquiries made on the spot showed that no excessive rains had occurred immediately preceding the slip, but that a great depth of snow lay upon the ground during the latter part of the preceding winter. These statements are confirmed by the meteorological observations made at Quebec, about 40 miles distant, which have been obligingly furnished by Mr R. F. Stupart, director of the meteorological service. From these it appears that the total precipitation (in rain or melted snow) for the months of November and December, 1897, and in January, March, and April, 1898, was slightly below the normal for the past 24 years, but that in February, 1898, it was two inches above the average, in the form of an abnormal excess of snowfall in that month of 17.9 inches, the total snowfall for February, being 44.2 inches. The ground was thus heavily burdened with snow in the later winter. During April most of this melted and the soil itself thawed, permitting

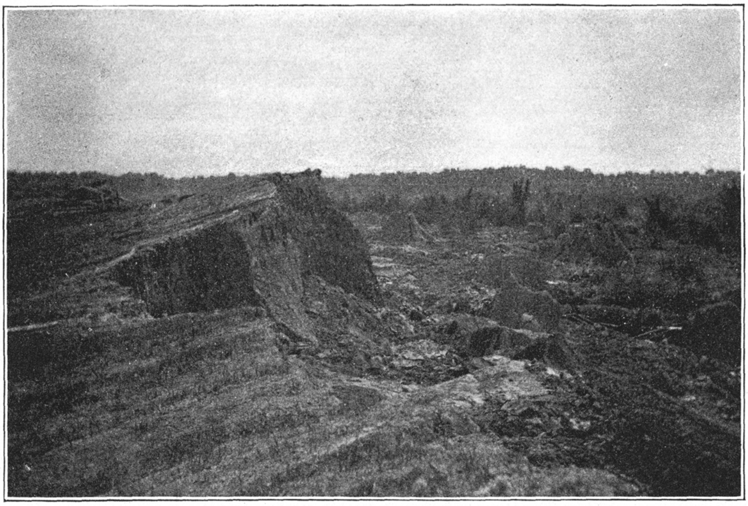

FIGURE 1.—NORTH EDGE OF LANDSLIP AREA, VIEWED EASTWARD FROM NEAR THE OUTLET

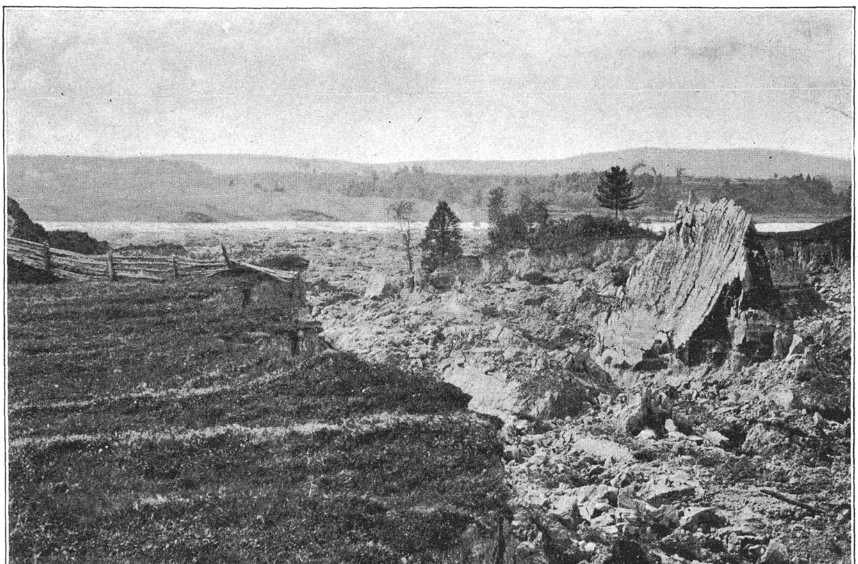

FIGURE 2.—OUTLET OF LANDSLIP, LOOKING TOWARD BLANCHE VALLEY

RIVIÈRE BLANCHE LANDSLIP

the absorption of the water and resulting, early in May, when the clay beds had thus become thoroughly saturated, in the landslip which has been described.

Protection from similar Disasters

The only way in which the recurrence of such slips in regions of country of the same character and under similar exceptional conditions of precipitation can be guarded against appears to be the provision of effective surface drainage, such as to carry off the excess of water before the rather slow process of absorption by the subjacent clays can take place.

Similar Occurrences in the same Region

In a paper entitled "L'Eboulis de Saint Alban," * Monseigneur Laflamme has given an excellent account of a landslip that occurred on April 27, 1894, on the Sainte Anne river, distant about 7 miles only from that above described and affecting similar deposits of the same plain, although at Saint Alban a large part of the slide consisted of the Saxicava sands, there developed in great thickness above the Leda clay.

The landslip at Saint Alban was also much larger than that on the Blanche, an area more than 3 miles in length along the river and about 7,700 feet in greatest width having moved bodily down into the valley. Five or six farm-houses were destroyed or swallowed up, four lives were lost, and the entire mass of the slide is estimated at from 600,000,000 to 700,000,000 cubic feet.

The landslip at Saint Alban was also different in its cause and character. The river was first dammed by a comparatively small slide, and when the water thus held back eventually broke through, its undermining action on the high banks of the valley was such as to precipitate the collapse of the much greater area above noted.†

A brief description of a landslip almost identical in character with that of the Blanche and affecting a similarly situated part of the same Saint Lawrence plain has, however, previously been given by Sir William Logan in a paper read before the Geological Society of London in 1842.‡

This landslip occurred on the Maskinongé river, about 50 miles to the southwest of the Rivière Blanche, on April 4, 1840, and was examined by Logan in the following autumn. Like that on the Blanche, its outlet through the bank of the valley was narrow, and its greatest width, about 600 yards, occurred at some distance back from this bank. The length of the collapsed area was 1,300 yards, and its area about 84 acres, the depth of the depression being about 30 feet. The nearly liquid clay flowed both up and down the valley of the Maskinongé for a distance of about three-quarters of a mile in each direction, bearing with it large blocks and masses of unbroken clay. The whole movement was effected in about 3 hours, the first mass of clay detached being about 200 yards in width by 700 in length.

* Transactions Royal Society of Canada, vol. xii, part iv, 1894, p. 63.

† Since the present paper was read a short note by the same author on the Blanche landslip has been published in the Report of the Commissioner of Colonization and Mines of Quebec for 1898, p. 131.

‡ Proceedings of the Geological Society of London, vol. iii, p. 767; also Life of Sir William Logan, p. 95.

Logan particularly notes that, except on one side, the area of the terrace-flat affected by the slip was bounded by lower land, a ridge or crest being left between the collapsed area and this lower land. This is quite similar to the fact observed in connection with the landslip on the Blanche, and is, no doubt, to be explained in the manner previously alluded to. He nowhere saw the underlying rock or other material below the clay, but is inclined to the belief that the movement may have occurred on a sloping bed of rock. If, however, my interpretation of the facts on the Blanche be correct, it seems unnecessary to assume the existence of such a sliding surface in either case, the action of gravitation upon the saturated mass of clay itself being probably sufficient to account for its flow to the lower level, the retaining bank having been broken through in the first instance.

The fifth paper of the morning session was:

RIPPLE-MARKS AND CROSS-BEDDING

BY G. K. GILBERT

Remarks were made by the President, B. K. Emerson, A. C. Spencer, C. W. Hayes, and the author. The paper is printed as pages 135–140 of this volume.

The sixth and closing paper of the session was upon

VOLCANOES OF SOUTHEASTERN RUSSIA

BY H. FIELDING REID

Doctor Reid's paper was discussed by E. O. Hovey, J. Stanley-Brown, Angelo Heilprin, L. V. Pirsson, I. C. Russell, C. D. Walcott, and the author. A short abstract is printed in Science, volume 9, January 27, 1899, page 139.

The Secretary made some announcements regarding the order of papers in the program. It was voted to organize for the afternoon session a petrographic section, before which the papers on petrology and mineralogy should be read. The proceedings of this section will be found on page 499.

The Society adjourned for lunch, and reconvened at 1.30 o'clock p m.

The first paper of the afternoon session in the general section was read by title.

FORMATION OF DIKES AND VEINS

BY N. S. SHALER

The paper is printed as pages 253–262 of this volume.

The second paper presented was:

PRECAMBRIAN FOSSILIFEROUS FORMATIONS

BY C. D. WALCOTT

The paper was discussed by J. A. Holmes, H. S. Williams, H. M. Ami, Bailey Willis, and the author. It is printed as pages 199–244 of this volume.

The discussion of the paper by Mr W. D. Johnson, postponed from Thursday (see page 479), was announced. Remarks were made by I. C. Russell, H. F. Reid, G. K. Gilbert, and the author.

The next two papers were read and discussed as one.

GLACIAL SCULPTURE IN WESTERN NEW YORK

BY G. K. GILBERT

The paper is printed as pages 121–130 of this volume.

DISLOCATION AT THIRTY-MILE POINT, NEW YORK

BY G. K. GILBERT

The paper is printed as pages 131–134 of this volume. Remarks upon the two papers by Doctor Gilbert were made by H. F. Reid, Robert Bell. and the author.

The following paper was read by the senior author:

WIND DEPOSITS OF EASTERN MONTANA

BY C. W. HALL AND F. W. SARDESON

Remarks were made by J. B. Woodworth and Arthur Hollick. The paper is printed as pages 349–360 of this volume.

The next paper was:

LAKE IROQUOIS AND ITS PREDECESSORS AT TORONTO

BY A. P. COLEMAN

This paper was discussed by G. K. Gilbert and Robert Bell. It is printed as pages 165–176 of this volume.

The next paper was entitled:

THAMES RIVER TERRACES IN CONNECTICUT

BY F. P. GULLIVER

Dana classed the terraces on the sides of the drowned valley of the Thames river, Connecticut, as fluviatile deposits of the Champlain period, and thus considered that they were formed as floodplains in a greatly expanded river, their summits marking the greatest height reached by the floods from the fast melting ice-sheet. The writer has for some time considered the above hypothesis inadequate to account for the many forms assumed by the glacial waste at levels intermediate between the upper terrace and the present bed of the Thames river, particularly those typical eskers which today lie partly submerged in the waters of the estuary. Not until the recent cuts, made for the new line of the New York, New Haven and Hartford railroad in eastern Connecticut, along the east bank of the Thames river between Norwich and New London, had revealed the delta structure of these flat-topped deposits lying against the steep sides of this valley, which had been developed to adolescence before the depression of the land took place, was it possible to make out a more detailed history of the aggradation which occurred in this valley in Pleistocene time. The present paper outlines more in detail the method of this deposition.

The first question testing the flooded river hypothesis is whether these deposits form a uniform grade, rising gradually higher farther and farther upstream. Roughly, this is the fact. The terraces rise 10 to 15 feet above the river at New London and increase in height up the river until they are 90 to 100 feet above tide at Norwich. These level-topped deposits are not continuous, however, and a series of accurate levels run up the river might show that these deposits belong to more than one system and do not fall into one grade.*

At several points along the river there are typical eskers which do not rise to the level of the flat-topped deposits. These present to the eye the characteristic ridge, with steep sides and curving first to the right and then to the left, which has generally been recognized as a constructional form produced by glacial rivers at a late stage in the melting of the ice. A very good example is found about 3 miles below Norwich, on the east side of the river, opposite the little Indian village called Mohegan. The unsubmerged portion of this esker has been used by the railroad, as a part of its embankment, in crossing one of the numerous coves which resulted from the drowning of the Thames valley. The summit of this esker is in places more than 80 feet beneath the level of the gravel plain less than a mile to the north. This gravel ridge has the typical constructional esker form, as if the glacier had left it but a few weeks ago; therefore it is very difficult to conceive that a flooded river could have built a floodplain 80 feet above this deposit without obliterating its ridge-like form.

Two miles above the United States naval station there was another short esker, some 30 feet below the level of the terrace at this point on the river, which has been almost entirely removed by the engineers to fill in across one of the deep side valleys. The bottom at this place was found to be covered with very fine mud, which slid to one side when rock and gravel were piled on top, so that a great deal

*See paper by F. B. Koons, Am. Jour. Sci., 1882, p. 425.

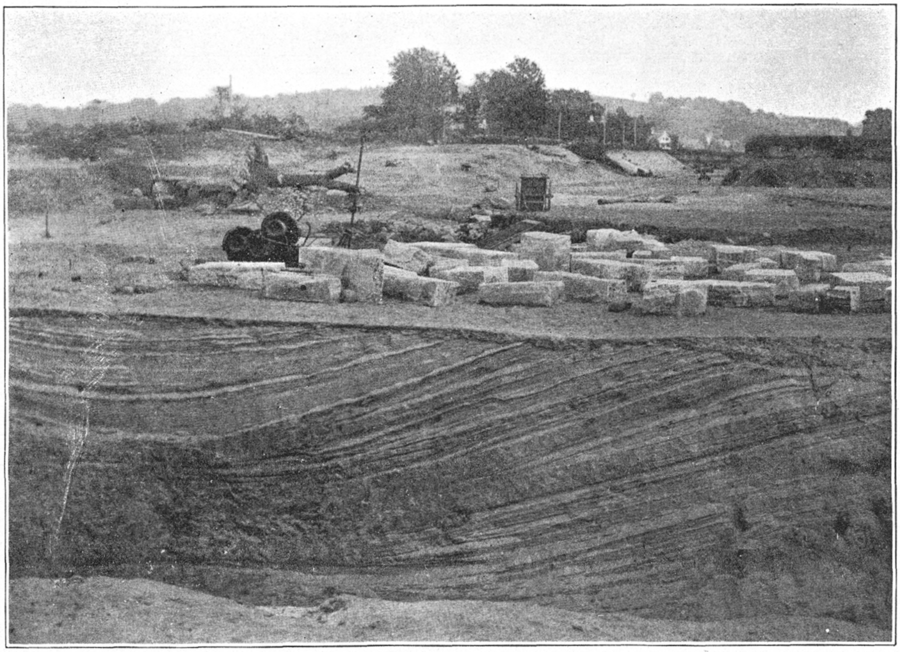

FIGURE 1.—GENERAL VIEW OF CUT AT NAVY YARD, LOOKING SOUTH

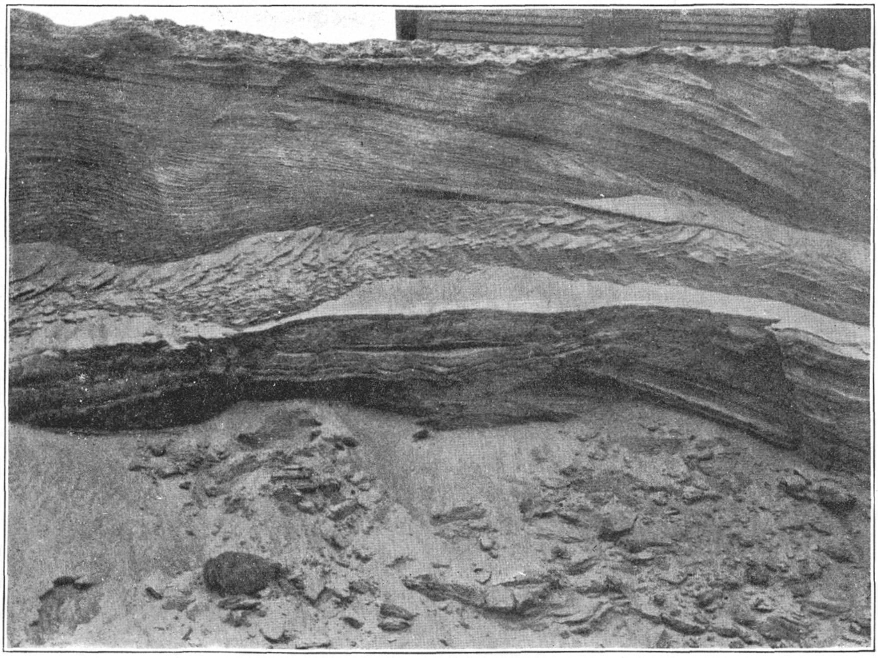

FIGURE 2.—VIEW AT NAVY YARD CUT, LOOKING NORTH

THAMES RIVER TERRACES IN CONNECTICUT

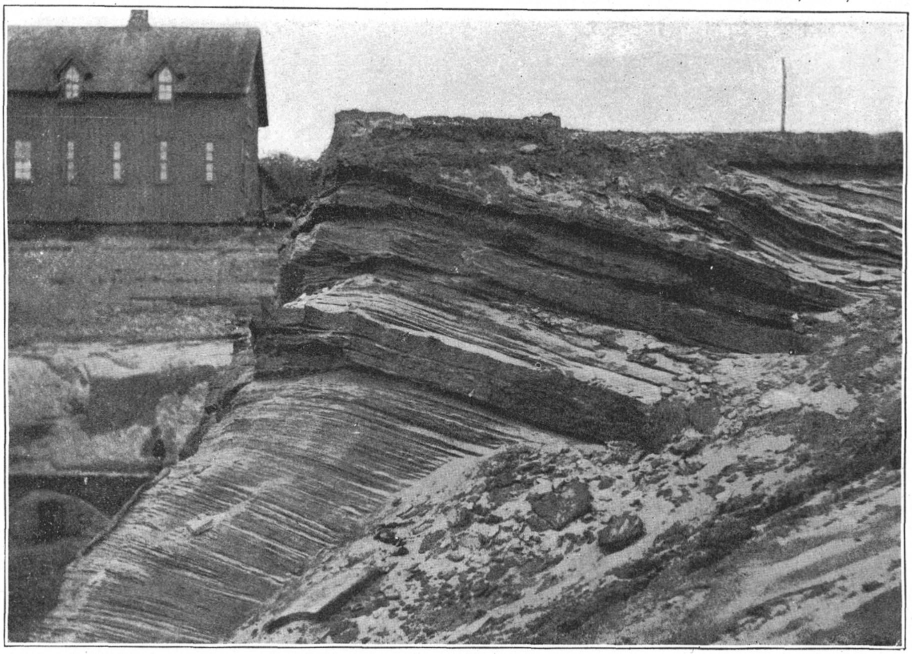

FIGURE 1.—NAVY YARD CUT, LOOKING EAST

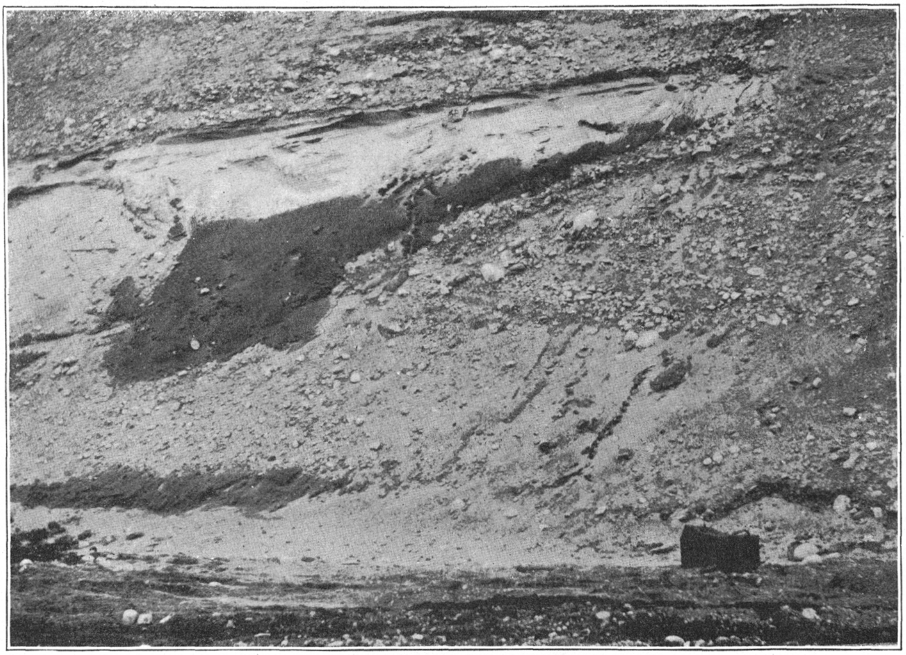

FIGURE 2.—EASTERN END OF NAVY YARD CUT, LOOKING NORTHEAST

THAMES RIVER TERRACES IN CONNECTICUT

of material was used, thus nearly obliterating the little esker that played a most important part in the history of the deposits now to be discussed.

Another difficulty with the hypothesis of a flooded river is that these terraces have numerous depressions, 10 to 15 feet in depth, which are very similar in form to kettleholes seen in sandplains in other parts of New England. These kettleholes would suggest that ice was probably present when the deposits were being built up, the sand having been washed around ice blocks.

The cuts made at the navy yard will now be considered. In order that there should be no grade crossings at this point, the road leading from the highway toward the river was cut below the level of the track. At this point, therefore, the sections were exposed much deeper into the terrace than at any other place, and the writer was so fortunate as to obtain a number of photographs of these cuts before the banks were sloped back to make the sides of the road. Four of these are here reproduced. They all show delta structure.

Figure 1 of plate 53 is a general view looking south across the cut for the road. The granite blocks lie on the level where the railroad now runs, the cut for which through the overlying deposits may be seen to the right of the cart. These overlying deposits are some 10 feet thick and made up of coarse gravel and sand in nearly horizontal layers, and are typical top-set beds of a glacial delta. At the place where the view is taken they have been removed almost entirely, leaving the fore set beds beneath them. This photograph is taken where the fore-set beds from one lobe merge into those of another lobe of the delta, the upper portions of all the layers being cut off by the succeeding top-set beds, a small portion of which had fortunately not been removed when the view was taken.

Figure 2 of plate 53 is taken in the cut looking north at southward-dipping fore-set beds, the water-laid character of which is evident from a glance at the structure as shown in the photograph. A few inches of the top-set beds are shown here also just beneath the small house.

Figure 1 of plate 54 is also taken in the cut, but looking eastward, and therefore at right angles to the general direction of water and ice flow down the valley. The connection of the top-set with the fore-set beds is here very clearly shown, in places continuous with them and in places cutting off the tops of the previously laid fore-sets. The delta character of this deposit is here unmistakable, and this is in a region where the flat-topped deposit laps up against the till-covered slopes of the sides of the valley in a manner strongly to suggest the terrace origin.

Figure 2, plate 54, is taken at the extreme eastern end of the cut and shows the better stratified deposits overlying the less stratified deposits at the edge of the delta-terrace, where the stratified drift ends and the unstratified drift begins. Less than 20 feet east of where this photograph is taken, there is unmistakable till. Along the margin of the terrace at this point the sections show, mixed with the less stratified water-worn material, some more angular rock waste that is morainal in character. This point would thus appear to have been an ice-margin at a time immediately preceding that of delta-building. This deposit would indicate that there was a tongue of ice extending down the valley with its margin at this point when the water from the melting glacier came out farther down the valley, perhaps at New London; and that a little later, when the tongue did not quite fill the valley, a glacial delta was built at this point, filling in completely the space between the ice and the valley side. The stream which supplied this waste was some 2 miles above the navy yard, as is indicated by the esker mentioned above. For the method of building up of this deposit the reader is referred to Professor Russell's account of the Malaspina glacier.*

There are no lobes pointing downstream in the direction of ice and water movement, as one would be led to expect from a study of New England sandplains; † but the position of all the eskers at the side of the valley indicates that the ice was in the center of the valley, and if the waste was sufficient to fill in all the space between the ice and the valley sides, as the deposit at the navy yard seems to show, there would have been no chance for the formation of lobes.

Although there are no lobes at the navy yard, the writer found several places along the river where tributaries enter, which were not completely filled in by waste from the ice-tongue to valley margin, and here the typical lobe form was found. One of the best examples is seen at Poquetannock cove, on the east side of the river, where there is a large amount of washed drift, on the eastern margin of which there are a number of well developed lobes which point eastward, as if formed by streams flowing from an ice tongue in the center of the river.

The ice-contact slope or moraine terrace is the steep slope of these flat-topped deposits which now faces the Thames river, if the above outlined delta hypothesis is to replace the floodplain hypothesis. It would then follow that the washed drift in this valley had been very slightly altered in form since the last retreat of the ice. In all points where man has not materially changed the aspect of these terrace slopes the form seems to the writer to be better explained as an ice-contact slope than in any other way. In a number of places boulders are found on these steep slopes facing the river, the position of which is easy to explain if we conceive a contiguous ice-margin from which they might have fallen; but it is impossible to see how they could stand where they do if the edge of this deposit is the result of erosion.

There are many other interesting features about these Thames River deposits, such as the rock hill at Montville, around which the ice flowed in two streams, forming two sets of terraces, the sandplain at Montville, or the extensive plains at Norwich, which should all be described in making out the history of this region in the way it has been done for Narragansett bay.‡ The field survey for this work has not been completed yet, so the details of the history of these deposits is not here given. Enough facts have been mentioned to show that these delta-terraces were formed when the ice was present in the drowned valley, and the suggestion is made that the structure of other so-called glacial terraces be examined to see if they were not similarly formed. There are undoubted fluviatile terraces,§ and these should be discriminated from such delta-terraces as are here described.

A most interesting question is the water level shown by these delta deposits. It may be the sealevel, in which case a tilting of the land is shown by these Thames River deposits, the greater elevation being inland; it may be a series of lakes, as has been suggested by Mr Robert Chalmers, ‖ or it may be that there was a blocking up of the valley at New London by ice or rock waste or both, and that as the ice melted first from the sides of the valley it left water bodies on each side of an

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* Nat. Geog. Mag., vol. iii, 1891, pp. 106–109.

† W. M. Davis, in Bull. Geol. Soc. Am., vol. i, 188–, pp. 195–202. F. P. Gulliver, in Chicago Jour. of Geol., vol. i, 1893, pp. 803–812.

‡ J. B. Woodworth, in Am. Geologist, vol. xviii, 1896, pp. 150–168.

§ See paper by R. E. Dodge, in Proc. Boston Soc. Nat. Hist., vol. xxvi, 1894, pp. 257–273.

‖ Ann. Rep. Geol. and Nat. Hist. Survey of Canada, vol. iv, 1888, p. 61.

ice-tongue, and that the streams from this tongue built out their deltas into this water on either side. From the facts known at present it is not possible to say just which condition prevailed in the Thames valley.

Remarks on Mr Gulliver's paper were made by J. B. Woodworth.

In the absence of the author the following paper was read in abstract by Robert Bell:

GOLD-BEARING VEINS OF BOG BAY, LAKE OF THE WOODS

BY PETER MCKELLAR

[*Abstract*]

Many auriferous veins have been prospected and a considerable number mined in this part of the gold region of western Ontario. Three of the companies operating there, namely, the Tycoon, Toronto and Western, and the Mikado, are working on veins cutting the Bog Bay granite mass. The peculiar feature of these veins is the smallness of the quartz fissures compared with the total size of the ore bodies, and it is this characteristic that the present paper is intended to explain.

The geology of the whole district from lake Superior to the west side of lake of the Woods, with a breadth of over 300 miles, has been investigated and the results published in detail by the Geological Survey of Canada.

Doctor Bell commenced the real work in the Thunder Bay district in 1869, and in the Wabigoon and Lake of the Woods regions in 1881, and made the first geological maps of these territories. He showed that the rocks of this great area were essentially Laurentian and Huronian, the gneisses and the principal acid eruptives being classed with the former, while the green schists in general and the basic eruptives were provisionally included in the latter system. In many places both groups of rocks were shown to be intersected by felsitic and greenstone dikes and numerous fissure veins, many of which are now proving to be auriferous.

The author described, illustrating by diagrams, the three mines above mentioned and showed that small quartz veins cutting the granite were accompanied on one or both sides by a workable thickness of an auriferous mineral to which he gave the tentative name mikadoite.

The quartz veins are frequently so small as to be traced with difficulty for any considerable distance on the surface, yet when opened up by mining they generally show a breadth of 2 to 6 feet or more of gold-bearing ore, consisting mostly of this mineral, which resembles light greenish-gray serpentine, but has a coarse granular fracture like the granite itself. It passes by insensible degrees into quartz, but when pure it is easily distinguished by its softness and the unctuous character of its powder.

Iron pyrites in very fine grains is disseminated through it to the extent of one-half to three per cent or more, and this vein-mineral may be identical with a similar one, also characterized by fine-grained iron pyrites, which forms parts of some of the gold-bearing veins of the Ural mountains. The weathered surface of the mikadoite resembles that of the adjoining granite, and the outcroppings of these peculiar veins would be passed over as unworthy of notice, even by experienced

prospectors, unless their attention had been previously called to their character and importance.

Even when veins of this nature contain but little gold at the surface they are generally found to be richer in depth, and from their supposed mode of formation the author attempts to give a rational explanation of this circumstance.

They are evidently true fissures, as indicated by the faulting which may be seen along some of them, and also from the fact that they intersect alike both the massive and the stratified rocks. The mikadoite spreads out irregularly on either side of the quartz sheet which accompanies it and forms, as it were, the backbone of the vein. The latter may carry small quantities of the sulphides of copper, lead, zinc, and more rarely bismuth, but these minerals are scarcer in the mikadoite, in which the fine grained pyrite above mentioned is the prevailing sulphide.

Many of the felsite and greenstone dikes of Bog Bay district have been found by assay to be auriferous and a few of them are being worked for gold with promising results.

It seems highly probable to the author that the gold was derived from heated vapors and solutions which ascended through the fissures from great depths, presumably from the vicinity of the magmas—the source of the felsites and greenstones.

The felsite dikes are generally present near the veins and are usually more or less charged with the fine grained sulphide of iron that almost invariably accompanies the gold in the veins. Their auriferous character is more marked when they are close to the quartz veins. The felsite in many places loses the crystalline texture and passes into phonolite with the usual metallic ring. It is probable that this rock may have some connection with the occurrence of the gold here, as the phonolites of the famous Cripple Creek district of Colorado are admitted to have in that region. In a somewhat similar way the trappean eruptions of the Keweenaw district are believed to be connected with the presence of native copper there. For these reasons the auriferous veins under consideration may be expected to continue productive to a considerable depth, and to improve rather than the reverse at lower depths.

In regard to the manner in which these veins were formed, the author, after much study and observation, reaches the conclusion that during the movements which caused these rents a sufficient pressure was exerted to prevent a separation of the walls so as to leave openings for the reception of the vein matter; hence the openings now filled with gangue must have been subsequently created. The heated solutions that would be certain to percolate through these fissures would dissolve the silica out of the wall-rocks and deposit it as vein-quartz, while the crushed rock adjoining the fissures would be metamorphosed in the manner described by Professor C. R. Van Hise in his admirable paper "Metamorphism of Rocks and Rock-flowage." Referring to the same subject, Dr M. E. Wadsworth, states in his pamphlet "The Lake Superior Copper Deposits," issued in 1891, that "one of the latest phases of the formation of deposits of value has been the filling in of fissures by the water-deposited quartz and other vein materials, or, in case no crack nor fissure existed, by the removal of the country rocks along certain lines and their replacement by vein matter."

Attention is called to the great difference in character between the gold-bearing fissure veins of Archean time and those of later age, such as the silver-bearing veins of the Thunder Bay district.

The latter show well defined walls with brecciated extraneous matter frequently inclosed in the quartz or sparry matrix, while the adjacent rocks are but slightly, if at all, laminated or metamorphosed. The newer or open-fissure veins of the later formations are sometimes continued with the same characters into the underlying Archean rocks. On the other hand the veins in the Archean rocks of more ancient origin rarely show two well defined walls, they seldom contain extraneous brecciated matter, and the adjacent country rock is generally laminated and highly metamorphosed. The laminated portions are, in many instances, an important factor in the gold veins of the latter class, as shown by those of Bog bay.

The author believes that the auriferous veins of this western Ontario district were all formed in Archean time, because after many years of exploration he knows of no place around lake Superior where such veins penetrate the later formations. Such veins occur in the Archean areas on both sides of this lake, as at Jackfish bay, at Schreiber and around Shebandowan lake on the north side, and again at the Ropes gold mine near Ishpeming on the south side, but nowhere in the later rocks which lie between the last mentioned locality and the others.

The metalliferous veins formed during the Archean period have, therefore, a different set of characters from those which originated in subsequent times, when the crust of the earth had become thicker and colder. In the early age of the globe to which the Archean rocks belong, the crust must have been thinner and weaker, the heat greater, the gaseous elements more powerful, and the shrinkage of the crust more rapid and intense than in later times. Therefore we might expect to find the rock formations greatly fractured and the sides of the rents ground and laminated to a greater extent than in veins of later date. Although veins of the open spaced fissure kind do occur in some places in these ancient rocks, still the majority of their veins are of the other variety, in which the space for the reception of the gangue was created by solvents circulating through the crushed material along the fractures. In the latter case, the size of the vein proper is not a fair measure for comparing the strength, value, or continuity of the ore-body with that of an ordinary fissure vein occurring in newer formations. The lamination of the walls of the veins formed in Archean time may be taken as a guide for distinguishing them from those of the other class. The author is of the opinion that mining men and experts in general will be mistaken if they look for the general characteristics of open-fissure veins in judging of those of the western gold fields of Ontario.

Gold-bearing veins of the class here described are not confined to the Bog Bay district. Similar ones, accompanied by mikadoite, cut granite rocks in the vicinity of Sawbill lake on the Seine river. It is supposed that the granite of this locality was erupted about the same time as that of Bog bay and from an analogous magma. Dikes of felsite and diorite, like those of the latter locality, intersect this granite. The Hammond Reef mine of the Sawbill region is situated upon a belt from 100 to 500 feet in width of parallel quartz and mikadoite veins having characters similar to those of Bog bay. In fact, these characteristics, to a more or less extent, prevail throughout these extensive Ontario western gold fields.

The following papers were all read by title:

ROCKY MOUNTAINS OF MONTANA

BY BAILEY WILLIS

ORIGIN OF SOME ARCHEAN CONGLOMERATES

BY A. E. BARLOW

GEOLOGY OF THE CRYSTALLINE ROCKS OF MANHATTAN ISLAND AND VICINITY

BY FREDERICK J. H. MERRILL

ORIGIN OF THE HIGHLAND GORGE OF THE HUDSON RIVER

BY FREDERICK J. H. MERRILL

[*Abstract*]

The object of this paper is to call attention to some facts of geologic structure which have had a very important influence on the course of the Hudson river and the location of its gorge through the pre-Cambrian highlands of Putnam and Orange counties, New York.

This gorge has been for many years a subject of interest to geologists, and various theories have been advanced concerning its origin. The most prominent of these was that the river had followed an old fault line, erosion having been guided by a line of displacement.

Careful examination of the gorge and the adjacent territory shows that no displacement has occurred and that no fault is there, but stratigraphic study of the region has recently brought to light some facts which aid materially in assigning a reason for the course taken by the river through the area of crystalline rocks under consideration.

The central portion of the highland gorge, about 7 miles in length, extending from Cold Spring to Anthonys Nose, has a direction about north 30 degrees east, following the general strike of the gneisses which form its sides. These rocks are very distinct in character from the massive granites which form the highland mountains, being quite schistose in structure, and include, at a number of points along the east shore of the river, small areas of highly crystalline limestone. The river in this part of the gorge is about half a mile wide. All evidence of the character of the rocks which form its bottom is wanting, and we are obliged to go northward along the line of strike to determine their probable character. As may be seen from an inspection of the West Point topographic sheet, from Cold Spring northeastward extends a continuation of the valley occupied by the river, which, about 8 miles from Cold Spring, opens into the Paleozoic plain of southern Dutchess county. Through this valley the Trenton-Calciferous limestone of the latter region can be traced for some distance southward in a closely pressed synclinal fold, the pale blue, fine-grained limestone of Fishkill being succeeded farther southwest, near Cold Spring, by a crystalline limestone which is apparently, in stratigraphic continuity with the former, but which, by metamorphism, has become vastly changed in its condition.

This crystalline limestone is inclosed by gneisses similar in character to those

bordering the river between West Point and Fort Montgomery. The inference from stratigraphic continuity is therefore that the Hudson river from West Point to Fort Montgomery follows a synclinal valley, along the bottom of which is a narrow belt of limestone bordered on either side by schistose rocks which have been more susceptible to erosion than the massive granites of the Highland mountains which form the walls of the valley. This feature, which is characteristic of the central portion of the gorge, does not exist at its northern and southern extremities. Each of these is much shorter than the central part and has a trend quite oblique to it.

An examination of the terminal portions shows that their determining cause is not a syncline of softer gneisses and limestone, but a synclinal cross-folding of the granite, which is characteristic of the crystalline area of southeastern New York and has everywhere an important influence on its drainage. This cross-folding is usually attended by fracture, and although we cannot positively assert that the latter has occurred at the two points mentioned, it is highly probable that the work of erosion has been aided in this way.

IOWAN DRIFT

BY SAMUEL CALVIN

The paper is printed as pages 107–120 of this volume.

LOESS DEPOSITS OF MONTANA

BY N. S. SHALER

The paper is printed as pages 245–252 of this volume.

SPACING OF RIVERS WITH REFERENCE TO HYPOTHESIS OF BASELEVELING

BY N. S. SHALER

The paper is printed as pages 263–276 of this volume.

The general session was then transferred to the room where the Petrographic Section was yet in progress. The work in this special section was as follows:

Proceedings of the Petrographic Section

This temporary section was convened on Friday, at 2 o'clock p m, in the geological lecture-room of Schermerhorn Hall. Vice-President Emerson was made chairman and J. F. Kemp secretary. Six papers were read before the section, the first of which was

DIFFERENCE IN BATHOLITHIC GRANITES ACCORDING TO DEPTH OF EROSION

BY B. K. EMERSON

[*Abstract*]

It was stated that the Quincy granite band with the associated quartz-porphyries, rhyolitic breccias, and granophyrs extended south beneath the Carboniferous to

South Greenwich, south of Providence, Rhode Island, and a quartz-porphyry and granite containing blue quartz were especially described. South of the Boston area these granites do not alter the Cambrian schists and do not absorb any material from them. Several other bands extending across Worcester county were contrasted with the Quincy band in the following particulars: They are often coarsely porphyritic, while the Quincy granites are not. They are microcline granites. The Quincy granites are orthoclase granites. They contain biotite or biotite and muscovite instead of biotite and hornblende or glaucophane.

These granite batholites are also contrasted with the Quincy rock in having a broad peripheral layer which has all the peculiarities of pegmatite in some cases, and grades into black albitic granites or even quartz-diorites.

These differences are largely due to the fact that these rocks have fused much of the surrounding schist into their composition, and this was proved by finding characteristic inclusions of the schist in great numbers and of every size in the granite, and also by tracing these inclusions into smaller and smaller filaments until they faded from sight, and finding with the microscope far beyond this point in the fresh granite clear traces of the schists. When the schist contains pyrite, garnet, fibrolite, cordierite, or graphite, the granite becomes more ferruginous and garnetiferous. The amber coarse fibrolite of the schist appears dissolved and recrystallized as a white, silky bucholzite or fazer-kiesel in the granite, and the graphite scales are inclosed in all the constituents of the granite over many square miles.

Over the whole surface of the great Hubbardston batholite of perfect, coarse porphyritic granite 32 miles long and 6 miles wide it was possible to map the areas once occupied by the different schists, which formerly mantled over the granite mass by means of the indestructible constituents of the former schists; by the portions which had melted into the mass of the granite; by the filaments still remaining unabsorbed, and by the different aspect of the granite, dependent largely on the great increment of iron. Using especially the first two criteria, this double mapping of the region will be carried out in the sheets being prepared for the United States Geological Survey.

The region extending for several miles south from mount Wachusett and that north and south of Brookfield in the Hubbardston batholite furnish abundant exposures for the study of the phenomena here described.

The paper was discussed by Whitman Cross, M. E. Wadsworth, J. F. Kemp, and the author. Two papers by Kemp followed:

METAMORPHOSED BASIC DIKES IN THE MANHATTAN SCHISTS

BY J. F. KEMP

Remarks were made by M. E. Wadsworth.

GRANITES OF SOUTHERN RHODE ISLAND AND CONNECTICUT, WITH OBSERVATIONS ON ATLANTIC COAST GRANITES IN GENERAL

BY J. F. KEMP

Remarks were made by J. E. Wolff. The paper is printed as pages 361–382 of this volume.

The next paper was

AUGITE-SYENITE GNEISS NEAR LOON LAKE, NEW YORK

BY H. P. CUSHING

Remarks were made by H. S. Washington, J. F. Kemp, M. E. Wadsworth, and N. H. Winchell. The paper is printed as pages 177–192 of this volume. It was followed by

PHENOCRYSTS OF INTRUSIVE IGNEOUS ROCKS

BY L. V. PIRSSON

Remarks were made by J. P. Iddings and Whitman Cross. The last paper was

MICA DEPOSITS OF THE UNITED STATES

BY J. A. HOLMES

[*Abstract*]

The deposits of commercial mica in the United States, though widely distributed, are limited to a few districts. They have been worked to some extent along the Appalachian system of mountains in New Hampshire, Virginia, North Carolina, the Black Hills region of South Dakota, the Cribbensville district of northern New Mexico, and western Idaho.

Additional deposits of promise have been found and developed on a small scale in the Appalachian region in Maine, Maryland, South Carolina, Georgia, and Alabama, and in California, Wyoming, Nevada, and other portions of New Mexico. As to the geologic occurrence of these deposits it may be said that as far as examined in the United States they are all found in pegmatite "veins" or dikes; and these pegmatite dikes occur in schistose and gneissic rocks which are usually classed as Archean in age, but some of them are evidently more recent. The dikes yielding the best and largest quantities of mica are found in the hornblende and micaceous gneisses and schists, and are in places parallel to but generally breaking across the schistosity of these rocks at varying angles.

Pegmatite dikes, as is well known, vary in thickness from a few inches to more than 250 feet, and can be traced for distances varying from a few feet in the smaller ones to sometimes several miles in the larger ones. They are generally quite irregular and have arms branching out in almost every direction. Many are vertical, while others are horizontal; most of them vary considerably in this respect.

In character the pegmatite may be called an exceedingly coarse granite, consisting mainly of quartz and feldspar, in equal or variable proportions, and muscovite mica. In some places the quartz and feldspar are somewhat uniformly distributed through the pegmatite mass, while in other cases the two are fairly well separated, the feldspar sometimes crystallized out into masses more than a ton in weight. In addition to these three common minerals, there occur in these dikes a large number of accessory minerals with varying degrees of rarity. The dikes in certain localities sometimes contain a considerable number of these min-

erals—20 or more species being occasionally observed in a single dike—and in other regions few of them are to be found. Thus in the dikes of Mitchell and Yancey counties, North Carolina, these accessory minerals are both numerous and varied, 47 or more being enumerated by Pratt, of which the following most common 20 species may be named, approximately in the order of their abundance: kaolin, almandite, and andradite (garnets), tourmaline, beryl, apatite, epidote, biotite, microcline, orthoclase, allanite (?), uraninite, gummite, autunite, columbite, samarskite, zosite (var. thulite), pyrite, magnetite, menaccanite. But in Macon county, over 100 miles southwest, accessory minerals are exceedingly rare.

In the Black Hills region of South Dakota these mica dikes contain a number of accessory minerals, but not in such variety as has been found in the North Carolina region. The following species were observed there by the writer: tourmaline (mostly black), microcline, albite—oligoclase (sparingly well crystallized), quartz (massive—pink or rose), muscovite, lepidolite, biotite, epidote, garnet (rare), columbite, wolframite, spodumene (large rough crystals), apatite (rare), menaccanite, cassiterite. Two additional species, triphylite and leucopyrite, have been reported by Blake. In the Cribbensville district, New Mexico, there are but few accessory minerals and these are rare.

The country rock immediately adjacent to these pegmatite dikes have as a rule undergone but slight changes. Frequently they are somewhat impregnated with the quartz and feldspar of the dike, these materials being sufficiently abundant in some cases to give the walls of the dike for several inches from the contact a grayish or whitish appearance, although the country rock may have been a darker color. The alteration as a rule does not extend out more than one or two feet from the dike, generally not more than a few inches. After this perhaps the most common feature is what may be called the tourmalinization of the country rock to a distance of from a few inches to one or more feet distant from the rock, the tourmaline in small grains or crystals being at times quite abundant next the dike and gradually diminishing as this distance increases. As a rule, the crystals ("blocks" or "books") of commercial mica need not be looked for in the dikes or veins under two feet in diameter, but there are cases in which crystals two by two and one-half feet in diameter have been found in the dikes, the width of which was scarcely greater than these figures. On the other hand, in case of some of the larger dikes no mica whatever of commercial value has been found, as, for example, the large dike being mined for kaolin by the Harris Clay company, near Webster, North Carolina.

As to the distribution of mica in the dike, it may be said that generally these crystals are scattered irregularly through the matrix of quartz and feldspar, and in mining operations a large amount of useless material has to be blasted down and removed from the mine in order to secure the commercial product. In other cases, however, the crystals of mica occur in the outer part of the dike near the wall rock, and in such cases the mica "lead" may be more easily followed. In some cases the mica constitutes as high as 10 per cent of the total mass of the dike, but in the majority of cases it will prove to be less than one per cent of the total, and in many of the largest pegmatite dikes, as stated above, no commercial mica is found, the mica present being in small scales and crystals, the largest diameter of which would rarely exceed two inches. Of the mica taken from the dike in ordinary mining operations, usually less than 10 per cent, and sometimes less than 2 per cent, has a commercial value as sheet mica, the remainder being either thrown away as waste material or pulverized for commercial uses.

The age of these dikes in different parts of the country may be said to vary considerably. In crystalline rocks exposed in the lower part of the Grand canyon of the Colorado in northern Arizona, the dikes break up through the granitic rocks, but come unconformable against the base of the Algonkin series there, and are consequently pre-Algonkin in age. All of the dikes observed in the Rocky Mountain region have been to a greater or less degree involved in the schistosity and other structural modifications of the crystalline rocks, and consequently were probably formed during the earlier stages of the uplift of these mountains. In the Appalachian region these dikes are not in most cases extensively involved in the schistose structures of the rocks, but in some cases they have undergone considerable changes in connection with the production of these structures, and the conditions surrounding these dikes seem to indicate that they were formed during the later stages of the uplift of this mountain region, though in some cases the smaller dikes are involved in folds quite similar in general character to those typical of the Appalachian structure. In cases of these larger Appalachian dikes, however, the crystalline character is such as to indicate few or no great pressure changes, and to suggest the association of such dikes with the later development of this mountain region.

Occasionally in the Black hills and in New Mexico, and less frequently in the Appalachian region, the sheets of mica have themselves been folded under pressure, but as a rule they show little such distortion, having been, like the coarse feldspar and quartz of the dike, but little modified in connection with the mountain uplifting. These blocks of mica, however, frequently have their commercial value in large measure destroyed by the reproduction of what is called "ruled" or "ribbon" mica, the sheets of mica being cut into narrow strips with parallel edges, the line of ruling or cutting appearing in all cases to be parallel to certain axes of crystallization; but the cause of this "ruling" and the conditions under which it has been produced are not yet well understood.

During the reading of Professor Holmes' paper the Fellows in attendance at the meeting gathered in the Petrographic Section, which was then regarded as the general Society meeting, with Vice-President Emerson in the chair.

The scientific work was declared completed.

Mr J. S. Diller presented a resolution of thanks to the President and Trustees of Columbia University for the welcome to the University and the use of the rooms and facilities, to the resident Fellows who had served as a local Committee of Arrangements, and to Mr George F. Kunz for his labors in connection with the annual dinner.

The Society then adjourned.

Register of the New York Meeting, 1898*

The following Fellows were in attendance at the meeting:

F. D. Adams.
H. M. Ami.
Florence Bascom.
Robert Bell.
S. W. Beyer.
A. S. Bickmore.
J. M. Clarke.
A. P. Coleman.
F. W. Cragin.
W. O. Crosby.
Whitman Cross.
H. P. Cushing.
N. H. Darton.
G. M. Dawson.
J. S. Diller.
E. V. d'Invilliers.
R. E. Dodge.
C. R. Eastman.
B. K. Emerson.
S. F. Emmons.
H. L. Fairchild.
H. T. Fuller.
G. K. Gilbert.
A. C. Gill.
L. S. Griswold.
F. P. Gulliver.
C. W. Hall.
C. W. Hayes.
Angelo Heilprin.
Arthur Hollick.
J. A. Holmes.
T. C. Hopkins.
E. O. Hovey.
E. E. Howell.
J. P. Iddings.
W. D. Johnson.
A. A. Julien.
J. F. Kemp.
H. B. Kümmell.
G. F. Kunz.
W J McGee.
A. M. Miller.
H. F. Osborn.
Charles Palache.
L. V. Pirsson.
J. W. Powell.
C. S. Prosser.
F. L. Ransome.
H. F. Reid.
Heinrich Ries.
I. C. Russell.
H. M. Seely.
N. S. Shaler.
E. A. Smith.
G. O. Smith.
J. C. Smock.
A. C. Spencer.
Joseph Stanley-Brown.
J. J. Stevenson.
J. A. Taff.
H. W. Turner.
J. B. Tyrrell.
A. W. Vogdes.
M. E. Wadsworth.
C. D. Walcott.
H. S. Washington.
David White.
I. C. White.
H. S. Williams.
Bailey Willis.
N. H. Winchell.
J. E. Wolff.
R. S. Woodward.
J. B. Woodworth.
A. A. Wright.
W. S. Yeates.

Fellow-elect: T. G. White.

Total attendance, 77.

* During some part of the last day of the meeting the Society was pleased to have in attendance as a visitor Dr Oliver P. Hubbard, one of the surviving members of the Association of American Geologists and Naturalists, 1840–1847.

OFFICERS AND FELLOWS OF THE GEOLOGICAL SOCIETY OF AMERICA

OFFICERS FOR 1899

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B. K. EMERSON, Amherst, Mass.

Vice-Presidents

G. M. DAWSON, Ottawa, Canada
C. D. WALCOTT, Washington, D. C.

Secretary

H. L. FAIRCHILD, Rochester, N. Y.

Treasurer

I. C. WHITE, Morgantown, W. Va.

Editor

J. STANLEY-BROWN, Washington, D. C.

Librarian

H. P. CUSHING, Cleveland, O.

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(Term expires 1899)

J. S. DILLER, Washington, D. C.
W. B. SCOTT, Princeton, N. J.

(Term expires 1900)

ROBERT BELL, Ottawa, Canada
M. E. WADSWORTH, Houghton, Mich.

(Term expires 1901)

W. M. DAVIS, Cambridge, Mass.
J. A. HOLMES, Chapel Hill, N. C.

FELLOWS, DECEMBER, 1899

*Indicates Original Fellow (see article III of Constitution)

CLEVELAND ABBE, JR., Ph. D., Rock Hill, S. C.; Professor in Winthrop Normal College of South Carolina. August, 1899.

FRANK DAWSON ADAMS, Ph. D., Montreal Canada; Professor of Geology in McGill University. December, 1889.

JOSÉ GUADALUPE AGUILERA, Esquela N. de Ingeneiros, City of Mexico, Mexico; Director del Instituto Geologico de Mexico. August, 1896.

TRUMAN H. ALDRICH, M. E., Birmingham, Ala. May, 1889.

HENRY M. AMI, A. M., Geological Survey Office, Ottawa, Canada; Assistant Paleontologist on Geological and Natural History Survey of Canada. December, 1889.

PHILIP ARGALL, 821 Equitable Building, Denver, Colo.; Mining Eng. August, 1896.

GEORGE HALL ASHLEY, M. E., A. M., Ph. D., 207 East Fifteenth St., Indianapolis, Ind.; Assistant Geologist, Indiana Geological Survey. August, 1896.

HARRY FOSTER BAIN, M. S., Des Moines, Iowa; Assistant Geologist, Iowa Geological Survey. December, 1895.

RUFUS MATHER BAGG, A. B., Ph. D., Colorado College, Colorado Springs, Colo. December, 1896.

S. PRENTISS BALDWIN, 1345 Euclid Ave., Cleveland, Ohio. August, 1895.

ERWIN HINCKLEY BARBOUR, A. B., Ph. D., Lincoln, Neb.; Professor of Geology, University of Nebraska, and Acting State Geologist. December, 1896.

GEORGE H. BARTON, B. S., Boston, Mass.; Instructor in Geology in Massachusetts Institute of Technology. August, 1890.

FLORENCE BASCOM, A. M., B. S., Ph. D., Bryn Mawr, Pa.; Instructor in Geology, Petrography, and Mineralogy in Bryn Mawr College. August, 1894.

WILLIAM S. BAYLEY, Ph. D., Waterville, Maine; Professor of Geology in Colby University. December, 1888.

*GEORGE F. BECKER, Ph. D., Washington, D. C.; U. S. Geological Survey.

CHARLES E. BEECHER, Ph. D., Yale University, New Haven, Conn. May, 1889.

ROBERT BELL, C. E., M. D., LL. D., Ottawa, Canada; Assistant Director of the Geological and Natural History Survey of Canada. May, 1889.

SAMUEL WALKER BEYER, B. Sc., Ph. D., Ames, Iowa; Assistant Professor in Geology, Iowa Agricultural College. December, 1896.

ALBERT S. BICKMORE, Ph. D., American Museum of Natural History, New York; Professor in charge Department of Public Instruction. December, 1889.

*JOHN C. BRANNER, Ph. D., Stanford University, Cal.; Professor of Geology in Leland Stanford Jr. University.

ALBERT PERRY BRIGHAM, A. B., A. M., Hamilton, N. Y.; Professor of Geology and Natural History, Colgate University. December, 1893.

*GARLAND C. BROADHEAD, Columbia, Mo.; Professor of Geology in the University of Missouri.

ALFRED HULSE BROOKS, B. S., Washington, D. C.; Assistant Geologist, U. S. Geological Survey, August, 1899.

*SAMUEL CALVIN, Iowa City, Iowa; Professor of Geology and Zoology in the State University of Iowa. State Geologist.

HENRY DONALD CAMPBELL, Ph. D., Lexington, Va.; Professor of Geology and Biology in Washington and Lee University. May, 1889.

MARIUS R. CAMPBELL, U. S. Geological Survey, Washington, D. C. August, 1892.

FRANKLIN R. CARPENTER, Ph. D., Deadwood, South Dakota; Superintendent Deadwood and Delaware Smelting Company. May, 1889.

ROBERT CHALMERS, Geological Survey Office, Ottawa, Canada; Geologist on Geological and Natural History Survey of Canada. May, 1889.

*T. C. CHAMBERLIN, LL. D., Chicago, Ill.; Head Professor of Geology, University of Chicago.

CLARENCE RAYMOND CLAGHORN, B. S., M. E., Vintondale, Pa. August, 1891.

* WILLIAM BULLOCK CLARK, Ph. D., Baltimore, Md.; Professor of Geology in Johns Hopkins University; State Geologist.

JOHN MASON CLARKE, A. M., Albany, N. Y.; State Paleontologist. December, 1897.

* EDWARD W. CLAYPOLE, D. Sc., Pasadena, Cal.

J. MORGAN CLEMENTS, B. A., Ph. D., Madison, Wis.; Assistant Professor of Geology in University of Wisconsin. December, 1894.

COLLIER COBB, A. B., A. M., Chapel Hill, N. C.; Professor of Geology in University of North Carolina. December, 1894.

ARTHUR P. COLEMAN, Ph. D., Toronto, Canada; Professor of Geology, Toronto University, and Geologist of Bureau of Mines of Ontario. December, 1896.

GEORGE L. COLLIE, Ph. D., Beloit, Wis.; Professor of Geology in Beloit College. December, 1897.

*THEODORE B. COMSTOCK, Los Angeles, Cal.; Mining Engineer.

* FRANCIS W. CRAGIN, B. S., Colorado Springs, Colo.; Professor of Geology and Natural History in Colorado College.

*ALBERT R. CRANDALL, A. M., Alfred, N. Y.

ALJA ROBINSON CROOK, A. B., Evanston, Ill.; Professor of Mineralogy and Petrography in Northwestern University. December, 1898.

*WILLIAM O. CROSBY, B. S., Boston Society of Natural History, Boston, Mass.; Asst. Prof. of Mineralogy and Lithology in Massachusetts Inst. of Technology.

WHITMAN CROSS, Ph. D., U. S. Geological Survey, Washington, D. C. May, 1889.

GARRY E. CULVER, A. M., 1104 Wisconsin St., Stevens Point, Wis. December, 1891.

* HENRY P. CUSHING, M. S., Adelbert College, Cleveland, Ohio; Professor of Geology, Western Reserve University.

T. NELSON DALE, Williamstown, Mass.; Geologist, U. S. Geological Survey; Instructor in Geology, Williams College. December, 1890.

* NELSON H. DARTON, United States Geological Survey, Washington, D. C.

* WILLIAM M. DAVIS, Cambridge, Mass.; Professor of Physical Geography in Harvard University.

GEORGE M. DAWSON, D. Sc., A. R. S. M., Geological Survey Office, Ottawa, Canada; Director of Geological and Natural History Survey of Canada. May, 1889.

DAVID T. DAY, A. B., Ph. D., U. S. Geol. Survey, Washington, D. C. August, 1891.

ORVILLE A. DERBY, M. S., Sao Paulo, Brazil; Director of the Geographical and Geological Survey of the Province of Sao Paulo, Brazil. December, 1890.

* JOSEPH S. DILLER, B. S., United States Geological Survey, Washington, D. C.

EDWARD V. D'INVILLIERS, E. M., 711 Walnut St., Philadelphia, Pa., Dec., 1888.

RICHARD E. DODGE, A. M., Teachers' College, West 120th St., New York city; Professor of Geography in the Teachers' College. August, 1897.

NOAH FIELDS DRAKE, Ph. D., Tientsin, China; Professor of Geology in Imperial Tientsin University. December, 1898.

CHARLES R. DRYER, M. A., M. D., Terre Haute, Ind.; Professor of Geography, Indiana State Normal School. August, 1897.

* EDWIN T. DUMBLE, Austin, Texas; State Geologist.

CLARENCE E. DUTTON, Major, U. S. A., Ordnance Department, Washington, D. C. August, 1891.

* WILLIAM B. DWIGHT, M. A., Ph. B., Poughkeepsie, N. Y.; Professor of Natural History in Vassar College.

CHARLES R. EASTMAN, A. M., Ph. D., Cambridge, Mass.; Assistant in Paleontology in Harvard University. December, 1895.

* GEORGE H. ELDRIDGE, A. B., United States Geological Survey, Washington, D. C.

ARTHUR H. ELFTMAN, Ph. D., Grand Marais, Minn. December, 1898.

ROBERT W. ELLS, LL. D., Geological Survey Office, Ottawa, Canada; Geologist on Geological and Natural History Survey of Canada. December, 1888.

* BENJAMIN K. EMERSON, Ph. D., Amherst, Mass.; Professor in Amherst College.

* SAMUEL F. EMMONS, A. M., E. M., U. S. Geological Survey, Washington, D. C.

JOHN EYERMAN, F. Z. S., Oakhurst, Easton, Pa. August, 1891.

HAROLD W. FAIRBANKS, B. S., Berkeley, Cal.; Geologist State Mining Bureau. August, 1892.

* HERMAN L. FAIRCHILD, B. S., Rochester, N. Y.; Professor of Geology in University of Rochester.

J. C. FALES, Danville, Kentucky; Professor in Centre College. December, 1888.

OLIVER C. FARRINGTON, Ph. D., Chicago, Ill.; In charge of Department of Geology, Field Columbian Museum. December, 1895.

WILLIAM M. FONTAINE, A. M., University of Virginia, Va.; Professor of Natural History and Geology in University of Virginia. December, 1888.

* PERSIFOR FRAZER, D. Sc., 1042 Drexel Building, Philadelphia, Pa.; Professor of Chemistry in Franklin Institute.

* HOMER T. FULLER, Ph. D., Springfield, Mo.; President of Drury College.

MYRON LESLIE FULLER, S. B., Boston, Mass.; Instructor in Geology, Massachusetts Institute of Technology. December, 1898.

HENRY STEWART GANE, A. B., Ph. D., 425 La Salle Ave., Chicago, Ill. Dec., 1896.

HENRY GANNETT, S. B., A. Met. B., U. S. Geological Survey. Washington, D. C. December, 1891.

* GROVE K. GILBERT, A. M., LL. D., U. S. Geological Survey, Washington, D. C.

ADAM CAPEN GILL, A. B., Ph. D., Ithaca, N. Y.; Assistant Professor of Mineralogy and Petrography in Cornell University. December, 1888.

CHARLES H. GORDON, M. S., Ph. D., Lincoln, Neb.; Superintendent of Schools. August, 1893.

AMADEUS WILLIAM GRABAU, S. B., Cambridge, Mass.; Fellow in Paleontology, Harvard University. December, 1898.

ULYSSES SHERMAN GRANT, Ph. D., Evanston, Ill.; Professor of Geology, Northwestern University. December, 1890.

WILLIAM STUKELEY GRESLEY, Erie, Pa.; Mining Engineer. December, 1893.

GEORGE P. GRIMSLEY, M. A., Ph. D., Topeka, Kan.; Professor of Geology in Washburn College. August, 1895.

LEON S. GRISWOLD, A. B., 238 Boston St., Dorchester, Mass. August, 1892.

FREDERICK P. GULLIVER, A. M., St. Mark's School, Southboro, Mass. August, 1895.

ARNOLD HAGUE, Ph. B., U. S. Geological Survey, Washington, D. C. May, 1889.

* CHRISTOPHER W. HALL, A. M., 803 University Ave., Minneapolis, Minn.; Professor of Geology and Mineralogy in University of Minnesota.

JOHN B. HASTINGS, M. E., Rossland, British Columbia. May, 1889.

JOHN B. HATCHER, Ph. B., Princeton, N. J.; Assistant in Geology, College of New Jersey. August, 1895.

* ERASMUS HAWORTH, Ph. D., Lawrence, Kan.; Professor of Geology, University of Kansas.

C. WILLARD HAYES, Ph. D., U. S. Geological Survey, Washington, D. C. May, 1889.

* ANGELO HEILPRIN, Academy of Natural Sciences, Philadelphia, Pa.; Professor of Paleontology in the Academy of Natural Sciences.

* EUGENE W. HILGARD, Ph. D., LL. D., Berkeley, Cal.; Professor of Agriculture in University of California.

FRANK A. HILL, Roanoke, Va. May, 1889.

* ROBERT T. HILL, B. S., U. S. Geological Survey, Washington, D. C.

RICHARD C. HILLS, Mining Engineer, Denver, Colo. August, 1894.

* CHARLES H. HITCHCOCK, Ph. D., LL. D., Hanover, N. H.; Professor of Geology in Dartmouth College.

WILLIAM HERBERT HOBBS, B. Sc., Ph. D., Madison, Wis.; Assistant Professor of Mineralogy in the University of Wisconsin. August, 1891.

* LEVI HOLBROOK, A. M., P. O. Box 536, New York city.

ARTHUR HOLLICK, Ph. B., Columbia University, New York; Instructor in Geology. August, 1893.

* JOSEPH A. HOLMES, Chapel Hill, N. C.; State Geologist and Professor of Geology in University of North Carolina.

THOMAS C. HOPKINS, A. M., Walker Museum, University of Chicago. Dec., 1894.

* EDMUND OTIS HOVEY, Ph. D., American Museum of Natural History, New York city; Assistant Curator of Geology.

* HORACE C. HOVEY, D. D., Newburyport, Mass.

* EDWIN E. HOWELL, A. M., 612 Seventeenth St. N. W., Washington, D. C.

LUCIUS L. HUBBARD, A. B., LL. D., Ph. D., Houghton, Mich.; State Geologist of Michigan. December, 1894.

* ALPHEUS HYATT, B. S., Boston Society of Natural History, Boston, Mass.; Curator of Boston Society of Natural History.

JOSEPH P. IDDINGS, Ph. B., Professor of Petrographic Geology, University of Chicago, Chicago, Ill. May, 1889.

A. WENDELL JACKSON, Ph. B., 407 St. Nicholas Ave., New York city. Dec., 1888.

ROBERT T. JACKSON, S. B., S. D., 33 Gloucester St., Boston, Mass.; Instructor in Paleontology in Harvard University. August, 1894.

THOMAS M. JACKSON, C. E., S. D., Clarksburg, W. Va. May, 1889.

* WILLARD D. JOHNSON, United States Geological Survey, Washington, D. C.

ALEXIS A. JULIEN, Ph. D., Columbia College, New York city; Instructor in Columbia College. May, 1889.

ARTHUR KEITH, A. M., U. S. Geological Survey, Washington, D. C. May, 1889.

* JAMES F. KEMP, A. B., E. M., Columbia University, New York city; Professor of Geology.

CHARLES ROLLIN KEYES, A. M., Ph. D., 944 Fifth St., Des Moines, Iowa. Aug., 1890.

WILBUR C. KNIGHT, B. S., A. M., Laramie, Wyo.; Professor of Mining and Geology in the University of Wyoming. August, 1897.

FRANK H. KNOWLTON, M. S., Washington, D. C.; Assistant Paleontologist, U. S. Geological Survey. May, 1889.

HENRY B. KÜMMEL, A. M., Ph. D., Trenton, N. J.; Assistant State Geologist. December, 1895.

* GEORGE F. KUNZ, care of Tiffany & Co., 15 Union Square, New York city.

RALPH D. LACOE, Pittston, Pa. December, 1889.

GEORGE EDGAR LADD, A. M., Ph., D., Rolla, Mo.; Director, School of Mines. August, 1891.

J. C. K. LAFLAMME, M. A., D. D., Quebec, Canada; Professor of Mineralogy and Geology in University Laval, Quebec. August, 1890.

ALFRED C. LANE, Ph. D., Lansing, Mich.; Assistant State Geologist. Dec., 1889.

DANIEL W. LANGTON, Ph. D., 39 East Tenth St., New York city; Mining Engineer. December, 1889.

ANDREW C. LAWSON, Ph. D., Berkeley, Cal.; Assistant Professor of Geology in the University of California. May, 1889.

* JOSEPH LE CONTE, M. D., LL. D., Berkeley, Cal.; Professor of Geology in the University of California.

* J. PETER LESLEY, LL. D., 1008 Clinton St., Philadelphia, Pa.; State Geologist.

FRANK LEVERETT, B. S., Denmark, Iowa; Asst., U. S. Geol. Survey. Aug., 1890.

WILLIAM LIBBEY, Sc. D., Princeton, N. J.; Professor of Physical Geography in Princeton University. August, 1899.

WALDEMAR LINDGREN, U. S. Geological Survey, Washington, D. C. August, 1890.

ROBERT H. LOUGHRIDGE, Ph. D., Berkeley, Cal.; Assistant Professor of Agricultural Chemistry in University of California. May, 1889.

ALBERT P. LOW, B. S., Geological Survey Office, Ottawa, Canada; Geologist on Canadian Geological Survey. August, 1892.

THOMAS H. MACBRIDE, Iowa City, Iowa; Professor of Botany in the State University of Iowa. May, 1889.

HENRY MCCALLEY, A. M., C. E., University, Tuscaloosa county, Ala.; Assistant on Geological Survey of Alabama. May, 1889.

RICHARD G. MCCONNELL, A. B., Geological Survey Office, Ottawa, Canada; Geologist on Geological and Natural History Survey of Canada. May, 1889.

JAMES RIEMAN MACFARLANE, A. B., 100 Diamond St., Pittsburg, Pa. August, 1891.

* W J MCGEE, Washington, D. C.; Bureau of North American Ethnology.

WILLIAM MCINNES, A. B., Geological Survey Office, Ottawa, Canada; Geologist, Geological and Natural History Survey of Canada. May, 1889.

PETER MCKELLAR, Fort William, Ontario, Canada. August, 1890.

CYRUS F. MARBUT, A. M., State University, Columbia, Mo.; Instructor in Geology and Assistant on Missouri Geological Survey. August, 1897.

VERNON F. MASTERS, A. M., Bloomington, Ind.; Professor of Geology in Indiana State University. August, 1892.

EDWARD B. MATHEWS, Ph. D., Baltimore, Md.; Instructor in Petrography in Johns Hopkins University. August, 1895.

P. H. MELL, M. E., Ph. D., Auburn, Ala.; Professor of Geology and Natural History in the State Polytechnic Institute. December, 1888.

JOHN C. MERRIAM, Ph. D., Berkeley, Cal.; Instructor in Paleontology in University of California. August, 1895.

* FREDERICK J. H. MERRILL, Ph. D., State Museum, Albany, N. Y.; Assistant State Geologist and Assistant Director of State Museum.

GEORGE P. MERRILL, M. S., U. S. National Museum, Washington, D. C.; Curator of Department of Lithology and Physical Geology. December, 1888.

Arthur M. Miller, A. M., Lexington, Ky.; Professor of Geology, State University of Kentucky. December, 1897.

James E. Mills, B. S., Quincy, Plumas Co., Cal. December, 1888.

Thomas F. Moses, M. D., Worcester Lane, Waltham, Mass. May, 1889.

* Frank L. Nason, A. B., West Haven, Conn.

* Peter Neff, A. M., 361 Russell Ave., Cleveland, Ohio; Librarian, Western Reserve Historical Society.

Frederick H. Newell, B. S., U. S. Geol. Survey, Washington, D. C. May, 1889.

William H. Niles, Ph. B., M. A., Cambridge, Mass. August, 1891.

William H. Norton, M. A., Mt. Vernon, Iowa; Professor of Geology in Cornell College. December, 1895.

Charles J. Norwood, Frankfort, Ky.; Mining Engineer. August, 1894.

Ezequiel Ordonez, Esquela N. de Ingeneiros, City of Mexico, Mexico; Geologist del Instituto Geologico de Mexico. August, 1896.

* Amos O. Osborn, Waterville, Oneida Co., N. Y.

Henry F. Osborn, Sc. D., Columbia University, New York city; Professor of Zoology, Columbia University. August, 1897.

Charles Palache, B. S., University Museum, Cambridge, Mass.; Instructor in Mineralogy, Harvard University. August, 1894.

* Horace B. Patton, Ph. D., Golden, Colo.; Professor of Geology and Mineralogy in Colorado School of Mines.

Richard A. F. Penrose, Jr., Ph. D., 1331 Spruce St., Philadelphia, Pa. May, 1889.

Joseph H. Perry, 176 Highland St., Worcester, Mass. December, 1888.

* William H. Pettee, A. M., Ann Arbor, Mich.; Professor of Mineralogy, Economical Geology, and Mining Engineering in Michigan University.

Louis V. Pirsson, Ph. D., New Haven, Conn.; Assistant Professor of Inorganic Geology, Sheffield Scientific School. August, 1894.

* Franklin Platt, 1617 Chestnut St., Philadelphia, Pa.

* Julius Pohlman, M. D., University of Buffalo, Buffalo, N. Y.

John Bonsall Porter, E. M., Ph. D., Montreal, Canada; Professor of Mining, McGill University. December, 1896.

* John W. Powell, Bureau of Ethnology, Washington, D. C.

Joseph Hyde Pratt, Ph. D., Chapel Hill, N. C.; Assistant Geologist, North Carolina Geological Survey. December, 1898.

* Charles S. Prosser, M. S., Columbus, Ohio; Associate Professor of Historical Geology in Ohio State University.

* Raphael Pumpelly, U. S. Geological Survey, Dublin, N. H.

Edmund C. Quereau, Ph. D., Aurora, Ill.; Professor of Geology, Syracuse University. August, 1897.

Frederick Leslie Ransome, Ph. D., Washington, D. C.; Assistant Geologist, U. S. Geological Survey. August, 1895.

Harry Fielding Reid, Ph. D., Johns Hopkins Univ., Baltimore, Md. Dec., 1892.

William North Rice, A. M., Ph. D., LL. D., Middletown, Conn.; Professor of Geology in Wesleyan University. August, 1890.

Heinrich Ries, A. M., Ph. D., Cornell University, Ithaca, N. Y.; Instructor in Economic Geology. December, 1893.

Charles W. Rolfe, M. S., 601 John St., Champaign, Ill.; Professor of Geology in University of Illinois. May, 1889.

* Israel C. Russell, LL. D., Ann Arbor, Mich.; Professor of Geology in University of Michigan.

* JAMES M. SAFFORD, M. D., LL. D., Nashville, Tenn.; State Geologist; Professor in Vanderbilt University.

ORESTES H. ST. JOHN, Raton, N. Mex. May, 1889.

* ROLLIN D. SALISBURY, A. M., Chicago, Ill.; Professor of General and Geographic Geology in University of Chicago.

FREDERICK W. SARDESON, L. B., M. S., Ph. D., Instructor in Paleontology, University of Minnesota, Minneapolis, Minn. December, 1892.

* CHARLES SCHAEFFER, M. D., 1309 Arch St., Philadelphia, Pa.

CHARLES SCHUCHERT, Washington, D. C.; Assistant Curator in Paleontology, U. S. National Museum. August, 1895.

WILLIAM B. SCOTT, M. A., Ph. D., 56 Bayard Ave., Princeton, N. J.; Blair Professor of Geology in College of New Jersey. August, 1892.

HENRY M. SEELY, M. D., Middlebury, Vt.; Professor of Geology in Middlebury College. May, 1889.

* NATHANIEL S. SHALER, LL. D., Cambridge, Mass.; Professor of Geology in Harvard University.

GEORGE BURBANK SHATTUCK, Ph. D., Baltimore, Md.; Associate Professor in Physiographic Geology, Johns Hopkins University. August, 1899.

WILL H. SHERZER, M. S., Ypsilanti, Mich.; Professor in State Normal School. December, 1890.

* FREDERICK W. SIMONDS, Ph. D., Austin, Texas; Professor of Geology in University of Texas.

* EUGENE A. SMITH, Ph. D., University, Tuscaloosa Co., Ala.; State Geologist and Professor of Chemistry and Geology in University of Alabama.

FRANK CLEMES SMITH, B. S., Deadwood, S. Dak.; Mining Engineer. Dec., 1898.

GEORGE OTIS SMITH, Ph. D., Washington, D. C.; Assistant Geologist, U. S. Geological Survey. August, 1897.

* JOHN C. SMOCK, Ph. D., Trenton, N. J.; State Geologist.

CHARLES H. SMYTH, JR., Ph. D., Clinton, N. Y.; Professor of Geology in Hamilton College. August, 1892.

HENRY L. SMYTH, A. B., Cambridge, Mass.; Instructor in Mining Geology in Harvard University. August, 1894.

ARTHUR COE SPENCER, B. S., Ph. D., Washington, D. C.; Assistant Geologist, U. S. Geological Survey. December, 1896.

* J. W. SPENCER, A. M., Ph. D., 152 Bloor St. East, Toronto, Canada.

JOSIAH E. SPURR, A. B., A. M., U. S. Geol. Survey, Washington, D. C. Dec., 1894.

JOSEPH STANLEY-BROWN, 1318 Massachusetts Ave., Washington, D. C. August, 1892.

TIMOTHY WILLIAM STANTON, B. S., U. S. National Museum, Washington, D. C.; Assistant Paleontologist, U. S. Geological Survey. August, 1891.

* JOHN J. STEVENSON, Ph. D., LL. D., New York University; Professor of Geology in the New York University.

JOSEPH A. TAFF, B. S., Washington, D. C.; Assistant Geologist, U. S. Geological Survey. August, 1895.

JAMES E. TALMAGE, Ph. D., Salt Lake City, Utah; Professor of Geology in University of Utah. December, 1897.

RALPH S. TARR, Cornell University, Ithaca, N. Y.; Professor of Dynamic Geology and Physical Geography. August, 1890.

FRANK B. TAYLOR, Fort Wayne, Ind. December, 1895.

WILLIAM G. TIGHT, M. S., Granville, Ohio; Professor of Geology and Biology, Denison University. August, 1897.

* JAMES E. TODD, A. M., Vermilion, S. Dak.; Professor of Geology and Mineralogy in University of South Dakota.

* HENRY W. TURNER, B. S., U. S. Geological Survey, Washington, D. C.

JOSEPH B. TYRRELL, M. A., B. Sc., Geological Survey Office, Ottawa, Canada; Geologist on the Canadian Geological Survey. May, 1889.

JOHAN A. UDDEN, A. M., Rock Island, Ill.; Professor of Geology and Natural History in Augustana College. August, 1897.

* WARREN UPHAM, A. M., Librarian Minnesota Historical Society, St. Paul, Minn.

* CHARLES R. VAN HISE, M. S., Madison, Wis.; Professor of Mineralogy and Petrography in Wisconsin University; Geologist, U. S. Geological Survey.

FRANK ROBERTSON VAN HORN, Ph. D., Cleveland, Ohio; Instructor in Geology and Mineralogy, Case School of Applied Science. December, 1898.

THOMAS WAYLAND VAUGHAN, B. S., A. B., A. M., Washington, D. C.; Assistant Geologist, U. S. Geological Survey. August, 1896.

* ANTHONY W. VOGDES, Fort Wadsworth, Staten Island, N. Y.; Captain Fifth Artillery, U. S. Army.

* MARSHMAN E. WADSWORTH, Ph. D., Box 296, Chicago, Ill.

* CHARLES D. WALCOTT, U. S. National Museum, Washington, D. C.; Director U. S. Geological Survey.

HENRY STEPHENS WASHINGTON, B. A., M. A., Ph. D., Locust, Monmouth Co., N. J. August, 1896.

WALTER H. WEED, M. E., U. S. Geological Survey, Washington, D. C. May, 1889.

LEWIS G. WESTGATE, Ph. D., 805 Sherman Ave., Evanston, Ill. August, 1894.

THOMAS C. WESTON, Ottawa, Canada. August, 1893.

DAVID WHITE, U. S. National Museum, Washington, D. C.; Assistant Paleontologist, U. S. Geological Survey, Washington, D. C. May, 1889.

* ISRAEL C. WHITE, Ph. D., Morgantown, W. Va.

THEODORE GREELY WHITE, Ph. B., A. M., New York city; Assistant in Physics, Columbia University. December, 1898.

* ROBERT P. WHITFIELD, Ph. D., American Museum of Natural History, 78th St. and Eighth Ave., New York city; Curator of Geology and Paleontology.

* EDWARD H. WILLIAMS, JR., A. C., E. M., 117 Church St., Bethlehem, Pa.; Professor of Mining Engineering and Geology in Lehigh University.

* HENRY S. WILLIAMS, Ph. D., New Haven, Conn.; Professor of Geology and Paleontology in Yale University.

BAILEY WILLIS, U. S. Geological Survey, Washington, D. C. December, 1889.

SAMUEL WENDELL WILLISTON, Ph. D., M. D., Lawrence, Kan.; Professor of Historical Geology, University of Kansas. December, 1898.

* HORACE VAUGHN WINCHELL, Butte, Montana; Geologist of the Anaconda Copper Mining Company.

* NEWTON H. WINCHELL, A. M., Minneapolis, Minn.; State Geologist; Professor in University of Minnesota.

* ARTHUR WINSLOW, B. S., care of Missouri, Kansas and Texas Trust Company, Kansas City, Mo.

JOHN E. WOLFF, Ph. D., Harvard University, Cambridge, Mass.; Professor of Petrography and Mineralogy in Harvard University and Curator of the Mineralogical Museum. December, 1889.

ROBERT SIMPSON WOODWARD, C. E., Columbia College, New York city; Professor of Mechanics in Columbia College. May, 1889.

JAY B. WOODWORTH, B. S., 27 Dana St., Cambridge, Mass; Instructor in Harvard University. December, 1895.

ALBERT A. WRIGHT, A. M., Ph. D., Oberlin, Ohio; Professor of Geology in Oberlin College. August, 1893.

* G. FREDERICK WRIGHT, D. D., Oberlin, Ohio; Professor in Oberlin Theological Seminary.

WILLIAM S. YEATES, A. B., A. M., Atlanta, Ga.; State Geologist of Ga. Aug., 1894.

FELLOWS DECEASED

* Indicates Original Fellow (see article III of Constitution)

* CHARLES A. ASHBURNER, M. S., C. E. Died December 24, 1889.
AMOS BOWMAN. Died June 18, 1894.
* J. H. CHAPIN, Ph. D. Died March 14, 1892.
GEORGE H. COOK, Ph. D., LL. D. Died September 22, 1889.
* EDWARD D. COPE, Ph. D. Died April 12, 1897.
ANTONIO DEL CASTILLO. Died October 28, 1895.
* JAMES D. DANA, LL. D. Died April 14, 1895.
Sir J. WILLIAM DAWSON, LL. D. Died November 19, 1899
* ALBERT E. FOOTE. Died October 10, 1895.
N. J. GIROUX, C. E. Died November 30, 1896.
* JAMES HALL, LL. D. Died August 7, 1898.
* ROBERT HAY. Died December 14, 1895.
DAVID HONEYMAN, D. C. L. Died October 17, 1889.
THOMAS STERRY HUNT, D. Sc., LL. D. Died February 12, 1892.
* JOSEPH F. JAMES, M. S. Died March 29, 1897.
OLIVER MARCY, LL. D. Died March 19, 1899.
OTHNIEL C. MARSH, Ph. D., LL. D. Died March 18, 1899.
* HENRY B. NASON, M. D., Ph. D., LL. D. Died January 17, 1895.
* JOHN S. NEWBERRY, M. D., LL. D. Died December 7, 1892.
* EDWARD ORTON, Ph. D., LL. D. Died October 16, 1899.
* RICHARD OWEN, LL. D. Died March 24, 1890.
CHARLES WACHSMUTH. Died February 7, 1896.
* GEORGE H. WILLIAMS, Ph. D. Died July 12, 1894.
* J. FRANCIS WILLIAMS, Ph. D. Died November 9, 1891.
* ALEXANDER WINCHELL, LL. D. Died February 19, 1891.

Summary.

Original Fellows	78
Elected Fellows	161
Membership	239
Deceased Fellows	25

ACCESSIONS TO LIBRARY FROM MARCH, 1898, TO MARCH, 1899

BY H. P. CUSHING, *Librarian*

Contents

(*A*) FROM SOCIETIES AND INSTITUTIONS RECEIVING THE BULLETIN AS DONATION ("EXCHANGES")

(*a*) *AMERICA*

NEW YORK STATE MUSEUM, ALBANY

1500. Annual Report, no. 50, part 1, 1896.

BOSTON SOCIETY OF NATURAL HISTORY, BOSTON

1267. Proceedings, vol. xxviii, parts 7-14.

MUSEO NACIONAL DE BUENOS AIRES, BUENOS AIRES

1539. Comunicaciones, tomo i, núm. i, 1898.

CHICAGO ACADEMY OF SCIENCES, CHICAGO

FIELD COLUMBIAN MUSEUM. CHICAGO

1030. Publications 26, 27, Zoological Series, vol. i, nos. 9, 10, 1898.
1031. " 29, Report Series, vol. i, no. 4, 1898.

CINCINNATI SOCIETY OF NATURAL HISTORY, CINCINNATI

1034. Journal, vol. xix, no. 4, 1898.

COLORADO SCIENTIFIC SOCIETY, DENVER

1482. Proceedings, vol. v, 1894–'96.

NOVA SCOTIAN INSTITUTE OF SCIENCE, HALIFAX

MUSEO DE LA PLATA, LA PLATA

1477. Revista, tomo ix, pp. 1–79, 1898.
1484. Annales, Anthropologie, ii; Notes Ethnographiques sur les Indiens Guyaquis, etcetera, 1898.
1485. Reconnaissance de la Region Andine, 1.
1512. Revista, tomo viii, 1898, royal 8vo.

INSTITUTO GEOLOGICO DE MEXICO, MEXICO

1563. Boletin, núm. 10, Bibliografia, etcetera, 1898.

NATURAL HISTORY SOCIETY, MONTREAL

AMERICAN GEOGRAPHICAL SOCIETY, NEW YORK

1445. Bulletin, vol. xxx, nos. 1–5, 1898.

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK

1486. Annual Report of the President, etcetera, 1897, pp. 1–123.
1507. Bulletin, vol. xi, part i, 1898.
1564. " " x, 1898, pp. 1–478, pls. 1–24.

NEW YORK ACADEMY OF SCIENCES, NEW YORK

1491. Annals, vol. xi, parts 1, 2, 1898.
1498. Transactions, vol. xvi, 1896–'97.
1578. Annals, vol. x, 1898.

GEOLOGICAL SURVEY OF CANADA, OTTAWA

1447–1449. Annual Reports (new series), vols. vi–viii, 1893–'95, with maps.
1523. Annual Report (new series), vol. ix, 1896.

ROYAL SOCIETY OF CANADA, OTTAWA

1524–1526. Proceedings, second series, vols. i–iii, 1895–'97.

ACADEMY OF NATURAL SCIENCES, PHILADELPHIA

1279. Proceedings, vol. 1897, part iii.
1461. " " 1898, parts i–iii.

AMERICAN PHILOSOPHICAL SOCIETY, PHILADELPHIA

1280. Proceedings, vol. xxxvi, no. 156.
1495. " " xxxvii, no. 157.

MUSEO NACIONAL DO RIO DE JANEIRO, RIO DE JANEIRO

CALIFORNIA ACADEMY OF SCIENCES, SAN FRANCISCO

1282. Proceedings, third series, Geology, vol. i, no. 4, 1898.

GEOLOGICAL SURVEY OF NEWFOUNDLAND, ST JOHNS

ACADEMY OF SCIENCE, ST LOUIS

1053. Transactions, vol. vii, nos. 18-20.
1454. " " viii, nos. 1-6.

COMMISSAO GEOGRAPHICA E GEOLOGICO, SAO PAULO

NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON

1057. National Geographic Magazine, vol. viii, no. 12, 1897.
1457. " " " " ix, nos. 1-12, 1898.

LIBRARY OF CONGRESS, WASHINGTON

SMITHSONIAN INSTITUTION, WASHINGTON

UNITED STATES GEOLOGICAL SURVEY, WASHINGTON

1462-1463. Eighteenth Annual Report, part v, 2 vols., 1896-'97.
1528-1534. Bulletins, nos. 150-156, 1898.
1574-1576. " " 88, 89, and 149, 1898.
1577. Monograph no. xxx, 1898.

UNITED STATES NATIONAL MUSEUM, WASHINGTON

1649. Descriptions of the species of Cycadeoidea, etcetera.

(b) *EUROPE*

DEUTSCHE GEOLOGISCHE GESELLSCHAFT, BERLIN

1326. Zeitschrift, band xlix, heft iii-iv, 1897.
1509. " " l, heft i-ii, 1898.

KÖNIGLICH PREUSSISCHEN GEOLOGISCHEN LANDESANSTALT UND BERGAKADEMIE, BERLIN

GEOGRAPHISCHEN GESELLSCHAFT, BERNE

R. ACCADEMIA DELLE SCIENZE DELL' INSTITUTO DI BOLOGNA, BOLOGNA

1502. Memorie, serie v, tomo vi, 1897, 4to.

ACADÉMIE ROYALE DES SCIENCES, BRUSSELS

SOCIÉTÉ BELGE DE GÉOLOGIE, DE PALÉONTOLOGIE ET D'HYDROLOGIE, BRUSSELS

1331. Bulletin, tome x, fasc. 2-3, 1896.
1444. " " xi, fasc. 1-3, 1897.

BIUROULI GEOLOGICA, BUCHAREST

1435. Harta Geologica generala a Romaniei, sheets xliv–xlvii.
1584. Anuarulŭ, Mus. de geol. si de Paleon., 1895, 227 pp., 5 pl.

MAGYARHONI FÖLDTANI TARSULAT, BUDAPEST

1333. Földtani Közlöny, xxvii Kötet, 11–12 Fuset, 1897.
1503. " " xxviii Kötet, 1–9 Fuset, 1898.

NORGES GEOLOGISKE UNDERSOGELSE, CHRISTIANA

ACADÉMIE ROYALE DES SCIENCES ET DES LETTRES DE DANEMARK, COPENHAGEN

1334. Oversigt i Aaret, 1897, nr. 6.
1483. " " " 1898, nr. 1–5.

NATURWISSENSCHAFTLICHEN GESELLSCHAFT ISIS, DRESDEN

1335. Sitzungsberichte und Abhandlungen, Jahrg. 1897, Jul.–Dec.
1527. " " " " 1898, Jan.–Jun.

ROYAL SOCIETY OF EDINBURGH, EDINBURGH

1124. Transactions, vol. xxxviii, parts 3–4, 1894–'95, 4to.
1489. " " xxxix, part 1, 1896–'97, 4to.
1400. Proceedings, vol. xxi, 1895–'97, 8vo.

NATURFORSCHENDEN GESELLSCHAFT, FREIBURG, I. B.

1504. Berichte, band x, heft 1–3, 1898.

GEOLOGICAL SOCIETY OF GLASGOW, GLASGOW

PETERMANN'S GEOGRAPHISCHE MITTHEILUNGEN, GOTHA

KSL. LEOP. CAROL. DEUTSCHEN AKADEMIE DER NATURFORSCHER, HALLE

1451. Nova Acta, band lxviii, 1897, 680 pp., 25 pl.
1452. " " " lxix, 1898, 419 pp., 29 pl.
1453. Leopoldina, heft xxxiii, 1897.

GEOLOGISKA UNDERSOKNING, HELSINGFORS

1126. Beskrifning till kartbladet, nos. 32–33, 1896–'98, 2 maps.
1516. Bulletin no. 7, 1898.

SOCIÉTÉ GÉOGRAPHIE DE FINLANDE, HELSINGFORS

SOCIÉTÉ GÉOLOGIQUE SUISSE, LAUSANNE

GEOLOGISCH REICHS-MUSEUM, LEIDEN

1585. Beiträge zur Geologie Ost-Asiens und Australiens, band v, heft v, 1898.

KÖNIGLICH-SACHSISCHE GESELLSCHAFT DER WISSENSCHAFTEN, LEIPSIC

1340. Abhandlungen der Mathematische-Physische Classe, band xxiv, nos. 2-5.
1339. Berichte über die Verhandlungen, Mathem.-Phys. Classe, 1897, heft iv.
1505. Berichte über die Verhandlungen der Math.-Phys. Classe, band l, heft i-v, 1898.
1131. Berichte über die Verhandlungen der Math.-Phys. Classe, 1896, heft iv.

SOCIÉTÉ GÉOLOGIQUE DE BELGIQUE, IEGEL

891. Annales, tome xxii, livr. 3, 1894-'97.
1134. " " xxiii, livr. 3, 1895-'97.
1342. " " xxiv, livr. 2, 1897.
1501. " " xxv, livr. 1, 1898.

SOCIÉTÉ GÉOLOGIQUE DU NORD, LILLE

1487. Annales, xxvi, 1897.

COMMISSAO DOS TRABALHOS GEOLOGICOS DE PORTUGAL, LISBON

BRITISH MUSEUM (NATURAL HISTORY), LONDON

GEOLOGICAL SOCIETY, LONDON

945. Quarterly Journal, vol. lii, part iv, no. 208, 1896.
1458. " " " liv, parts i-iv, nos. 213-216, 1898.
1459. Geological Literature 4, literature added during 1897.
1350. List of the Geological Society of London, November 1, 1898.

GEOLOGICAL SURVEY, LONDON

GEOLOGISTS' ASSOCIATION, LONDON

1351. Proceedings, vol. xv, parts 6-10, 1897-'98.
1460. List of members, February, 1898.

COMISION DEL MAPA GEOLOGICA DE ESPANA, MADRID

1513. Memorias, tomo ii, 1896, Sistemas Cambriano y Siluriano.
1514. " " iii, 1896, Sistemas Devoniano y Carbonifero.
1582. Boletin, tomo iv, segunda serie, 1897.

SOCIETA ITALIANA DI SCIENZE NATURALI, MILAN

1353. Atti, vol. xxxvii, fasc. 2-4, 1897-'98.
1354. Memorie, tomo vi, fasc. 2, 1898.

SOCIÉTÉ IMPÉRIALE DES NATURALISTES DE MOSCOU, MOSCOW

1355. Bulletin, Année 1897, nos. 2-4.

K. BAYERISCHE AKADEMIE DER WISSENSCHAFTEN, MUNICH

1437. Sitzungsberichte der mathematisch-physikalischen Classe, 1897, heft 3.
1571. Sitzungsberichte der mathematisch-physikalischen Classe, 1898, heft 1–3.
1572. Ueber Studium und Auffassung der Anpassungserscheinungen bei Pflanzen, von Karl Goebel.
1573. Gedächtnissrede auf Philipp Ludwig von Seidel, von Ferdinand Lindemann.

RADCLIFFE LIBRARY, OXFORD UNIVERSITY MUSEUM, OXFORD

ANNALES DES MINES, PARIS

950. Annales, tome ix, livr. 5, 1896.
1357. " " xii, livr. 12, 1897.
1455. " " xiii, livr. 1–6, 1898.
1506. " " xiv, livr. 7–11, 1898.

SOCIÉTÉ GÉOLOGIQUE DE FRANCE, PARIS

1164. Bulletin, 3d Série, tome xxiv, no. 3, 1896.
1358. " " " xxv, nos. 8–9, 1897.
1488. " " " xxvi, nos. 1–4, 1898.

REALE COMITATO GEOLOGICO D'ITALIA, ROME

1439. Bolletino, vol. xxviii, 1897, nos. 3–4.
1497. " " xxix, 1898, nos. 1–2.

SOCIETA GEOLOGICA ITALIANA, ROME

1167. Bolletino, vol. xv, fasc. iv–v, 1896.
1515. " " xvi, fasc. i–ii, 1897.

ACADÉMIE IMPÉRIALE DES SCIENCES, ST PETERSBURG

1361. Bulletin, v^{e} Série, tome vii, nos. 2–5, 1897.
1535. " " " viii, nos. 1–5, 1898.
1536. " " " ix, no. 1, 1898.

COMITÉ GÉOLOGIQUE DE LA RUSSIE, ST PETERSBURG

1363. Bulletin, vol. xvi, nos. 3–9, 1897.
1537. " " xvii, nos. 1–3, 1898.
1538. " " xvi, supplement, Bibliotheque, 1897.

RÜSSICH-KAISERLICHEN MINERALOGISCHEN GESELLSCHAFT, ST PETERSBURG

1365. Verhandlungen, Zweite Serie, band xxxiv, lief. ii, 1896.
1492. " " " " xxxv, lief. i, 1897.
1493. Materialen zur Geologie Russlands, band xviii, 1897.
1494. Systematisches Sach-und Namen-Register zu der zweiten Serie der Verhandlungen, etc., 1897.

GEOLOGISKA BYRAN, STOCKHOLM

1464–1476. Sveriges Geologiska Undersokning, Ser. C, nos. 161, 163–171, 173–175.

GEOLOGISKA FORENINGENS, STOCKHOLM

1446. Forhandlingar, band xx, hafte 1–6, nos. 183–189, 1898.

NEUES JAHRBUCH FUR MINERALOGIE, GÉOLOGIE UND PALEONTOLOGIE, STUTTGART

1450. Jahrgang, 1898, band i, heft 1–3.
1510. " 1898, band ii, heft 1–3.

KAISERLICH-KÖNIGLICHEN GEOLOGISCHEN REICHSANSTALT, VIENNA

1368. Jahrbuch, band xlvii, heft 3, 4, 1897.
1508. " " xlviii, heft 1, 2, 1898.

KAISERLICH-KÖNIGLICHEN NATURHISTORISCHEN HOFMUSEUMS, VIENNA

1440. Annalen, band xii, nos. 2–4, 1897.

DIE BIBLIOTHEK DES EIDG. POLYTECHNICUMS, ZURICH

(*c*) *ASIA*

GEOLOGICAL SURVEY OF INDIA, CALCUTTA

1208. Memoirs, vol. xxvii, part ii.
1517. General Report of the work carried on in 1897.

IMPERIAL GEOLOGICAL SURVEY, TOKYO

(*d*) *AUSTRALASIA*

GEOLOGICAL DEPARTMENT OF SOUTH AUSTRALIA, ADELAIDE

1456. Report on Explorations in the western part of S. A., 1898.
1480. Record of the Mines of S. A. The Mannahill gold field, 1898.
1496. " " " " The Balhannah mine, 1898.
1515. " " " " The Wadnaminga gold field, 1898.
1590. Geological map of the northern territory of S. A., 1898.

GEOLOGICAL SURVEY OF QUEENSLAND, BRISBANE

1518–1519. Department of Mines, Bulletins nos. 5 and 7.
1376. Two reports on gold fields, etcetera, with maps, 1898.
1579–1581. Department of Mines, Bulletins nos. 8–10.
1376. On the Geology of the country round Stanthorpe and Warwick, South Queensland, etcetera, 1898.
1586. The Mesozoic Coal Measures of Stanwell and Associated Formations, 1898.

CANTERBURY MUSEUM, CHRISTCHURCH

DEPARTMENT OF MINES OF VICTORIA, MELBOURNE

1521. Annual Report for 1897, pp. 1–66, 4to.
1522. Geological Survey of Victoria, Progress Report, no. ix.

GEOLOGICAL DEPARTMENT OF WESTERN AUSTRALIA, PERTH

1481. Reports in connection with the Water Supply of the Gold Fields, 1898, 4to.
1499. Geological Survey, Bulletins nos. 1, 2, 1898.
1582. Annual Progress Report for the Year 1897.
1588. Geological Map of Northampton.

GEOLOGICAL SURVEY OF NEW SOUTH WALES, SYDNEY

1215. Records, vol. v, part 4, 1898.
1478. Mineral Resources, nos. 1–4, 1898.
1520. Annual Report for 1897, pp. 1–215, 11 plates.
1479. Memoirs, Paleontology no. 6, Paleozoic Fossils of N. S. W., 298 pp., 24 pl., 4to.
1562. Records, vol. vi, part 1, 1898.

ROYAL SOCIETY OF NEW SOUTH WALES, SYDNEY

1511. Journal and Proceedings, vol. xxxi, 1897.

(*e*) *AFRICA*

GEOLOGICAL COMMISSION, CAPE TOWN

(*f*) *HAWAIIAN ISLANDS*

HAWAIIAN GOVERNMENT SURVEY, HONOLULU

(*B*) From State Geological Surveys and Mining Bureaus

UNIVERSITY GEOLOGICAL SURVEY OF KANSAS, LAWRENCE

1565–1568. Reports, vols. i–iii, and vol. iv, part 1.
1569. Mineral Resources of Kansas, 1897.

GEOLOGICAL SURVEY OF NEW JERSEY, TRENTON

1540. Report on the Clay Deposits of New Jersey, 1878.
1541–1554. Annual Reports, 1884–1897, inclusive.
1555–1559. Final Reports, vols. 1–4, vol. ii in 2 parts.
1560–1561. Paleontology of the Cretaceous and Tertiary, vols. i–ii.

(C) From Scientific Societies and Institutions

(a) *AMERICA*

BUFFALO SOCIETY OF NATURAL SCIENCES, BUFFALO

1594. Bulletin, vol. v, no. 5, 1897.
1595. " " vi, no. 1, 1898.

SOCIEDAD CIENTIFICA "ANTONIO ALZATE," MEXICO

1599. Mémorias y revista, tomo xi, nums. 9–12, 1898.

(b) *EUROPE*

NATURWISSENSCHAFTLICHEN GESELLSCHAFT ISIS ZU BAUTZEN

1600. Sitzungsberichte und Abhandlungen, 1896–'97.

SCHLESISCHE GESELLSCHAFT FÜR VATERLÄNDISCHE CULTUR, BRESLAU

1601. Fünfundsiebzigster Jahres-Bericht, 1897.
1602. Litteratur der Landes-und Volkskunde der Provinz Schlesien, heft 6, 1898.

NATURFORSCHER-VEREINS ZU RIGA, RIGA

1603. Korrespondenzblatt, xl, 1898.

SECTION GÉOLOGIQUE DU CABINET DE SA MAJESTE, ST PETERSBURG

1247. Travaux, vol. ii, livr. 3, 1898.
1604. " " iii, livr. 1, 1898.

GEOLOGICAL INSTITUTION OF THE UNIVERSITY OF UPSALA, UPSALA

936. Bulletin, vol. iii, part 2, no. 6, 1897.

(c) *ASIA*

TOKYO GEOGRAPHICAL SOCIETY, TOKYO

1605. Journal of Geography, vol. x, nos. 109–117, 1898.

(d) *AUSTRALASIA*

AUSTRALASIAN INSTITUTE OF MINING ENGINEERS

1606. Proceedings Annual Meeting, January 14, 1898, and first ordinary meeting, 1898.

(*D*) From Fellows of the Geological Society of America (Personal Publications)

WHITMAN CROSS

1607. An Analcite Basalt from Colorado.
1608. The Geological *versus* The Petrographical Classification of Igneous Rocks.
1609. Igneous Rocks of the Leucite Hills and Pilot Butte, Wyoming.

SIR J. WILLIAM DAWSON

1610. On the Genus Lephidophloios.

H. L. FAIRCHILD

1611. Kettle Holes in Glacial Lake Deltas.

GEO. P. MERRILL

1612. Notes on the Geology and Natural History of the Peninsula of Lower California.

M. EZEQUIEL ORDOÑEZ

1638. Note sur le Gisements d'Or du Mexique.
1639. Les Volcans Colima et Ceboruco.

JOSEPH H. PERRY

1613. The Physical Geography of Worcester, Massachusetts.

HEINRICH RIES

1625. The Kaolins and Fire Clays of Europe, etcetera.

M. E. WADSWORTH

1614. The Fortieth Parallel Rocks.
1615. The Theories of Ore Deposits.
1616. On the Classification of Rocks.
1617. The South Trap Range of the Keweenawan Series.
1618. On the Relation of the Keweenawan Series to the Eastern Sandstone in the Vicinity of Torch Lake, Michigan.
1619. A Sketch of the Geology of the Marquette and Keweenawan Districts.
1620. Some Methods of Determining the Positive or Negative Character of Mineral Plates in Converging Polarized Light, etcetera.
1621. Twelve pamphlets on various subjects.

HENRY S. WASHINGTON

1622. Sölvsbergite and Tinguaite from Essex County, Massachusetts.
1623. The Jerome (Kansas) Meteorite.
1624. The Petrographical Province of Essex County, Massachusetts.

(E) From Miscellaneous Sources

BOSTON PUBLIC LIBRARY, BOSTON

1626. Forty-sixth Annual Report.

COLORADO COLLEGE SCIENTIFIC SOCIETY, COLORADO SPRINGS

1627. Colorado College Studies, vol. vii, 1898.

UNIVERSITY OF TENNESSEE, KNOXVILLE

1596. The University Scientific Magazine, no. 3, October, 1897.
1597. University of Tennessee Record, Review of 1897.
1598. " " " " Announcements for 1898–'99.

BOARD OF IRRIGATION SURVEY AND EXPERIMENT, TOPEKA

1570. Report for 1895–'96 to the Legislature of Kansas.

MINING BULLETIN, STATE COLLEGE

1425. Mining Bulletin, vol. iv, nos. 2–6, 1898.

DR AUGUST BÖHM EDLEN VON BÖHMERSHEIM, VIENNA

1628. Recht und Wahrheit in der Nomenclatur der oberen Alpinen Trias.

DR HENRY HICKS, LONDON

1629. Anniversary Address to the Geological Society of London, February, 1898.

PROFESSOR A. LACROIX, PARIS

1630. Les Enclaves des Roches Volcaniques.
1631. Les Contacts de la Haute-Ariège.
1632. Notes Minéralogiques.
1633. Twenty-five short pamphlets.

DR MARSDEN MANSON

1634. The Laws of Climatic Evolution.

PROFESSOR ROMOLO MELI, ROME

1635. Appunti di Storia Naturale sul Viterbese.
1636. Relazioni Sommarie delle Escursioni Geologiche, etc.
1637. Sopra Alcuni Denti Fossili di Mammiferi, etc.

LUELLA AGNES OWEN

1647. Cave Regions of the Ozarks and Black Hills.

PROFESSOR ALBRECHT PENCK, VIENNA

1640. Oberlercher's Glocknerrelief.
1641. Das grosse australische Wallriff.
1642. Die geographische Lage von Wien.
1643. Ueber die einheitliche Pflege der Hydrographie der Verbandslander.
1645. Gletscherstudien in Sonnblickgebiete.
1644. Die Geomorphologie als Genetische Wissenschaft.
1646. Geomorphologische Probleme aus Nordwest-Schottland.

X. STANIER, LOUVAIN

1650. La Fin du Monde.

P. H. VAN DIEST

1648. A Mineralogical Mistake.