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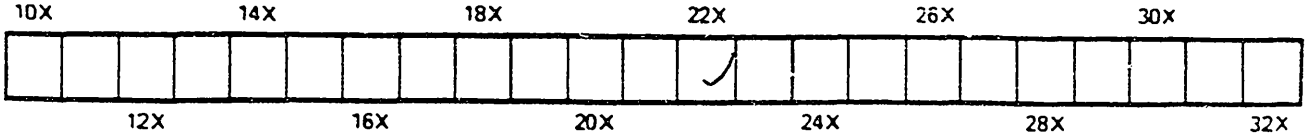

THIRD SERIES. VOL. IV. FASCICULUS No. 1.

PROCEEDINGS

THE CANADIAN INSTITUTE,

TORONTO,

BEING A CONTINUATION OF THE "CANADIAN JOURNAL" OF SCIENCE, LITERATURE AND HISTORY.

NOVEMBER, 1886.

Whole No. Vol. XXII.] [No. 146.

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TORONTO:
THE COPP, CLARK COMPANY, LIMITED,
1886.

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CANADIAN INSTITUTE

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PROCEEDINGS

OF

THE CANADIAN INSTITUTE,

SESSION 1885-'86.

FIRST MEETING.

The First Meeting of the Session 1885-'86, being an open meeting and Conversazione, was held on Saturday, 21st November, 1885, the President in the Chair.

The President delivered an address, in which he announced the union of The Natural History Society with the Canadian Institute. He was followed by Mr. Brodie, President of The Natural History Society.

Mr. David Boyle read the following paper, entitled

THE ARCHÆOLOGICAL OUTLOOK.

Mr. President, Ladies and Gentlemen :

I take it that the purpose of the Council in asking me to write this paper was rather that I should lay before you what the Institute has done and proposes to do by way of recording archæological data and forming a collection illustrative thereof, than to attempt anything like a disquisition on the subject in its widest sense.

Still, it may be well to understand clearly just where we stand at the outset, and perhaps I can scarcely do better than tell you wha in my opinion, the study of archæology is *not.*

It is not merely the collecting of arrow-points, tomahawks, pipe-heads and pottery, at so much or at nothing apiece from farmers and other persons. It is not even the actual digging up of such objects

from the last resting places of Indian braves, nor is it the knowledge of where the largest number of specimens may be found. To do and to know these things is little more than stepping upon the verge of the study, and to prosecute work of this kind it is only necessary to possess a mania for bric-a-brac, some persistence, and a little money.

Persons who so conduct the work are collectors, and collectors only, and it is extremely doubtful whether their services are always of unmixed good. In so far as they further the preservation of specimens which otherwise might be lost, they answer a useful purpose, but when these people (forgetful of "ne sutor ultra crepidam,") undertake to ransack, to spoliate, to desecrate the graves of the Indians, for the purpose of satisfying a craving for curiosities, then their labors are not to be commended.

It is true that archæology includes the collection of illustrative specimens—without these the study would be somewhat devoid of interest, and the Canadian Institute aims at the formation of as large and as choice a collection as it is possible to make.

But archæology can only be said to possess any genuine public interest in so far as it is a handmaid to its elder sister, history, and it is the purpose of the Institute so to prosecute its researches in this line that its records and specimens may be mutually instructive.

If we take the whole Dominion as a field, the magnitude of the undertaking is too great either for our Society or for any similar organization to entertain for a single moment, and when it is clearly understood how much is involved in the prosecution of the task, it may be doubted whether even our own Province is not more than we can hope to work to the best advantage. I have no hesitation in saying, for my own part, that I think it is, and as it is not improbable that every other member of the Institute is of the same opinion, the question naturally arises, Why, then, undertake so much? The reply is twofold, but brief: First, because hitherto absolutely nothing has been done methodically or scientifically; and second, because the opportunities for doing anything are rapidly passing away, thousands having already gone for ever.

As I have already stated, it is not enough that we collect specimens. It is required in the first place that we make as full and complete a record as possible of every spot in the Province that gives or has given any indication of having been in any way identified with the life-history of our aborigines, and that with these should be collated

every passage in the narratives of our early travellers for the purpose of identifying, as nearly as possible, those localities that are most intimately associated with the historical exploration of the country. Every mound, every village site, every camping-ground, every battle-field, every burial-pit, and every place upon which has been conducted the manufacture of clay vessels, pipes, arrow-points, or other articles, should be accurately measured, sketched, thoroughly explored and fully described.

Here, I may take the opportunity to express my pleasure in the knowledge that Mr. Arthur Harvey, a gentleman most deeply read in Canadian historic lore, and who takes more than a warm interest in our project, agrees with me that all such places as those named should be declared public property, and be made inviolate to all bric-a-brackers and pot-hunters until examined by some competent person appointed for that purpose.

I am afraid, however, that although this proposition is theoretically sound, and agrees with what has been done in Great Britain for the preservation of historical monuments, there would be too many opportunities and too many temptations to set such an enactment at defiance in this country, for us to expect much assistance by means of any legislation having this object in view.

Reports of progress should be made from time to time, and if we could afford to imitate our American cousins in their issue of beautifully illustrated documents, we might, as a matter of course, expect to arouse a much livelier interest among the people than if we present them with what they will be likely to regard as something akin to parliamentary blue-books.

Besides all this, the preservation and proper display of the illustrative objects will prove a matter of no small importance. These must be arranged in suitable cases and be properly classified for the purpose of comparing one with the other.

This, ladies and gentlemen, is, in brief, something like what we ought to do, or like what ought to be done, through one agency or another.

As already mentioned, the Canadian Institute has felt impelled to take action simply for the reason that no other organization or party seemed to evince any similar desire.

To prosecute the work in the way it should be prosecuted would necessitate the expenditure of from $5,000 to $6,000 annually for

four or five years, and twice either of these sums might be employed to good advantage.

In April of the current year we issued a circular asking for information relative to this subject, in response to which many letters have been received, some expressive of sympathy with the project, some giving information regarding specimens, some promising assistance, and others extending hearty invitations to explore in promising localities.

In accepting one of these invitations from the Rev. T. T. Johnstone of Ancaster, I went, accompanied by Messrs. James Bain and Arthur Cox, F.R.S.A., to that township, which, from an aboriginal point of view, may almost be called *classic*—the township of Beverley. Here we collected a number of valuable relics, but owing to the ground having been seeded down we were unable to do more than examine the surface. Mr. Cox kindly sketched, on the spot, two of the most interesting localities, and I have been peculiarly fortunate in securing the services of an artistic friend to enlarge Mr. Cox's sketches for our use this evening, and I am sure you will agree with me that for the purpose in view the work has been admirably done.

On the farm of Mr. James Rae we were taken over a field of about five acres from which there have been collected since the time it was cleared no fewer than 200 iron tomahawks. Of course these are of European manufacture, but are of the type used by the early French and British occupiers to befool the red man in exchange for his peltries, or, it may be, simply for liberty to traverse the country unmolested.

In proof of the statement made by Mr. Rae regarding the number of tomahawks turned up here, we found by actual count more than 70 of these uncouth but murderous looking weapons mounted picturesquely along the top of the pickets forming one side of his garden fence. Under the stump of a tree in the field referred to, we unearthed several pieces of pottery, and as the tree itself (judging from an examination of the stump), must have been at least 150 years old, we have an approximation to a date which would correspond very closely with the appearance of the French in these western wilds. Why the tomahawks were left upon the ground by their possessors, is just one of these problems which, if capable of solution at all, we may hope to solve only by the aid of the cognate studies, history and archæology. The settlers in the neighborhood appear to have

theorized a good deal about the question, the opinions, so far as we could gather, being pretty evenly divided between a great battle and a great epidemic.

What adds to the mystery is that only the other day I had a communication from a gentleman who formerly lived in the same township, and who informed me that within a few miles of the locality in question he had found, when clearing his farm, the most indubitable evidences of a formerly existing palisaded village upon the site of which he had picked up at least 300 of these iron tomahawks. It would be interesting to compare the weapons found on each place if only for the purpose of discovering whether they are of the same manufacture—both French, or, English and French respectively.

Three miles from Mr. Rae's farm we were driven to that of Mr. James Dwyer, where we were told there was an extensive ossuary. This was pointed out to us by Mr. Dwyer almost on the crest of a hill, forming the highest ground in the neighborhood for many miles all round, and within a few rods of the farm buildings. We found the dimensions of the pit, so far as could be ascertained by surface indications, to be about 25 feet in length and nearly half as wide. For the reason already assigned no examination could be made, but I visited the same place again this fall, my friend, the Rev. Mr. Johnstone, being also present, he having engaged the services of four stout men to handle spades and shovels. Nearly twice as many more hands came as volunteers, and in the course of the day we succeeded in exhuming a large number of valuable relics, including an almost perfect clay cup, four perfect clay pipes, a small, neatly-carved human head in stone, about one thousand pieces of white wampum, and many other specimens, all of which are on exhibition here this evening.

I should not omit to mention that at the foot and in the rear of the hill on which this burial-pit or ossuary is situated there is a large piece of freestone which has evidently been used by the Indians for grinding and polishing purposes. The proprietor has promised to present it to our museum.*

For other valuable contributions we are indebted to the generosity of Mr. Baldwin Jackes, Druggist, 351 Yonge street, Mr. Andrew Elvins, Tailor, Arcade, Mr. Loughead, of the township of Sunnidale,

* Since presented to us.

and to the York Pioneers. This Society has just made the Institute custodian of a good collection of several hundreds of specimens, and now the demand is for cases in which to preserve all that is in our possession.

Although we have to deplore that no records have been kept of numerous historic sites, the very traces of which have become wholly obliterated by the plough and otherwise, it is not yet too late to do *something*. From the letters I have received during the summer, it appears that there are still many localities that it would be of immense importance to explore before either the farmer or the curiosity-man thinks it desirable, for his own purposes, to begin the work of levelling or burrowing.

A recent communication to the *Mail* points out that in the valley of the Rainy River there is a series of mounds, few of which have as yet been disturbed. The writer, Mr. Chas. N. Bell, of Winnipeg, urges the expediency of having these scientifically treated with all convenient promptitude, but the probability is that nothing will be done until Tom, Dick and Harry, with all their relatives, have so disfigured the landscape and despoiled the deposits as to render any intelligent examination an impossibility.

To my mind these monuments, forming, as in all likelihood they do, the very outposts of the territory occupied by the Mound Builders, possess more than ordinary interest. We know their southern limit and their central range, and who can say that the exploration of those in the extreme north may not prove, like a third term in proportion, what is a necessity, by way of enabling us to arrive at a solution of the problem—the problem in this case being: Who were the people that erected these immense earth heaps, and did they move from the north southwards or *vice versa*?

At the very least we should have a survey made of these ancient works, with ground-plans, perspective drawings, and accurate descriptions.

Near St. Thomas there is said to be another mound, and I have no doubt, if I may judge from letters in my possession, that there are several other similar structures in various parts of the country. So far as private collections are concerned we have reason to be thankful that a few good ones exist, and it is not improbable that *some* of them at any rate may be secured for a provincial museum as soon as it is within our power to purchase.

To conclude, ladies and gentlemen, let me repeat that the work to be done is of such magnitude that without a considerable expenditure of time and money it will be quite out of the question to perform it in anything like a thorough or satisfactory manner. It should be either aided or wholly executed by the Dominion or Provincial Government. There can be no doubt that under the auspices of the former there would be immense and peculiarly advantageous opportunities, but in that case the collection formed would centre at Ottawa, which can scarcely be pronounced the educational or literary capital of the Dominion.

We shall hail with delight any efforts made towards the prosecution of archæological research, from a really national standpoint, but when we regard our own Province (and so regard it we must) as the most important of these colonies, and when we recognize the even more apparent fact that Toronto is the principal literary and scientific city in the Province, if not in the whole confederation, we naturally and quite unselfishly desire to see the outcome of public effort placed where it will do the most good.

But quite independent of any Dominion scheme that may or may not be consummated, Ontario owes it to herself as the richest, most populous, and most advanced Province, to work her own territory to the best advantage in this respect, and to form an archæological museum in the City of Toronto—the Queen City—the City of Schools—that will not only redound to our credit as an intelligent people, but that will attract students from distant lands, and enable the scientific investigator of the future to thank heaven for the somewhat tardy foresight that has provided for him, (figuratively speaking) a feast of fat things.

SECOND MEETING.

The Second Meeting was held on Saturday, 28th November, 1885, the President in the Chair.

It was moved by Dr. E. A. Meredith, seconded by Dr. George Kennedy,

"That the members of the Canadian Institute cannot allow this, their first meeting since the death of John Milne Buchan, M.A., to

pass without placing on record the expression of their deep regret at the loss which the Society has sustained in his removal from amongst them, in the prime of life, and when, apparently, he had before him many years of honorable and useful work. They gratefully remember the marked progress which the Institute made during the two years of his Presidency, the earnest and active interest which he took in all its proceedings, and the kindliness and sympathy which characterized all his relations with his fellow-workers in the Institute. They desire also to express their sincere and heartfelt sympathy with Mr. Buchan's widow and family, in their great and sudden bereavement."

The President, in declaring the motion carried, expressed his deep sense of the loss which had befallen the Institute, and his personal sympathy with the words of the resolution.

The following list of donations and exchanges received since the annual meeting was read :

I.—CANADIAN.

1. Valuation Tables at Compound Interest, by Walter S. Andrews. (From the author.)
2. Monthly Weather Review, Dominion of Canada, April, May, June, July, August, September and October, 1885—7 Nos.
3. Proceedings and Transactions of the Nova Scotia Institute of Natural Science, Vol. VI., Part II., 1883-84.
4. Proceedings and Transactions of the Royal Society of Canada, Vol. II., 1884.
5. The Canadian Entomologist, Vol. XVII., Nos. 4, 5, 6, 7, 8, 9, 10—7 Nos.
6. The Canadian Practitioner, Vol. X., Nos. 6, 7, 8, 9, 10, 11, June—Nov., 1885—6 Nos.
7. Monthly Health Bulletin of Ontario, for March and April, May, July, 1885—3 Nos.
8. Geological and Natural History Survey of Canada :
   (1) Report of Progress for 1882-83-84.
   (2) Maps to accompany the above Report—4.
   (3) Ten Sheets Geological Map of New Brunswick, Quebec and Prince Edward Island.
   (4) Twenty-four Sheets Geological Map of Cape Breton.
9. The Extinct Cuttle-Fish of the Canadian North-West, by A. McCharles.
10. Statutes of Ontario, 48th Victoria, 1885.
11. In Memoriam—George Etienne Cartier. Presented by the author. G. W. Wicksteed, Esq., through Dr. E. A. Meredith.
12. Number and Nature of the Vowel Sounds, by M. L. Rouse, Esq.
13. The Canadian Record of Science, Vol. I., Nos. 3 and 4.

14. Fifteenth Annual Report of the Entomological Society of Ontario.
15. Collections of the Nova Scotia Historical Society, Vol. IV., 1884.
16. Ancient Rock Inscriptions on the Lake of the Woods, by A. C. Lawson, M.A.
17. Le Naturaliste Canadien, Vol. XV., Nos. 1, 3, 4, 5.
18. Sessional Papers relating to the Canadian Pacific Railway, 1882-83.
19. Toronto Water Works—Annual Report of the City Engineer and Manager for 1883-84.
20. The Innervation of the Heart of the Slido Terrapin (Pseudemys Rugosa) by T. Wesley Mills, M.A.
21. The Secretion of Oxalic Acid in the Dog under a varying diet, by the same.
22. Memorial Volume—Toronto Past and Present, 1834—1884. From the Mayor and Corporation.
23. Catalogue of Books presented to the Toronto Public Library by John Hallam, Esq. From the Public Library Board.
24. Annual Report of the Bureau of Industries, Province of Ontario, 1884, by Mr. A. Blue.

Total Canadian, 48 numbers and 38 maps.

II.—UNITED STATES EXCHANGES.

1. The School of Mines Quarterly, Columbia College, New York.
   Vol. III., Nos. 2, 3, 4.
   " IV., " 2, 3, 4.
   " V., " 1, 2, 3, 4.
   " VI., " 1, 2, 3, 4.
   " VII., No. 1.
2. The American Journal of Science, for May, June, July, August, Sept., Oct., Nov., 1885.
3. Science, Vol. V., Nos. 118, 119, 120, 121, 122, 123, 124, 125. Vol. VI., Nos. 126—146, 147.
4. Journal of the New York Microscopical Society, Vol. I., Nos. 4—7.
5. Proceedings of the American Academy of Natural Sciences of Philadelphia, Parts I. and II., 1885.
6. Memoirs of the Boston Society of Natural History, Vol. III., No. XI.
7. Proceedings of the Boston Society of Natural History, Vol. XXIII., Part I.
8. From the U. S. Geological Survey :
   (1) The Copper-Bearing Rocks of Lake Superior, by Prof. R. D. Irving.
   (2) Third Annual Report of the U. S. Geological Survey, 1881-82, by the Director, J. W. Powell.
   (3) Geology of the Comstock Lode and the Washoe District, by George F. Becker.
   (4) Atlas to accompany the same.
   (5) Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by William Morris Fontaine.
   (6) Silver-Lead Deposits of Eureka, Nevada, by Joseph Story Curtis.

(7) Palaeontology of the Eureka District, by Charles Doolittle Walcott.

(8) Fourth Annual Report of the U. S. Geological Survey, 1882-83.

9. Harvard University Bulletin, Vol. IV., Nos. 31 and 32.
10. The Pennsylvania Magazine of History and Biography, Vol. IX., Nos. 1, 2, 3.
11. Proceedings of the Worcester Society of Antiquity, Nos. XXI. and XXII.
12. Annals of the New York Academy of Sciences, Vol. III., Nos. 5—8. (3)
13. (1) Historical Collections of the Essex Institute, Vol. XXI., Nos. 7—12 ; Vol. XXII., Nos. 1—3. (3)

(2) Bulletin of the Essex Institute, Vol. XVII., Nos. 1—3.

14. Catalogue of the Library of the Peabody Institute of the City of Baltimore, Part II., D.—G.
15. Journal of Speculative Philosophy, Vol. XVIII., No. 4 ; Vol. XIX., Nos. 1, 2.
16. Journal of the Franklin Institute, for June, July, August, Sept., Oct., Nov., 1885.
17. Bulletin of the Brockville Society of Natural History, No. 1.
18. (1) First Biennial Report of the Secretary of the State Board of Agriculture of the State of Michigan, from Sept. 1st, 1880, to Sept. 30, 1882.

(2) Twenty-second Annual Report of the same from Oct. 1st, 1882, to Sept. 30, 1883.

19. Transactions of the American Society of Civil Engineers, April, May, June, July, and August, Sept., Oct., 1885.
20. Eighteenth Annual Report of the Peabody Institute, of the City of Baltimore.
21. Appleton's Literary Bulletin, Vol. IV., May to October—3 Nos.
22. Proceedings of the Newport Natural History Society for 1883 and 1884-85. (2)
23. Diary of David Zeisberger, Trans., by Eugene F. Bliss, 2 Vols. (From the Historical and Philosophical Society of Ohio.)
24. Compendium of the Tenth Census of the United States, 2 Vols., Parts I. and II., (June 1st, 1880.) From the Hon. the Secretary of the Interior, Washington, D. C.
25. Transactions of the Connecticut Academy of Arts and Sciences, Vol. VI., Part 2.
26. Bulletin of the Museum of Comparative Zoölogy at Harvard College, Vol. XI., No. 11 ; Vol. XII., No. 1.
27. The International Standard, July, 1885.
28. Transactions of the Sixteenth and Seventeenth Annual Meetings of the Kansas Academy of Science, 1883-84, Vol. IX.
29. The Geological and Natural History Survey of Minnesota, 1872—1882, Vol. I. Geology, by N. H. Winchel, assisted by Warren Upham.
30. Bulletin of the Minnesota Academy of Natural Sciences, 1880-82, Vol. II., No. 5.
31. (1) Bulletin of the Illinois State Laboratory of Natural History, Vol. II., Article III., Part I.

(2) Description of New Illinois Fishes, by S. A. Forbes.

(3) Fourteenth Report of the State Entomologist of the Noxious and Beneficial Insects of the State of Illinois. S. A. Forbes. 1884.

32. Proceedings of the American Antiquarian Society, N. S. Vol. III., Part 4.
33. Bulletin of the Sedalia Natural History Society, No. 1. (August, 1885.)
34. (1) The Public Domains, with Statistics, U. S. A.
    (2) Land Laws of the United States, Local and Temporary, 2 Vols.
    (3) Existing Land Laws. (From the Hon. the Secretary of the Interior, Washington, D. C.
35. (1) Smithsonian Report for 1876.
    (2) Smithsonian Contributions to Knowledge, Vol. XXIV. and XXV.
36. Historical Fallacies regarding Colonial New York. (From the Oneida Historical Society.
37. (1) Proceedings of the Rhode Island Historical Society, 1883-84; 1884-85.
    (2) Same, New England Almanac, by Amos Perry. (Providence.)
38. From the Bureau of Steam Engineering, Navy Department, Washington, D. C.:
    (1) Extract from Annual Report of the Chief of Bureau of Steam Engineering, 1869.
    (2) Report made to the Bureau, Nov. 5, 1880.
    (3) " " " Aug. 9, 1882.
    (4) " " " March 3, 1883.
    (5) " " " April 6, 1883.
    (6) Annual Report for 1884.
39. Bulletin of the American Museum of Natural History, Central Park, New York, Vol. I., No. 6.
40. Johns Hopkins University Circulars, Vol. IV., 42; Vol. V., 43, 44.
41. Magazine of American History, Nov. and Dec., 1885.
42. Proceedings and Collections of the Wyoming Historical and Geological Society, Vol. II., Part 1.
43. Journal of the Cincinnati Society of Natural History:
    Vol. III., Nos. 1, 3, 4.
    " IV., V., VI., VII.
    " VIII., Nos. 1, 2, 3.
44. Bulletin of the American Geographical Society, 1885, No. 1.
45. Proceedings of the American Association for the Advancement of Science:
    Vol. 31, Parts 1, 2; Vol. 32.
    " 33, " 1, 2, 1882-83-84.
46. Abstract of Proceedings of the New York Academy of Anthropology for 1884.
47. Intimate Connection between Gravitation and the Solar Parallax, by Thomas Bassnett. (Per Mr. M. L Rouse.)
48. Transactions of the Kansas State Historical Society, Vols. I. and II.
49. Proceedings of the Colorado Scientific Society, Vol. 1.—1883 and 1884.
50. From the Georgia Historical Society:
    (1) Reply to Resolution of Georgia Historical Society, by Rt. Rev. Stephen Elliott—Feb. 12, 1866.
    (2) Eulogy of Rt. Rev. Stephen Elliott—1867.
    (3) Reminiscences of Service with the First Volunteer Regiment of Georgia, in Charleston Harbour—1863.

(4) & (5) Constitution and By-Laws of Georgia Historical Society—1871; ditto, 1883.

(6) Wilde's Summer Rose, by A. Barclay—1871.

(7) In Memoriam—Edward Jenkins Harden—1873.

(8) Dedication of Hodgson Hall, Feb. 14, 1876.

(9) Sergeant William Jasper, Jan. 3, 1876.

(10) The Georgia Historical Society —Fits oundertrno,andaPs Friends, Feb. 14, 1881.

(11) A Suggestion to the Origin of the Plan of Savannah, Sept. 7, 1885.

51. The American Naturalist, Vol. XIX., No. 11, for Nov., 1885. (From the publishers.)

52. The Library of Cornell University, Vol. I., No. 12.

Special Lists—No. I. Mathematics.

Total United States, 189 numbers.

III.—GREAT BRITAIN AND IRELAND.

1. (1) Minutes and Proceedings of the Institution of Civil Engineers, Vols. LXXIX., LXXX., LXXXI., LXXXII.

(2) Charter By-Laws and List of Members of the Institution of Civil Engineers, June 3, 1885.

(3) Heat and its Mechanical Applications. Lectures, I. C. E., 1883-84.

(4) Brief Subject—Index.—I. C. E. Vol. LIX. to LXXXII.; Sessions 1879-80 to 1884-85.

2. Journal of the Transactions of the Victoria Institute, Vol. XVIII., No. 72; Vol. XIX., Nos. 73, 74.

3. (1) Report and Transactions of the Birmingham Natural History and Microscopical Society, for 1883.

(2) The Midland Naturalist, (N.S.) Vol. VII., Nos. 73—84; Jan.—Dec., 1884; Vol. VIII., Nos. 85—95; Jan.—Nov., 1885.

(3) Report and Transactions of the Birmingham Natural History and Microscopical Society, Nos. 3, 4, 5, for 1880, 1881, 1882.

4. Archæologia Aeliana, Part 29, Vol. X., No. 3; Part 30, Vol. XI., No. 1.

5. Monthly Notices of the Royal Astronomical Society, Vol. XLV., Nos. 6, 7, 8, 9.

6. Proceedings of the Royal Geographical Society, (N.S.) Vol. VII., Nos. 5, 6, 7, 8, 9, 10, 11. May to Nov., 1885.

7. Transactions and Proceedings of the Botanical Society of Edinburgh, Vol. XVI., Part 1

8. Journal of the Anthropological Institute of Great Britain and Ireland, Vol. XIV., No. 4; Vol. XV., Nos. 1, 2.

9. Trübner's American, European and Oriental Literary Record, Nos. 209—212, 215—216.

10. Journal of the Linnean Society of London:

(1) Botany, Vols. XX. and XXI., Nos. 130—137.

(2) Zoölogy, " XVIII. and XIX., Nos. 101—108.

(3) Proceedings of the Linnean Society of London. March—Oct., 1883.

(4) List of the Linnean Society of London, 1883, 1884, 1885.

11. Proceedings of the Royal Colonial Institute, Vol. 16, 1884-85.

12. Journal of the Royal Microscopical Society, Ser. II., Vol. V., Pts. 3, 4, 5.

13. (1) Proceedings of the Cambridge Philosophical Society, Vol. V., Parts 1, 2, 3.
    (2) Transactions of the Cambridge Philosophical Society, Vol. XIV., Part 1.
14. (1) Proceedings of the Royal Society of Edinburgh, Vols. XI. and XII., 1881—83.
    (2) Transactions of the Royal Society of Edinburgh, Vol. XXX., Parts 2 and 3; Vol. XXXII., Part 1.
15. Transactions of the Manchester Geological Society, Vol. XVIII., Parts 8, 9, 10.
16. Quaritch's Catalogues, Nos. 362, 363, 364.
17. Proceedings of the London Mathematical Society, Nos. 237—249.
18. Journal of the Quekett Microscopical Club, Ser. II., Vol. II., Nos. 12, 13.
19. Ocean and Air Currents, by Thomas D. Smellie.
20. Proceedings of the Royal Physical Society of Edinburgh :
    Vol. I., Part 2. (1856-58.)
    " IV., Parts 1, 2, 3. (1874-78.)
    " V., Part I. (1878-79.)
    " VI., (1880-81.)
21. Proceedings of the Somersetshire Archæological and Natural History Society for 1884, (N.S.) Vol. X.
22. Annual Report of the Leeds Philosophical and Literary Society for 1884-85.
23. Proceedings of the Society of Antiquaries of Scotland, Vol. VI., (N. S.)
24. Proceedings of the Philosophical Society of Glasgow :
    Vol. XVI. and Vol. II., Parts 1—4.
    " III., " 1—6.
    " IV., " 1, 2.
    " IX., " 1, 2.
    " XI., " 2.
    " XIII., " 1.
    " XV.
25. Transactions of the Edinburgh Geological Society, Vol. IV., Part III.; Vol. V., Part 1.
26. Proceedings of the Royal Society, Vols. XXXVI.—XXXVIII., Nos. 228—238.
27. (1) Scientific Proceedings of the Royal Dublin Society, Vol. IV. (N. S.) Parts 5 and 6.
    (2) Scientific Transactions of the Royal Dublin Society, Vol. III. (Series II.) Parts 4, 5, 6.
28. (1) Transactions of the Geological Society of Glasgow :
    Vol. I., Parts 1, 2.
    " II., " 2, 3.
    " III., " 1, 2.
    " IV., " 2, 3.
    Vol. V., Part 1.
    Vols. VI. and VII, 1876—'84.
    Palæontological Series, Part I.
    (2) Catalogue of the Western Scottish Fossils.

29. Proceedings of the Cambridge Philosophical Society, Vol. X.—XI., 1885.
30. The Scottish Geographical Magazine, Vol. I., No. 4—11, April to Nov., 1885.
31. Palestine Exploration Fund—Quarterly Statement—Jan., April, July and Oct., 1885.

Total Great Britain and Ireland, 178 numbers.

IV.—BRITISH COLONIES, (EXCLUSIVE OF CANADA.)

1. (1) Proceedings of the Asiatic Society of Bengal, No. XI., Dec., 1884; No. I.—V., Jan.—May, 1885.
   (2) Journal of the Asiatic Society of Bengal, (N.S.) Vol. LIII., Part 1, Special Number.
   Part II., No. III., 1884.
   Vol. LIV., Part I., Nos. 1 and 2, 1885.
2. Papers and Proceedings of the Royal Society of Tasmania, for 1883 and 1884.
3. (1) Memoirs of the Geological Survey of India.
   Palæontologia Indica:
   Series IV., Vol. I., Part 4.
   " X., " III., Parts 4, 5 and 6.
   " XIV., " 13, Part 4.
   (2) Records of the Geological Survey of India, Vol. XVIII,, Parts 2 and 3, '85.
4. Transactions and Proceedings of the New Zealand Institute, Vol. XVII., 1884.
5. Journal and Proceedings of the Royal Society of New South Wales, for 1883, Vol. XVII.
6. Proceedings of the Royal Society of Queensland, Vol. I., Parts 1—4, 1884-85.

Total British Colonies, 23 numbers.

V.—FOREIGN EXCHANGES.

1. Bulletin de la Société d'Anthropologie de Paris, Tome Huitieme (III Série), Fascicules, 1, 2, 3. Janvier à Juillet, 1885.
2. Cosmos di Guido Cora, Vol. VIII., No. 1—7, 1884.
3. Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils, Novembre et Décembre, 1884; Janvier, Février, Avril, Mai et Juin, 1885.
4. Verhandlungen des Vereins für Naturwissenschaftliche Unterhaltung zu Hamburg, 1878—1882. Band V., 1883.
5. Bulletin de la Société Géologique de France:

3 Série,	Tome	I.,	No. 1.
"	"	III.,	" 3.
"	"	IV.,	" 6.
"	"	V.,	" 7.
"	"	VII.,	" 3, 7, 8, 9, 10, 11.
"	"	IX.,	" 7.
"	"	XI.,	" 2.
"	"	XII.,	" 2, 4, 5, 6, 9.
"	"	XIII.,	" 3, 4, 5, 7.

6. Ymer Tidskrift Utgifven af Svenska Sällskapet för Anthropologi och Geografi, 1885. (Femte ärgängen, 2*a*, 3*e*, 4*e*, Häftet.)
7. Compte Rendu des Séances de la Société de Physique et d'Histoire Naturelle de Genève, 1884.
8. Atti della Società Toscana di Scienze Naturali, Processi Verbali, Vol. IV.
9. (1) Sitzungsberichte und Abhandlungen der Naturwissenschaften Gesellschaft, Isis in Dresden, 1884. Juli bis December.
   (2) Festschrift der Natur. Gesell. Isis, 14 Mai, 1885.
10. Abhandlungen vom Naturwissenschaftlichen Vereine zu Bremen :
    VIII., Band, 2 Heft.
    IX., " 1, 2, "
11. (1) Verhandlungen der K. K. Geologischen Reichsanstalt, 1884, Nr. 1 bis 18.
    (2) Jahrbuch der K. K. Geologischen Reichsanstalt, 1884, XXXIV. Band, 4 Heft; XXXV. Band, 1 Heft, 1885.
    (3) Verhandlungen, 1885, Nr. 1—7. (Wien.)
12. Bulletin de la Société Royale Belge de Géographie, 1884. Nos. 3, 4, 5, 6.
13. Nachrichten von der K. Gesellschaft der Wissenschaften und der Georg-Augusts Universität zu Göttingen, 1884. No. 1—13.
14. (1) Sitzungsberichte der mathematisch-physikalischen Classe der k. b. Akademie der Wissenschaften zu München, 1884. Hefte I., II., III., IV.
    (2) Sitzungsberichte der philosophisch-philologischen und historischen Classe der k. b. Akademie der Wissen, zu München, 1884, Hefte I., II., III., IV., V., VI.
    (3) Gedachtnissrede auf Theodor L. W. von Bischoff.
    (4) Rudolph Agricola.
    (5) Franz von Kobell.
    (6) Almanach der k. b. Akademie der Wissen. zu München für 1884.
15. Annales des Mines, Huitiéme Série, Tome VII., 1, 2, 3, Livraisons de 1885.
16. Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, XVI. Jahrgang, Nr. 4, 5, 6, 7, 8, 9. April bis September, 1885.
17. Mittheilungen der deutschen Gesellschaft für Natur. und Volkerkunde Oestasiens 32, 33, Hefte Mai, u. August, 1885.
18. Acta Universitatis Lundensis, Tome XIX. to XX., 1882-83, 1883-84.
    (1) Theologi.
    (2) Philosophi, Språkvetenskap och Historia.
    (3) Rätts och Statsvetenskap.
    (4) Mathematik och Naturvetenskap. (8 numbers.)
    (5) Lunds Universitets—Bibliotek Accessions Katalog, 1884.
19. Le Globe, 4e Sèrie, Tome IV.
    Bulletin No. 2.
20. Boletin de la Academia Nacional de Ciencias en Córdoba. (Republica Argentina), Tomo VII., Entrega 4a.
21. Annaes da Escola de Minas de Ouro Preto, Nos. 1 and 2.
22. Sur la Valeur Morphologique de la Trompe d'Eustache par M. le Professeur Paul Albrecht, Bruxelles.
    Two other pamphlets by the same.

23. *Schriften der physikalisch-ökonomischen Gesellschaft i* Pr. fünfundzwanzigster Jahrgang, erste und Zweite Abtheilungen.
24. Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte, Sitzungen, 12, 17 Januar, 21 Februar, 21 März, 18 April, 16 Mai.
25. Annuaire Gèologique Universel et Guide du Gèologique, 1885.
26. Forhandlinger i Videnskabs-Selskabet i Christiania, 1884.
27. Memoirs of the University of Tokio, No. 11. A System of Iron Railroad Bridges for Japan, by J. A. L. Waddell, C.E , in 2 Vols.
28. Publications de la Société d'Ethnographie, Paris.
29. Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig, Mathematisch-Physische, Classe 1884 and 1885, I., II.
30. Bulletin de la Société Royale de Botanique de Belgique, Tome 24me. Fas. 1er, 1885.
31. Archivio per l'Antropologia e la Etnologia, Quindicesimo Volumè. Fas. Primo, Firenze.
32. Magnetische und Meteorologische Beobachtungen an der K. K. Sternwarte zu Prag, 1884. 45 Jahrgang.
33. Archives Néerlandaises des Sciences Exactes et Naturelles. Tome XIX. Nos. 3, 4, 5; Tome XX., 1, 2.
34. Verhandlungen der K. K. zoologisch-botanischen Gesellschaft in Wien, XXXIV. u. XXXV., Bände.
35. Anales del Museo Nacional de México, Tomo III., Entrega 7*a*, 1885.
36. Bijdragen tot de Dierkunde, Nos. 10, 11, 12, from La Société Royale de Zoologie "Natura Artis Magistra."
37. Mittheilungen der k. k. Geographischen Gesellschaft in Wien, XXXVII. Band.
38. Bulletin de la Société Royale Belge de Géographie Nos. 4, 5, 6, 1884. Juillet-Octobre.
39. Bulletin de l'Académie Royale de Copenhague, 1884, Nos. 2, 3; 1885, No. 1.
40. 24 und 25 Bericht über die Thätigkeit des Offenbacher Vereins für Naturkunde, vom 4. Mai, 1882, bis 11 Mai, 1884.
41. (1) Jaarboek van de K. Akademie van Wetenschappen, 1883.
    (2) Verslagen en Mededeelingen der K. Akademie van Wetenschappen, Deel XIX. Stuk 1, 2, 3.
    (3) Naam en Zaakredgister of de Verslagen en Mededeelingen. Deel 1—XX.
42. (1) Kongliga Svenska Vetenskaps-Akademiens Handlingar, 3 Vols., Bd. 18, 19-1-d 2, 1880-1881.
    (2) Bihang Bd. 6. 1, 2; 7 : 1, 2; 8 : 1, 2; 1880—1883. 6 Vols.
    (3) Ofversigt af K. Vetenskaps Akademiens Forhandlingar, 38, 39, 40.
    (4) Lefnadsteckningar 5, Band 2, Häfte 2.
    (5) Beskyddare, 1882, 1883, 1884.
43. (1) Sitzungsberichte der k. k. Gesellschaft der Wissenschaften zu Prag, 1882, 1883, 1884.
    (2) Kalousek Geschichte, I.
    (3) Studnicka Bericht, I.
    (4) Generalregister, 1874—1884.
    (5) Verzeichniss der Mitglieder.

44. Arbók hins Islenza Fornleifafélags, 1884–85, Reykjavik.
45. Yahrbücher der K. K. Central Anstalt für Meteorologie und Erdmagnetismus, Wien, 1883. XX. Band.
46. Bullettino della Sezione Fiorentina della Societá Africana d'Italia, Volume I., Fascicoli 1, 2, 3, 4.

Total Foreign, 207 numbers.

Summary Compared with the Number Received During the Same Period of Last Year.

	1884.	1885.
Canadian	36	48 and 38 maps.
United States	75	189
Great Britain and Ireland	63	178
British Colonies, exclusive of Canada	20	23
Foreign	93	207
Total	287	645
Increase		358

The following were elected members:—F. T. Shutt, B.A., J. H. Cameron, B.A., J. H. McGeary, B.A., Edward Farrar, Esq., W. S. Andrews, Esq., Dion C. Sullivan, LL.B., G. A. Dickson, M.A.

The President presented the following paper, by Professor Hutton, entitled

CLASSICAL NOTES.

In Demosthenes' first speech against Aphobus occur the following words (815):

"εἰς γὰρ τὴν συμμορίαν ὑπὲρ ἐμοῦ συνετάξαντο κατὰ τὰς πέντε καὶ εἴκοσι μνᾶς πεντακοσίας δραχμὰς εἰσφέρειν."

Compare the second speech, 836, 837, 838·

"ἡγεμόνα με τῆς συμμοριάς καταστήσας οὐκ ἐπὶ μικροῖς τιμήμασιν ἀλλ' ἐπὶ τηλικούτοις ὥστε κατὰ τὰς πέντε καὶ εἴκοσι μνᾶς πεντακοσίας εἰσφέρειν . . . . οὐδὲ ταῦτα ἀποφαίνοντες ἐξ ὧν τιμησάμενοι τὰς εἰσφορὰς εἰσεφέρετε . . . . . ἀλλὰ μὴν ἐκ γε τῆς οἰκίας καὶ τῶν τεττάρων καὶ δέκα ἀνδραπόδων καὶ τῶν τριάκοντα μνῶν τὴν εἰσφορὰν οὐχ οἷον τε γενέσθαι τοσαύτην, ὅσην ὑμεῖς συνετάξασθε πρὸς τὴν συμμορίαν."

In all these passages *εἰσφορὰ* and *εἰσφέρειν* mean *not* a special property tax and the payment of such, which is their usual meaning, but the taxable value of property and the return of such to the com-

missioners. "They agreed to return as taxable 500 drachmæ (or five minæ) for every twenty-five minæ": *i. e.*, they agreed to return the property as taxable upon one-fifth of its amount, *i. e.*, as belonging to the first class.

The five hundred drachmæ therefore is not the amount paid, but the amount returned as taxable out of every twenty-five minæ: the amount actually paid out of every twenty-five minæ would be, of course, a fraction much smaller than this one-fifth: (probably not more, as a general thing, than five per cent. on this fifth, or one per cent. on the whole. See Kennedy's Demosthenes, Vol. I., Appendix 4, p. 309, note).

These passages are fully explained by Boeckh (Public Economy of Athens, Vol. II., pp. 285–288, and again 316). Schaefer, however, reduces them to nonsense by taking *εἰσφέρειν* in its ordinary sense, of paying a property tax. Kennedy, of course, translates correctly; but he does not notice the difficulty. The school edition of Penrose is correct, and gives the reference to Boeckh; but, unless its readers turn up Boeckh for themselves, they will not find that the force which Demosthenes attaches to *εἰσφέρειν* and *εἰσφορὰ* here is merely anomalous, and due apparently to carelessness and the desire for brevity. Liddell and Scott (the last edition included) have missed these passages, and recognize the two words only in their ordinary sense.

Plato, Republic IX., chap. 9, 583 B.

"*ταῦτα μὲν τοίνυν οὕτω δύ' ἐφεξῆς ἂν εἴη καὶ δὶς νενικηκὼς ὁ δίκαιος τὸν ἄδικον· τὸ δὲ τρίτον ὀλυμπικῶς τῷ σωτῆρι τε καὶ τῷ Ὀλυμπίῳ Διὶ ἀθρει ὅτι καὶ κ.τ.λ.*"

The common explanation of this passage in Stallbaum and Bekker is satisfactory enough. The first libation at the Greek banquet was to Olympian Zeus; the second to the heroes or to Earth; the third to Zeus the Saviour. But the champion at Olympia would naturally couple with his last libation the double title of Zeus—the Olympian no less than the Saviour—for the omen's sake.

In the same way for Plato's just man, who is compared to an athlete of Olympia contending in three contests against his rival, the third libation poured by his friends is poured to Olympian Zeus.

To the references given in Stallbaum and Bekker it is worth while to add a very close parallel which they have overlooked. In

Pindar's fifth Isthmian ode (the sixth according to the other arrangement) occurs an exact counterpart:

"εἰη δὲ τρίτον
σωτῆρι πορσαίνοντας Ὀλυμπίῳ Αἴγιναν κάτα
σπένδειν μελιφθόγγοις ἀοιδαῖς." (10-12).

"May it be mine to offer a third bowl to Olympian Zeus the Saviour, and pour over the land of Ægina a libation of honey-sweet song."

Pindar has sung one ode (Nem. V.) for one member of his hero's family; and this is the second and celebrates an Isthmian victory. There remains therefore yet to be won victory at Olympia. Accordingly the poet prays that it may be his lot to pour a third libation-ode, in honour of Zeus, "Saviour and Olympian." "Saviour" because to Zeus by this title the third libation is poured. "Olympian" because the victory which he hopes to celebrate is to be won at Olympia.

NOTES ON JUVENAL AND HORACE

Juvenal, Sat. XIV., 281–283.

Grande operae pretium est, ut tenso folle reverti
Inde domum possis tumidaque superbus aluta
Oceani monstra et juvenes vidisse marinos.

Such is the form in which this passage appears in the first edition of Mr. Mayor, and in the editions of Jahn, Heinrich, Ruperti, Häckermann, Stocker, and Lemaire; and in the second edition of Mr. Escott.

Of these editors the last two only have translated the passage: the former correctly, the latter, misled by the punctuation, quite wrongly. Lemaire paraphrases "operae pretium est vidisse . . . unde redeant," making *vidisse* depend on *operae pretium est.* Mr. Escott translates, "you have an ample reward *in that* you are able to return home with swelling purse," etc. The others pass by the passage in silence. In whatever sense they took it, their punctuation, at any rate, is indefensible.

Better is the punctuation of Achaintre's and of the Delphin edition, which place commas at *est, possis, aluta,* and *monstra*; and better still the text of Mr. Simcox, who punctuates at *est, possis,* and *aluta* only. But, even so, the construction is obscured by the punctuation; and the Delphin editor seems to have missed it: he paraphrases "magnum quid fecisse putas si dives redeas," and again,

"si videas et redeas," as though *reverti* and *vidisse* were co-ordinate, and both dependent on *possis*. The punctuation of Mr. Macleane (a comma at *possis* only) seems to point yet more directly to this misunderstanding.

The true construction is obvious enough after a glance. The whole clause from *ut* to *aluta* is parenthetic and should stand by itself: *vidisse* is the subject of *operae pretium est.*

> Grande operae pretium est —— ut tenso folle reverti
> Inde domum possis tumidaque superbus aluta ——
> Oceani monstra et juvenes vidisse marinos.

"A precious reward this for all your trouble, to have faced the monsters of the deep and the mermen, and all for the sake of returning home with full purse and the pride of stuffed money-bags."

i. e. It is not worth your while to face the great leviathan for the sake of a full purse.

In his second edition Mr. Mayor has altered his punctuation correctly and introduced a comma at *aluta;* but his notes are still silent. Yet the fact that previous to this only one edition, and that the most modest of all, the school edition of Mr. Prior, had printed the passage correctly (Prior also added a correct translation), seems to show that a note is not unnecessary.

Horace, Epistle I., 1, lines 13–19.

> Ac ne forte roges quo me duce quo lare tuter,
> Nullius addictus jurare in verba magistri
> Quo me cunque rapit tempestas deferor hospes.
> Nunc agilis fio et mersor civilibus undis,
> Virtutis verae custos rigidusque satelles:
> Nunc in Aristippi furtim praecepta relabor
> Et mihi res non me rebus subjungere conor.

The difficulty of the passage lies in the last two lines. What is the connection between them? The most natural and, I believe, the correct interpretation makes the last an amplification of the line before, and a definition at once of "Aristippi praecepta," and of the Stoic creed contained in lines 16 and 17.

"At one time," says Horace, "I am all for action, and I plunge into the ocean of public life the guardian and stiff-necked champion of straight-laced righteousness; at another time I fall away unconsciously to Aristippus' maxims, and try to make the world serve me, instead of serving it."

That is to say, Horace is contrasting the Stoic, who is a missionary and lives not for himself but for the world, and who accordingly is a man of action and of affairs, with the Cyrenaic voluptuary, who sacrifices everything for himself, and who regulates his dealings with the world by the amount of pleasure to be extracted for himself therefrom. The latter also, if it so chance, will be a man of action and affairs; but if he is, it is only because he gets more enjoyment from the life of action than from the quietist's life. Like the Christian, but in a very different sense, the Cyrenaic is "in the world but not of it."

So understood the passage is coherent and simple. Unfortunately a good deal of misplaced ingenuity has been spent upon it till its simplicity has been obscured. Meineke and others even wished to transpose lines 19 and 17, and read:

> Et mihi res non me rebus subjungere conor
> Virtutis verae custos rigidusque satelles,
> Nunc in Aristippi, etc.,

while Dobree secured the same result awkwardly, though with less violence, by changing *non* to *nunc*. They could not understand how a Stoic, whose aim was to be independent of the world, could be said to submit himself to it. And even Orelli escapes the same conclusion only by denying that the last line contains any reference to Stoicism: the last line, he seems to say, is added to qualify and minimize the preceding. Horace proclaims himself a Cyrenaic, but hastens to add that, though he does not despise the good things of this world, he is yet no slave to them. Interpreted to refer to Stoicism, the last line is (he says) inconsistent with one of the articles of the Stoic creed: *οὐ δεῖ προσθήκην αὐτον τῶν ἐκτὸς γίγνεσθαι ἀλλ' ἐκεῖνα αὐτῷ προσθεῖναι* (Epict: 1, 4, 49). The inconsistency that Orelli sees here is imaginary. Epictetus is saying that the Stoic is not dependent upon worldly advantages or the creature of them: Horace is saying that the Stoic works for the world's good and not for his own pleasure; the two propositions are perfectly compatible. The only quotations concerning the Stoic creed which are to the point here are the well known—

> Non sibi sed toti genitos se credere mundo
> (Lucan 2, 383, quoted by Obbar.)
> Nec sibi tantum sed universis singulisque consulendum.
> (Seneca de clem.: 2, 5—Obbar.)

and "*πολιτεύεσθαι τὸν σοφόν.*"

But even Obbar, who has explained satisfactorily the significance of the last line, has introduced confusion into the passage by regarding the phrase *me rebus subjungere* as synonymous with the cardinal doctrine of the Stoic's ὁμολογουμένως τῇ φύσει ζῆν. This, as Orelli says, is far-fetched and unnatural. The φύσις referred to is primarily the abstract laws of life; on the other hand, "*rebus*" here seems to denote concrete human beings and human needs and interests. The connexion between the two exhortations is at the most by distant implication. The Greek exhortation means simply "Live according to nature," the Latin, "Live for others."

Finally, against the conjecture—

"Nec mihi res sed me rebus," etc.

which has found favour at different times, a conclusive argument is supplied by the Cyrenaic phrase "ἔχω ἀλλ' οὐκ ἔχομαι," words which, though used by Aristippus in a special context, express happily, in a nutshell, his relation to all external advantages. (Diog. Laert: 2, 8, 75). Obbar furnishes another text scarcely less to the point (id. sect. 95) τὸν σοφὸν ἑαυτοῦ ἕνεκα πάντα πράξειν. Both quotations furnish a description of Cyrenaic practice precisely parallel to Horace's *et mihi res non me rebus subjungere conor.*

SPONTANEITY IN NATURE ACCORDING TO EPICURUS.

Quare in seminibus quoque idem fateare necesse est,
Esse aliam praeter plagas et pondera causam
Motibus, unde haec est nobis innata potestas,
De nilo quoniam fieri nil posse videmus.
Pondus enim prohibet ne plagis omnia fiant
Externa quasi vi: sed ne mens ipsa necessum
Intestinum habeat cunctis in rebus agendis
Et devicta quasi hoc cogatur ferre patique,
Id facit exiguum clinamen principiorum
Nec regione loci certa nec tempore certo.

Lucretius II.: 284-293.

A considerable part of Mr. Masson's very interesting study of Lucretius' Atomic Theory * is taken up with an examination of this passage. M. Guyau † sees here the doctrine of free-will and contingency in matter; the reign of law in nature, therefore, so far from being a cardinal tenet of the Epicurean system is, according to him,

* The Atomic Theory of Lucretius, by John Masson, M.A., London.—George Bell & Sons, 1884.
† La Morale d'Epicure, par M. Guyau, 2me edit.—Paris: Librairie Germer Baillière et Cie, 1881.

expressly denied by Epicurus, or, to speak more correctly, limited: there are certain bounds beyond which no created thing can pass, but within these bounds it possesses a modified freedom and moves in this direction or in that, developes or degenerates. In the same spirit Mr. Benn* represents the Lucretian system as grasping only the negative side of natural law: Lucretius recognizes "the limiting possibilities of existence" rather than an omnipresent and unbending law: nature possesses only a right of veto, and is no longer the potter moulding passive clay.

Against all this Mr. Masson argues at length; he conceives the free-will of the Lucretian atoms to cease altogether in the world of inanimate nature, and also apparently in the brute creation: only in man is this free-will still operative. And Mr. Masson gives reasons why this conception is natural and easy:

(*a*) The free wills of the different atoms of matter, he says, would counteract each other.

(*b*) The force of gravity from within resists change.

(*c*) The pressure from without has the same effect.

(*d*) The atoms forming gross matter are in themselves heavier and slower of movement than others, and the gross matter they form is therefore of the same character.

(*e*) Finally M. Guyau's theory proves too much: it changes Epicurus into a Greek Hans Andersen, in whose creations the impulse of animism is supreme, and sticks and stones are conscious beings.

It is difficult to reconcile these arguments of Mr. Masson with other parts of his own book, with his quotations from M. Guyau, and with Lucretius.

Thus his first argument (*a*) is forcible enough, but it applies equally strongly to the Lucretian conception of free-will in man; and is no proof, therefore, that Lucretius denied free-will to nature. The difficulty seems to be analogous to that presented by the sense of personality: out of the various instincts derived from our common human nature and from our special parents rises yet a sense of a single personality.

(*b*) This is true, though in a less degree, of man also; and it

* The Greek Philosophers, by Alfred William Benn.—London: Kegan Paul, 1882.

should modify, but not destroy—on Lucretius' principles—the free-will of nature.

(*c* and *d*) These arguments also tend only to limit the extent of free-will that Lucretius can have attributed to nature: not to cast doubts on its existence.

(*e*) It is very difficult to understand how Mr. Masson can urge this objection. He has himself shown the similarity of Lucretius' (or, as he calls it, M. Guyau's) doctrine of spontaneity in nature to Schopenhauer's doctrine of will (p. 232), to Gassendi's doctrine of consciousness (p. 140), and to Professor Clifford's doctrine of mind-stuff (pp. 132 *seq.*); and we may add to the list the cognate theories of Zöllner (Lange's History of Materialism, vol. ii., p. 328), and of Czolbe (*id.*, p. 291), (comp. vol. i., p. 13, note). If these speculations are on a level, in respect of truth, with Andersen's fairy tales, then the same may be said of M. Guyau; not otherwise. No doubt there is a resemblance up to a point, but the question of degree is everything.

According to M. Guyau, Lucretius conceives that in nature as in man each thing has, so to speak, its tether (*foedera naturae, fati fines, foedera fati*, Lucretius V. 309-310, II. 254); when it has reached the end of its tether it stops necessarily; and practically, as with man, it stops short of this. This *finita potestas*, as Lucretius calls it (I., 76, 77), does not, says Mr. Masson, mean "limited power," but "fixed power" (p. 223, note); but the very next words, *atque alte terminus haerens*, "and the deep-set goal," make for M. Guyau's view, and are naturally interpreted by him to mean what Mr. Benn means by "the limiting possibilities of existence."

Why is it more difficult to reconcile the two—the law which tethers and the free-will which gives an area of freedom within that law, in the case of nature than in the case of man? No one denies free-will just because he cannot rid himself of the legacies received from human nature and the nature of his ancestors; and, conversely, no one argues that the believer in free-will substitutes for human life in this world Andersen's fairy-world.

It is an old suggestion that the so-called "waste" in nature, and the sacrifice of countless seeds and lower lives, is but the expression of the same freedom which in human life makes evil possible, and causes so much waste there also. If M. Guyau be right, Lucretius says no more than this.

Again, M. Guyau observes that this spontaneity does not disturb natural order, but works along the same lines. Mr. Masson (p. 224) thinks this an arbitrary assumption; but does not the same analogy apply once more? Free-will does not mean freedom to will arbitrarily, but freedom to act upon the highest law of our being; and the will is most free when most obedient to this law. In the same way then, in proportion to the worth and development of anything, will be its approximation to the highest law of its nature. The inner desire, the true will, of each thing moves in this one direction: *βούλησις*, in Aristotelian phrase, is always *τοῦ ἀγαθοῦ*.

In this sense spontaneity, human or not, may justly be said to work along the lines of nature. It appears to us—obscure though the connection may look—that the acutest defender of miracles, Canon Mozley, meant something of the same kind when he represented miracles as quickening merely, not resisting, the processes of nature. His theory seems to imply an elasticity in nature which Lucretius describes as free-will.

Mr. Masson shows, it is true, that the ascription of consciousness to matter is against the express testimony of Lucretius (Lucr. II. 972); but his own quotation from Gassendi (p. 220) proves that M. Guyau is not the only student of Epicureanism that has been more logical than Epicurus and Lucretius. It is inevitable that here, as in other speculations, there should be a "development" of doctrine. The ascription to matter of will without consciousness is, as Mr. Masson observes (p. 220), illogical. The spirit of the system in spite of the letter seems to require this assumption: the defect here is in Epicurus and Lucretius, not in the French critic.

After all, the *onus probandi* lies with Mr. Masson. Lucretius says that the atoms originally have free-will. He does not say that this free-will ceases for that majority of them which meet to form gross matter, and survives only in the minority which form the human soul.

The original free-will of nature is a necessary part of the Epicurean system; for without it the origin of the world is inexplicable. The permanence of such free-will in nature, if in one sense unscientific, in another recommends itself to science; for it establishes the "solidarity" of man and nature; and Epicurus, at any rate, believed in human free-will.

Finally, the visionariness and mysticism that undoubtedly attach

to it do not seem sufficient, when it is compared with similar speculations of science of recent date, to warrant its off-hand rejection.

Mr. Alfred S. Johnson, M.A., Fellow of University College, Toronto, read the following paper on

THE LAW OF HABIT.

Habit, more than any other principle of nature, may be said to be the *governing principle of life*. All the phases of our existence, conscious and unconscious, physical, psychical, moral, social, are under its control. Occasionally, it is true, there come into men's lives experiences of an exceptional character, elevating, ennobling, or depressing, which ever afterward in retrospection stand alone like mountain-peaks towering above the monotonous plain of common life. Occasions like these, however, are the exception. The vast majority of the actions and experiences of life are on a level plain; at every point the sway of habit obtains, and the general appearance which the plain presents is determined by the habits which have predominated in the individual life.

An instance or two, taken from different parts of our nature, will here suffice to show the wide spread influence of habit. The muscular movements of a very young child are generally performed at random, being the outcome of mere inborn spontaneous energy. If any co-ordinated movements are found, they are instinctive, or due to reflex processes, and not primarily under control of the will, though capable within certain limits of being brought into subjection. To trace the steps in the development of voluntary power of co-ordinated movement, *e.g.*, in learning to walk, is merely to show the influence of habit upon the physical part of our nature. Gradually, through the susceptibility of the child's organism to the plastic influence of repetition, the motions of its limbs become *co-ordinated*, linked together after a regular manner, and the necessity for strenuous attention and voluntary effort at every step dies away. Similarly, in learning to play upon a musical instrument. The great difficulty felt at first in making the movements of the fingers follow one another correctly is lessened by patient practice, the customary motion becomes easier, until a stage is reached where the mere act of sitting down to the instrument, or commencing the series of movements involved in

playing, seems capable of bringing on the whole connected train, without further attention on the player's part.

Leaving for the present our physical nature, we note that our intellectual life also owns the sway of habit. No idea ever arises in the mind except through association, and one of the conditions of the strength of association is habit or repetition. The customary thoughts which hold possession of the mind, the customary emotions which the individual feels, and which are often his most striking peculiarities, the ordinary methods adopted by men in working out the problems and aiming at the ends of life, the forms of speech, the various degrees in power of attention, deliberation and resolution, all exhibit to us the workings of this great formative law of nature.

Turning now to our moral nature, we find in the growth of character, the building up or the pulling down of the virtues or vices, the same dominion of habit. Witness the teaching of a child the duty of unselfishness. The sacrifice so painful at first, after a few trials, becomes easier; the tendencies opposing are gradually weakened and dissipated, those favorable are gradually increased, until finally there may even be developed a tendency to over-do the unselfish act, when care has to be taken lest unselfishness should exceed the limits within which alone it is a virtue.

These few instances are sufficient to give some idea of the extensive power enjoyed by habit. But not only is its influence far-reaching and wide-spread, its offices and effects also vary in the different spheres that come under its action. There is, perhaps, no principle of our nature characterized by greater variety in this direction. No other can to such an extent control and modify our physical constitution, accustoming it to strange uses and adapting it to its environment; no other has such power, without changing our psychical nature, to alter the whole method and drift of our intellection; nor is any other fraught with more important practical lessons, for it is only through consolidation of habits that moral character is placed upon a fixed and reliable foundation, and only through development in accordance with the law of habit can we ever hope to attain that destiny for which conscious life and morality were bestowed upon us. It is the greatest of all the appointed means to this end.

In spite, however, of the inestimable importance of the functions of habit, strangely enough, when we turn to the history of psychological speculation, throughout its range we can find perhaps no part

of our nature which has been more unsatisfactorily treated. For a full exposition of the manifestations of habit, or a clear understanding of the purposes which they serve, we must look away from professed works upon the subject.

It may not be uninteresting to inquire into the causes of this deficiency of treatment. They may probably be reduced to three :—

(*a*) The failure to bring the subject under discussion, a defect common to many works on psychology, may have been in some cases the result of mere oversight.

(*b*) It may have been from despair of ability to remove difficulties in the way of explanation; for some of the questions involved have appeared to distinguished writers inexplicable. For example, Dr. Reid says: "I see no reason to think that we shall ever be able to assign the physical cause either of instinct, or of the power of habit;" and Dugald Stewart, in the second volume of his works, speaking of the fact that while in some cases the muscles, under the law of habit, are increased in strength through repeated exercise, they yet become more and more obedient to the will, says: "This is a fact of which it is probable that philosophy will never be able to give any explanation."

(*c*) But the failure of adequate treatment in cases where the phenomena of habit have not been overlooked is mainly owing to the fact that certain important phases have entirely escaped detection, which, if their significance had been recognized, would probably have shown the inadequacy of the methods that had previously been adopted in explanation. Thinkers have a common tendency to forget (particularly when dealing with mental phenomena), that while a science remains stationary at a certain point, and until its advancement beyond this point is made possible through the acquisition of a more comprehensively detailed *knowledge of particulars*, of concomitant phenomena and conditions, the ordinary methods of classification and generalization, while their validity remains untouched, may yet prove in the strictest sense useless and inapplicable, and the facts may show themselves amenable only to a higher method.

It is proposed in the present paper to maintain that this is precisely the case in regard to the phenomena under discussion. By the bringing in of particular instances it will be shown that the ordinary definitions and explanations which have been given are inadequate. It is not maintained that the ordinary scientific methods must *forever*

here be inapplicable, but that *with the present extent of knowledge* they are so; and that until there is acquired a more comprehensive knowledge of the conditions that govern mental phenomena, which light may possibly come through the researches of physiological psychology as to the correlation of psychical and organic processes, these ordinary methods must remain so. The facts of habit are, in the present state of knowledge of the conditions of mental phenomena, explicable by that philosophy alone which refers them all to *final causes.* These alone shed light upon the varied facts of habit, and in the light that comes from them must these facts be seen and rendered. It will be shown that the effects of habit upon different portions of our nature are marked by the greatest variety, and by apparent confusion and contradictoriness. The known facts of habit are heterogeneous and incongruous. Though occurring in the midst of apparently similar circumstances, they yet refuse to take classification together, or to show themselves resolvable into different manifestations of one and the same law; in fact refuse to be treated by any of the ordinary methods of science, for the simple reason that amidst their heterogeneity no homogeneity, other than merely hypothetical, has yet been found. There may be, in all probability there is, some quantum (which we may designate by x) which further research may reveal, perhaps some modification of nervous organism concomitant alike with all the varied forms of habit, through which their variety may be reduced to unity, and in terms of which it may in all cases, be expressed. The discovery of the value of this x would make the ordinary methods applicable in treatment of the phenomena of habit; would eliminate from them the appearance they now present of opposition and incongruity, would make, in fact, that apparent contrariety of manifestation, the naturally to be expected, nay—the surely predictable result. It is maintained, however, that, even if this quantum should be at any time discovered, the ultimate necessity of an appeal to final causes would not be done away with. Explanation by physical causes, though quite legitimate, does not exclude, nor even render useless, explanation by final causes. The fact would still confront us that x, rëacting in its environment, in the midst of circumstances that are in all cases materially similar, presents us with the greatest diversity of results; and this variety of function must forever remain inexplicable, except as the result of chance (to which to refer it is no real explanation) unless it be recognized as precon-

ditioned and predetermined, and thus, in some sense at least, *caused* by that end to which it is so well adapted as a means.

To the above-mentioned three causes we may in all probability trace the inadequacy of the discussion which our subject has heretofore received. We find it formally examined, with greater or less minuteness as to detail, by most of those who profess to study with any method or precision the conduct of men and the laws of human nature; but nowhere have we a final settlement of the points involved. We can nowhere find a definition of habit comprehensive enough to embrace the whole field of its energies; there is nowhere to be found any logically complete and exact analysis of its phenomena; of their manifold variety we find seldom attempted any systematic classification; psychology, even though associated with physiology, has not yet philosophically unfolded the law by revealing any general fact or uniformity through which all specific varieties of manifestation may be reduced to system.

There is no general tendency to ignore or underrate the importance of the law of habit. But although the word is in very common use, and the significance attached to it familiar to the experience of everyone, and although writers and thinkers are aware of the importance of the law, and recognize its bearings upon the stability of character, it is yet true that they are unable to dispose of the varied facts which confront them, and do not know how to make provision for them.

It will be our duty, before making further advance, to define precisely that field of study into which the foregoing remarks have to some distance led us. This will best be done, in the first place, by excluding from our discussion all treatment of topics which are irrelevant, the handling of which, unfortunately in different works, has been incorporated with the remarks concerning habit. We note, accordingly, that a strict line of demarcation must be laid down in discussion between our subject on the one hand, and *natural instincts* and *appetites* on the other. True, there is an intimate connection between habits and these latter. An instinct or an appetite may furnish us with an impulse, continued obedience to which will lead to the formation of a habit, and one of the results of habitual action in a certain direction may be the creation of an appetite, as happens in the cases of the libertine and the drunkard. This close connection between the phenomena referred to has been the cause of some confusion in their study. For example, Macvicar, in his work "On

Human Nature," not only allows the treatment of habit to grow out of his remarks upon instinct and appetite, but even goes so far as to say that "the genesis of habits is fully explained by the existence of natural appetites and instincts." But we must not forget that, while the connection between them is confessedly intimate, it is no closer than that which exists between habit and any of the other tendencies or impulses of our nature, for each of these, equally with our instinctive or appetitive tendencies, will lead, if exercised, to the formation of a habit. Besides, however close the relation subsisting between the phenomena indicated may be, it yet remains that habit is neither instinct nor appetite. The word "appetite" is properly used only as referring to those impulsive states of feeling which are characterized by periodicity. They may be primitive and natural, such as hunger, thirst, sleep, &c., or they may be induced through continued indulgence, *e. g.*, the appetite for tobacco; but whatever their variety or origin, our appetites are merely states of feeling produced by the periodically recurring wants and necessities of our bodily or organic life, and which prompt to action for their gratification or alleviation.

Instincts, on the other hand, differ from appetites in that they are always primitive in the individual, never acquired. An instinct is the ability in any individual to perform actions involving complicated muscular adjustments, particularly such actions as are useful, which ability is untaught, and due to no steps of development or exercise through which the individual has passed. This, however views may differ as to the explanation to be given of these primitive facts, is a statement of the essential features of instinct. Individuals do, as a matter of fact, without any course of training, and without any causes that can be pointed out in their own experience, possess the ability to perform actions, which, in degree of complexity of the muscular movements involved, rank as high as many actions usually attained only after a process of development has been for some considerable time at work. We may note in passing, that upon this fact of primitive instinctive ability for complicated action great light is thrown by the modern doctrine of Evolution. To return, however. In neither of the above classes of phenomena do we find the essential features that mark our habits. What peculiarly belongs to habit as distinguished from instinct and appetite, is that *the word draws particular attention to the effects of repeated exercise*, and throughout

the present discussion we limit ourselves strictly to this field. We shall consider alone the effects which repetition of an experience or of an action produces, the "Law of Habit" meaning merely that principle according to which repeated experience or exercise produces its effect. And, as before indicated, it will be maintained that the known effects of repetition, in different spheres of its action, are so apparently diverse and incongruous, that the principle which alone, with the present reach to which means of investigation have attained, shows itself to be the governing principle of the facts, is that which regards them all as predetermined, and thus in some sense caused, by that end, as means to the attainment of which they, in their variety, are so strikingly adapted.

We might, at this point, guard ourselves against a peculiar view held by Mr. John Stuart Mill. According to this distinguished writer, habit is virtually the *annihilation of motive*, is a principle of action altogether incompatible with motive. Actions are in all cases originally done from some motive or other; but when through repeated exercise a certain course of conduct has become habitual, Mr. Mill thinks that the actions have ceased to be done from motive. His statements in this connection are made in the "Utilitarianism," Chap. IV., and in the "Logic of the Moral Sciences," Chap. II., Section IV. In the former, after laying down the thesis that pleasure (including its negative, freedom from pain,) is the sole motive to action, and attempting to reconcile this with his belief in the possibility of a purely disinterested act, Mr. Mill, apparently conscious of his weakness, has recourse to a further argument, the substance of which is briefly as follows:—Men perform actions in many cases toward ends which are either perfectly indifferent, or are positively hurtful in their tendencies. This being so, it might seem as if some other end than pleasure were capable of constituting a motive to action. However, instances of such action prove nothing contrary to my thesis that pleasure is the sole motive to action, for when men thus, in the course of repeated action, come to pursue ends which are indifferent, or even hurtful, they have ceased to act from motive, and are under the dominion of habit. "Many indifferent things which men originally did from a motive of some sort, they continue to do from habit. Sometimes this is done unconsciously, ... at other times with conscious volition, but volition which has become habitual, and is put into operation by the force of habit." Now, it would be

irrelevant to our subject to discuss the force of Mr. Mill's arguments in proof of his thesis as to the ultimate motive to action, and its consistency with the possibility of disinterestedness. It could easily be shown that, whatever possible construction be placed upon his statements, they involve an inconsistency. We are concerned, at present, only with his opinions regarding the nature of the state at which a man has arrived when we say that his action has become habitual. And while it is not denied that the force of habit may set up the standard of absolute dominion, and man may be its slave, "bound hand and foot," we nevertheless maintain that even in such a case a man's actions are done from motive, and the sway of habit is but the triumph of some particular motive over all opposing forces. For why is anything called a motive? Because, as it is in the mind's view, it stimulates to action. Why, even, do men say that pleasure is a motive? For no reason other than that pleasure is an end, to the attainment of which men direct their energies. To whatever extent views may differ as to the relation between motives and volitions, the general statement will not be disputed, that of motive no other account than that above indicated can be given, namely, as the end aimed at, which, as contemplated by the mind, stimulates to action. A motive is constituted whenever an end definitely in the mind's view is considered in some respect desirable. Well then, when a man by continued indulgence has so enslaved himself that from sheer force of habit he continues to pursue some end of action which has long ceased to give him pleasure, and which may even reap for him a "harvest of pain," are there not present all the elements requisite to constitute a motive? Does not the desire of attaining the end at which he actually aims stand to his action in the same relation in which the desire of pleasure stood, and is it not thus the motive of his action in precisely the same sense in which the desire of pleasure was the motive where pleasure was the end sought? It is not true that as we proceed in the formation of habits we cease to act from motive. Our motives may in the course of such development change, and permanently change, certain ends of action may forever lose their charm, and thus be stripped of their prompting or stimulating power, ceasing in this way to be motives, but they die only in giving way to stronger forces. The formation of a habit is not the disappearance of motive, it is rather the setting of some motive upon a throne, it having acquired such power as to operate

on all ordinary occasions on which its exercise could be looked for. Indulgence of lower appetite, *e. g.*, may have become so habitual that all the claims of moral law may practically have ceased to make their voice heard in the presence of immediate empirical instigation. But this is not the annihilation of motive; it is the usurpation by one motive of the sceptre and dominion that rightfully belong to another.

The attempt to find some single universal principle, under which all the various manifestations of habit may be brought, brings us face to face with the question so freqently discussed as to the relation in which the law of habit stands to the *association of ideas*. The views which have hitherto generally prevailed divide into two classes the diametrical opposites of one another. One class of writers contend that the law of habit is an ultimate original principle of our nature, incapable of analysis into simpler elementary constituents, or of subsumption under any wider law from which it may be deduced, or of which it may be regarded as a special case, and they resolve the association of ideas into the principle of habit. Of Dr. Reid it cannot, as a general thing, be said, as has been said of Mr. James Mill by one of his connotators, that his desire to avoid unnecessary multiplication of fundamental laws in exposition or explanation of mental phenomena has often led him into the error of resolving into different manifestations of the same law phenomena which are governed by laws really and fundamentally distinct. On the contrary, in general, there seems to be an absence of all such desire on the part of Dr. Reid. Occam's "razor" is a tool which he seldom uses. With a little more careful scrutiny he might easily have seen that principles which he regards as ultimate and original are not so, but are capable of resolution into, or at least of subsumption under, simpler and wider laws. However, the desire mentioned has certainly influenced Dr. Reid in his speculations on the point with which we are now concerned. He says: "I believe that the original principles of the mind of which we can give no account but that such is our constitution are more in number than is commonly thought. But we ought not to multiply them without necessity. That trains of thinking, which by frequent repetition have become familiar, should spontaneously offer themselves to our fancy seems to require no other original principle but the power of habit." And this view is not without its adherents at the present day, for Dr. Noah Porter, in his elaborate work entitled "The Human Intellect," contends that "the law of

association rests upon the same original principle which explains the law of habit," and even says "the law of mental suggestion or association is only a special form of this general law or principle."

The other class of writers, of which Dugald Stewart may be taken as an example, bring the principle of habit under the laws of association of ideas. It is, however, wisely remarked by Stewart, that the extension of the term "idea" must be widened so as to include every operation of mind, and we might note that a still wider application of the term is necessary in order to give the slightest plausibility to the theory, which will make it include not only every psychical, but also every corporeal effect capable of entering into conjunction with others. That philosophers should be so diametrically opposed in their views on such a question is perhaps, at first sight, a little surprising; but the variety of opinion is no greater than that which exists on all questions of a similar nature, where the point at issue is largely as to the meaning of a term. The discussion of the question involves distinctions which are to a great extent, if not altogether, merely verbal. It is not on that account, however, unimportant, for there is a wrong as well as a right use of words. Language has a use to serve, and its functional efficacy is destroyed by abuse; and expediency in its employment requires that, unless in very exceptional cases to subserve a higher use, words shall not be wrested from their ordinary meaning, nor be deprived of any of the associations that attach to them in the world's ordinary discourse. Now, keeping the above precept as to the use of words in view, it will readily be apparent that the merit, if any merit rest in the discussion at all, cannot lie with that class of writers typified by Dr. Reid, for association of ideas cannot be explained from habit, or resolved into the same, without at least depriving the expression of a part of its denotation, a very large part, and one of the greatest importance. It has been remarked by Sir Wm. Hamilton that "we can as well explain habit by association as association by habit," and we shall shortly give our reasons for thinking the remark probably true, if by "association" the principle of contiguity alone be referred to. But to restrict the expression thus is to wrest it from its ordinary and legitimate use, which makes it include in addition the principle of association by similarity. We certainly require a word to denote the working of this principle, the importance of whose influence cannot be over-estimated. The word "association" has been handed

down in this express use, and no valid reason can be given why it should not be continued in that meaning, which makes it include every principle whereby one mental or bodily state or action suggests another. These principles comprise similarity as well as contiguity. (For present purposes, as not relevant, we may leave out of consideration the principle of contrast.) Now, if the expression "association of ideas," allowing to the word "idea" the necessary widening of its application before referred to, be still used as ordinarily, the association of ideas cannot be resolved into or explained by the power of habit, for association by similarity cannot be so explained or resolved. It stands alone as a distinct and ultimate principle of our nature. Its working, though inextricably intermingled with that of contiguity, is logically prior to it. The absolute and indelible distinction between this principle of association and the power of habit is seen in the fact that association by similarity is primitive, whereas habit has express reference to the moulding power of repetition. Only after repetition can a habit be formed; but similarity may produce its effects at once. It is possible to cite instances of its working where there has been no previous experience, and therefore no possibility of the formation of any result through repetition, as *e.g.* in the identification hit upon by Franklin of the similarity in nature between lightning in the sky and the phenomena of electricity.

Evidently then association of ideas cannot be resolved into habit, unless *at least* the principle of similarity be left out of consideration. The question then remains:—Can we bring habit in under association of ideas as but a phase of the working of the principle of contiguity? We answer: Yes, in all probability. The hypothesis that all the varied manifestations of habit can ultimately be shown to be essentially similar in the working of contiguous association, is that which, in the present state of knowledge of the facts, most commends itself to our acceptance. We note, however, that it yet remains a mere hypothesis, not having been brought to the test of a complete scientific induction. We accept it, therefore, in the meantime only provisionally, awaiting complete verification from further research. Its commendation rests, in brief, on the following considerations:—

(*a*) Habit and contiguous association alike have express reference to the plastic power of repetition. Both recognize its necessity as a

condition of the growth and strength of tendencies in any direction. This fact is at least a finger-post, though admittedly fallible, pointing to similarity in the nature of both.

(*b*) Many of the results of habit are apparently completely resolvable into manifestations of contiguous association. Thus, in the case of the so-called "secondarily automatic" actions, as when an accomplished pianist commences playing, and the customary trains of muscular movement are kept up without the arising in consciousness of their mental concomitants, there is apparently no necessity of recognizing anything else as involved than the mere linking together by contiguous association of a series of muscular movements which have been frequently performed in regular succession, in such a way that the appearance of the first link tends to call up the rest.

(*c*) There are no phenomena of habit which are positively known to be incapable of reduction to the outcome of contiguous association, the utmost that can be said being that in some cases we cannot from direct evidence affirm the applicability of the principle of contiguity in explanation.

(*d*) Where this inability exists it seems to be accounted for by the empirical limitations upon our knowledge of the facts possibly concerned in the case. For example:—Repetition of exercise on the one hand increases the efficacy of some of our perceiving powers; the eye becomes more sensitive to shades of color, the ear more acute to apprehend distinctions of sound. But on the other hand, certain of our primary susceptibilities suffer a deadening effect from repetition of affection. Thus the sensibility to heat and cold, to the glare of sunlight, and to hard and rough contact with rude and pungent and hurtful agents, lessens under exposure to them. A similar apparently contradictory variety of effects is seen in the case of our emotions. Love, fear, pride, and other emotions are stimulated by exercise; but grief, by indulgence, in the healthily constituted nature gradually dies away. Now, it seems difficult to represent these diverse and apparently opposite results as in reality merely different manifestations of the working of some one law, such as the principle of contiguity. There is nothing illegitimate, however, in our setting up this account of them as a scientific hypothesis awaiting verification. It is quite possible that all such seemingly opposite directions of the energies of habit may have some common physical basis which further research into the correlation of mental and organic processes may reveal. It

is to be noted, however, that even if this physical basis, which we have before spoken of as a quantum x, should be discovered, and all forms of habit through it be shown reducible to energies of contiguous association: this would be no ultimate explanation; it would be merely to resolve one set of phenomena into another, which is to explain neither the one nor the other; it would be merely to employ different words to express at bottom one and the same identical fact. The need of belief in design would not be dispensed with, an appeal to final causes would still be demanded by the number and co-ordinated action of the facts of our nature concerned in the case, explicable in no other way than this, unless regarded as a chance co-incidence, in which explanation, however, the mind refuses to rest.

Omitting now further discussion of our subject in its aspect as related to association, we proceed to a brief exposition of the ultimate results attained by those who have heretofore given it careful thought. These writers we might in this aspect separate into two classes. Those of one class attempt to set forth in express definitions the main facts and principles of habit, and in this way would be very explicit in their treatment. We shall find, however, that it is precisely these authorities, these who strive most to be definite in exposition, who have really been the most inaccurate. The other class, not professing to offer definitions as explanations, endeavor by use of different forms of expression and the drawing of analogies, to present a comprehensive and systematic view of the principles of habit. Their expositions, however, are in all cases open to the serious objection either of vagueness, or of entire want of meaning.

Wherever definition has been attempted, we find a striking amount of agreement in the use of words. In these cases all the manifestations of habit have appeared to be comprehended under the notions "*facility*" and "*impulsiveness*." For example, Dr. J. D. Morell in his "Mental Philosophy" takes the following ground:—In many cases, even though volition be put forth, the desired movement of muscle fails to follow, and in order to bring about the result aimed at, no mere effort of volition is sufficient, a practical training is required; and "when by such training new *facility* is acquired, the power thus formed is termed the power of habit." Habit is thus merely facility of bodily action acquired through exercise. Dr. Reid too tells us: "Habit is commonly defined, a *facility* of doing a thing acquired by having done it frequently." But, conscious that the

notion of facility is not all-comprehending, and unable to do more than confess the weakness of the above definition, he supplements it by saying: "This definition is sufficient for habits of art, but the habits which may with propriety be called principles of action" (namely, our moral habits and acquired appetites) "must give more than a facility, they must give an *inclination* or *impulse* to do the action." To Dr. Noah Porter also the conception of facility appears to comprehend the main facts of habitual exercise. The following sentences indicate his position:—"Habit, Latin *habitus*, Greek ἕξις, is literally a way of being held, or of holding one's self. Thus defined it must denote a permanent state of rest which has been reached as the result of action or growth, or a permanent form of activity, or of *readiness* or *facility* for any kind of activity."

However, an attentive study of the specific differences in the energies of the law of habit will show us that, if put forth as all-embracing definitions of habit, these notions of *facility* and *proneness* or *impulsiveness* are lamentable failures, for they will be found to be false and inapplicable in as many cases as they are true, and for subserving any systematic purpose they are totally useless. In order to avoid these difficulties thus merely indicated, the other class of writers resort to various forms of expression which, however, are either possessed of no meaning at all, or leave the subject still upon our hands with none of its hard and rough points smoothed down, none of its difficulties explained away. The lexicographers, *e.g.* Webster, commonly tell us that habit is "a *disposition* or *condition* of the mind or body acquired by custom, or the frequent repetition of the same act." The embarrassment common to the lexicographers we find also among the psychologists. Upham in his "Mental Philosophy," in a section entitled, "Of the Effects of Habit in giving Strength to the Will," says: "We often see its results in the case of the vicious man whose unholy propensities go on *strengthening* and *strengthening* under its influence, till they assume the stubbornness and inflexibility of iron. . . . It is the result of the principle of habit that every act of the will . . . gives *vivacity* and *strength* to the succeeding act." We might cite here, too, in virtue of certain statements of his, the name of Dr. Morell before mentioned. He has recourse to the use of a word which, like the word "property" or "quality," is offered as an explanation, but amounts only to a restatement in different words of the fact or facts to be explained. It

occurs in the following passage :—"The power of habit may be traced to the operation of a certain law of our nature by which every time we perform a given action a *residuum* is left in the mind which renders the facility of performing it again, and the tendency to do so, greater." This word "residuum" explains nothing. Finally, Macvicar regards habit as the psychical expression of a special "myo-cerebral" rhythm. Such a rhythm, or organic binding together of parts, is produced "by practice or exercise." "And," says he, "if anything occur or is presented to the senses which commences that rhythmical state, the organism will tend, perhaps with insatiable or invincible force, to complete its act." This view, however, is given without any attempt at philosophical deduction, thus amounting, with the other views we have just cited, merely to the use of more or less convenient forms in which to express, without explaining, facts patent to observation. The treatment of the question in general at the hands of psychologists, is characterized by Dr. Chalmers as "an obscure and profitless speculation." Certainly little result has so far come of it, and its inadequacy we in some instances find confessed.

It is the extreme variety to be met with in the offices and manifestations of habit that renders so difficult a comprehension or a definition wide enough to embrace all the facts, and this for the reason that nothing can yet be definitely shown common to all the forms of this variety. This difficulty, betrayed or confessed by systematic thinkers, is likewise apparent when we look at the proverbs or maxims which express popular views of this subject. For example, we often hear the expression "Practice makes perfect." But, as if knowing that this was untrue when taken as an universal proposition, and needed correction, another proverb tells us "While habit *strengthens* reason, it *blunts* feeling." This latter view has been contended for philosophically. It appears to have been Bishop Butler's conception, and he cites it as an incentive to active virtue, pointing out that while habit comes to our aid in *action*, increasing the tendencies and facilities for the performance of work, it has a deadening effect upon our *passive* susceptibility.

Another adage tells us, referring to a wider operation of the law, "Habit is a second nature," this being allied to the view of Lord Bacon, "Custom alone doth alter and subdue nature." And still another maxim, recognizing the moral importance of the law, says "Man is a bundle of habits." In these maxims there is recognized

a variety of functions greater than belongs to any other law of our nature, namely: the power of habit to train and develop the intellectual and voluntary powers of mind and body; its different effects upon the reason and some of the emotions and simple feelings; and the great power which it has, while leaving untouched our intrinsic nature, to alter our whole moral character and mental tendencies and method. Maxims as a general thing embody the practical wisdom of mankind; and for all ordinary purposes of the world's business these maxims regarding habit are a sufficient practical philosophy. But, while the common and unwrought notions of customary experience do, only because they must, furnish that philosophy which serves the ordinary uses and necessities of life; yet for highest and ultimate truth we have to look away from these to science which proceeds upon some settled principle, and endeavors to reduce all facts of possible investigation to some precise, definite, and symmetrical system.

The defects common both to the ordinary popular and the studied and systematic views of this principle of habit will be easily apparent, if we notice now some of the specific varieties to be found in the manifestations of this great law of our manifold life. The following, presented without special regard to order, might be noted :—

Repetition of exercise strengthens and quickens our *external senses.* The eye is rendered more sensitive, the ear more acute to apprehend minute distinctions, and the same is true of the other senses. The sum total of the effects of previous impressions appears to be in every case re-instated, giving additional strength to the effect of present stimulation. Thus, in what appears to the landsman a mere speck upon the distant horizon, the practised eye of the sailor can read sufficient to enable him to tell the nation, size, character, and bearing of some outward or homeward bound vessel. Similar instances might be cited in connection with the senses of hearing, taste, and smell, and the history of the sense of touch and the muscular sense abounds with examples, as in the case of the blind.

Our *ideal representations* also are increased in intensity and vividness, in fulness and minuteness. While the pleasure or the pain of the pristine shock abates under repetition within certain limits, yet for intellectual purposes the value of an impression increases with every subsequent experience, and accordingly the ideal representations of memory and imagination, in degree of vivacity and minuteness of

detail, under the influence of habit, may rise very near their originals. Habit, too, develops our *acquired perceptions*, and the accuracy of the judgments to which it leads is often most remarkable. For example, the eye originally, and of itself, receives nothing but impressions of colour; but through habit we may acquire a wonderful degree of accuracy in judging by sight of the distances, forms, and magnitudes of objects; and these judgments may be framed so readily that to ordinary observation they appear immediate, and the intricate processes really at work are hidden from view. It is, however, curious to note that upon certain of our primary susceptibilities, *e. g.* the susceptibility to cold and heat, and the rough contact of hard or injurious stimuli with the sensitive surfaces both of the skin and intestinal passages, the effect of habit is directly the reverse of that which was found in our previously cited instances. There is no fact more familiar to everyone's experience, than that exposure lessens sensibility to pain. While the eye is increased in value as an instrument of mind by repeated impressions upon the visual nerve, while it becomes ever more and more sensible of those qualities of external objects which constitute its peculiar province, it at the same time becomes more and more insensible to hurtful impressions by exposure to them. The glare of sunlight and excessive heat are gradually stripped of their power to injure. In the same way the tongue and palate may become accustomed to the most pungent fluids and solids so as to bear them with impunity, while at the same time their power of appreciating minute distinctions of taste may regularly improve, as, for example, in the cases of the wine-tester and the gourmand. Here we find alongside of one another, nerves which have been subjected to the same action, on the one hand quite callous to the pungent and fiery effects of alcohol and strong spices, and, on the other, having such a delicacy of discriminating power as might seem impossible to an individual accustomed to plain diet. The general statement, then, that habit blunts feeling, is most inaccurate, for we find that even among our simple primary feelings there are cases which flatly contradict it. The effect of habit upon some is deadening, but upon others quickening. Still more inadequate is the notion shown by consideration of our complex states of feeling which we call emotions. Here, too, we find the same apparent contradictoriness in the effects of habit. As Dr. Bain points out, "our emotions may be steadily increased by culture." Fear or

flurry may be rendered the customary thing by habituation. Habit does not blunt the feelings of pride, of self-esteem, of the pleasures of benevolence, of paternal love, and motherly devotion and tenderness, but quickens and strengthens them. With all regular exercise these emotional tendencies grow in vigor; but, on the other hand, grief, and remorse, and shame, are gradually exhausted by being indulged.

In the same way frequency or persistency of exercise vary in their effects upon the different faculties of our moral nature. In short, the conclusion is established, with every degree of probability, that the effects of custom, or habit, or frequency of repetition (it matters not by what name we group together the influences at work), vary with every variety in the nature of the capacities exercised.

We note again, that not only do the effects of habit vary when different powers are subjected to it; but also that its energies may be exerted in strangely different directions within the sphere of each separate power. For example, let us compare the results developed by exercise of the power of voluntary muscular control in the following cases:—

(*a*) Of the accomplished pianist;

(*b*) Of the blacksmith, or the porter;

(*c*) Of the professional boxer, or the ballet-dancer.

In the first, exercise of the voluntary muscles gives extreme facility of movement without any proportionate increase of strength. In the second, it develops strength, massive power and endurance, without any corresponding increase in facility of rapid movement. In the third, the effect seems to be due to a combined action of the previous modes of increase, the muscles developing at the same time a surprising degree of rapidity of action and robust energy. Though greatly increased in strength, they are yet more and more brought under dominion of the will.

Our intellectual faculties, under habit, exhibit to us a similarly varied scene. Here, on the one hand, we find readiness and dexterity of thought and quickness of combination, as in the power of extempore speaking. There, on the other hand, is found massive power and plodding endurance. And yet again we find that exercise may develop energy and agility in unison, as in legal and parliamentary debate, and in the higher styles of poetry. In such cases as these, while the notion of increased facility or force, or both, is sufficient to

serve all ordinary purposes, yet, as has already been evident, as a scientific definition, it is not definite enough even where most applicable; and when regarded as a general apprehension, it is fallacious.

But still more than those instances which we have already mentioned, there are certain phases of the working of habit apparently not hitherto noticed, which render evident the essential defects in the treatment and explanation offered. The phases referred to are the following:—In relation to the will, the increased obedience of our thinking and voluntary powers of mind and body, and at the same time the increased resistance offered by another portion of our nature, including our emotional and impulsive tendencies, whether appetitive or instinctive. It is in reality just at this point that the difficulties, to Reid and Stewart, appear insuperable; but it is precisely here that, both for speculative and practical purposes, the greatest need becomes felt of a true and comprehensive philosophy of the facts. Our rational or thinking powers, as well as those directly under control of the will—the perceptive and reasoning faculties, the voluntary muscles—while their strength grows by frequent exercise, become continually more prompt in submission to the mandates of the will; but on the other hand our affectional and appetitive tendencies, by being indulged grow more and more ungovernable by the will acting under the law of reason. Fear, lust, anger, for example, may be cultivated until they become absolute rulers of the individual, until under them one loses all power of rational action, being tossed about hither and thither, like a cork upon the waves, by forces over which he cannot exercise the least control. This forfeiture of liberty, due to procedure along certain lines of habit, is something that demands the student's careful consideration. It is fraught with lessons of immense practical importance, and a thorough understanding of its conditions is necessary; but it is in vain to look for light to the history of psychological and ethical speculation. We are taught by Holy Writ in many ways that whoso committeth sin *enslaveth* himself, but philosophy has nowhere yet comprehensively seized upon this great fact.

A review of the phenomena resulting from the law of habit has now been given sufficient to show how inadequate the Inductive Method of philosophy as laid down by Lord Bacon must prove for purposes of explanation, so long as our knowledge of the facts pos-

sibly concerned remains as it is. The object of Induction is to unravel the great complexity of nature, to point out in the grand uniformity apparent amidst this complexity the particular uniformities that exist regarding special facts. Bacon himself thought that all other methods would be superseded by that which consists in the systematic classification and arrangement of facts. The foundation for all advancement to truth must be laid in the instances and facts of experience; man must begin by observing nature, then interrogating her, subjecting her to a critical observing and experimental investigation. He must then *ascend* from a clear and distinct knowledge of facts and particulars thus acquired to those general laws or principles on which they depend. The order of procedure, never to be reversed, is *upward* from particulars to classes, thence upward still from class to higher class or wider class, as from circle to circle, until the most general fact of all, which reveals to us the law, is reached at the central point and summit of the ascending series. The successive inductions are merely more general facts rising out of those more particular, until the process ends in the most general of all, the law or essential principle sought.

But clearly this method must fail of applicability in treatment of the now known facts of habit, facts which are incongruous and incoherent, which, occuring in the midst of apparently similar circumstances, nevertheless refuse to take classification together. This method, as has been beautifully said, "cannot march and countermarch upon the same plane in its route to results." One set of instances points toward a general law, but the next says "right about turn." We can find underlying the known phenomena of habit no general fact broad enough to embrace all specific varieties. In some cases we find that repetition or persistency of an action or impression gives *increase* of facility, or strength, or both; but we cannot thence infer a general law or construct a definition because, in turning to the very next set of instances, we find that similar repetition or continuance of action or impression gives *diminution* of strength or facility. No class of phenomena could be better chosen than the phenomena of habit to illustrate the weakness of the Baconian method. It collapses here in utter helplessness and unfitness. It can find no common centre for facts so eccentric; it cannot bring together lines so little convergent that the point at which they meet lies far beyond the utmost boundary of its vision. It might be

noted in passing that Bacon himself was rather timid and reserved in the application of his method to psychological investigations. As might naturally be expected, "with a boy's fondness for a name and a banner," Bacon carried his method, which though perhaps not to be called new, yet had been raised by him into a principle, beyond its legitimate province, and claimed for it an exaggerated power, and a range broader than its birthright; but, in relation to psychological and ethical speculations, he admits "it must be bounded by religion, else it will be subject to deceit and delusion."

It constitutes, perhaps, Mr. J. S. Mill's chief glory as a logician, that he showed the insufficiency of the Inductive method as laid down by Bacon. Bacon allowed only one order of procedure, namely, upward from particulars to generals, and thence still upward, this order never being reversed. But the greatest triumphs of science since Bacon's time have come (nor could they otherwise have come) through a method in which this order of procedure is directly reversed. Bacon failed to make room in his system for the Deductive Method of Inductive investigation, and it is clearly shown by Mill that this was the grand defect in Bacon's inductive philosophy. Subsequent history shows us the Deductive Method, that of *verified hypothesis*, to be the universally accredited method of modern science. It would, of course, be foreign to our subject to set forth the features of this inductive philosophy as amplified and extended by Mill. Suffice it to say here that the only laws it is capable of revealing are the laws of physical causes. Of final causes, such as those demanded by co-ordinated action of laws, it takes no cognizance. "The only notion of a cause, which the theory of induction requires" (if experience can give any *notion* at all) "is such a notion as can be gained from experience." To the consideration of such causes the province of scientific induction is strictly limited. It seeks not to penetrate beyond the sphere where phenomena are linked together according to definite and fixed rules by mechanical necessity. In short, physical causes are the sole objects of inductive science; and in dealing with the facts our reasoning cannot be too rigidly mathematical. Now, the same rules of careful observation, the same precautions against error, which are employed in physical science, are to be adopted when the phenomena of mind are the subject of investigation; the methods of analysis and classification that are available within the sphere of physical science also hold within the domain of mental

science; and there is profound truth in the saying of Prof. Huxley: "On whatever ground we term physiology science, psychology is entitled to the same appellation; and the method of investigation which elucidates the true relations of the one set of phenomena will discover those of the other." As facts given us for study, psychical facts are to be treated under the same rules of observation and analysis as those of physics; instances are to be brought in to establish conclusions, and must be ascertained by similar laws of evidence and with equal precision. But it should never be forgotten that in the region of mind, and when the laws and purposes of mental phenomena are in question, we are working in a region that in many ways transcends the physical, transcends it in the complexity of processes concerned, in the obscurity of many of its conditions, and the difficulty of available means of inquiry; and, at least in a certain stage of our advancement to truth, omitting here the question whether it must not always be the case, a higher mode of explanation than the merely physical is that which alone satisfies. It is only while psychical facts remain, as it were, upon the dissecting table, or are subjected to reagents in the laboratory, and only while thus they stand before us on the same footing with the facts of physiology or of chemistry, and we have, or may have, a thorough knowledge of the conditions affecting any particular experiment, that these facts are at all amenable to the methods that for scientific purposes prove sufficient within the spheres of speculation referred to. When they rise into the realm of rational life, and we attempt to philosophize upon them, and seek to discover the presuppositions they involve and to lay bare their governing purposes, the mind rests only when answer and illustration are given in the ends toward which they point.

Even the explanations offered by physical science shed no light upon the inner working of nature. What is called explanation is, as Mr. Mill admits, "but substituting one mystery for another, and does nothing to render the general course of nature other than mysterious; we can no more assign a *why* for the more extensive laws than for the partial ones." It might even be contended that until scientific methods take cognizance of final causes, they are not true to that principle of causality upon which they all alike rest; for until they do so the phenomenon of repeated co-incidence and co-ordinated action of causes remains unexplained. Even then within the range of inductive science want is felt of some higher explanation. The realm

of matter points us to mind, matter being only a means and a slave, with all its functions and references significant only in a region above and beyond itself. It acts and moves only as it is impelled; its laws are physical causes, and its expositor that philosophy which deals with facts of mathematical or mechanical necessity. But when we leave the merely material, or even the organic, and come to the world of psychical and rational life, we find that the ruling principle cannot be expressed as an impelling force, but as a moral purpose, and only through the thought of highest ends can the mysteries that involve us fade away into the light of intelligent solution.

Directed by the principles indicated, we will now note the most important facts and purposes of the working of habit.

It is a law of universal life obtaining in the vegetable, animal and rational kingdoms. It is a law not only of intellectual and moral faculties, but even of animate textures. It is a law of growth and development; only through it are those faculties educated and enlarged whose perfection is intended in the creature's existence. And, as a subsidiary to this end, it hedges the individual round with a protection against all *hurtful increase* of those feelings and tendencies whose indefinite enlargement would hinder the attainment of the end designed.

The influence of the law of habit varies in the different spheres of its action, and its effect upon the different faculties subjected to it are more or less remarkable according to the rank of importance which these faculties severally occupy in a scheme of our constitution. Their respective relative importance determines their rate of development. Its effects within the vegetable kingdom are easily noticeable. We find, for instance, that vegetables, within a narrow range, may become inured to strange climates. Still more apparent are the influences of habit upon animal organizations. Animals are adaptable to foreign climates; and, under training, surprising facility is developed for taking on new modes of muscular adjustment. But it is when we come to the higher emotions and intellectual and moral powers of man that we discover the greatest energy of the law. The capacities of development and of strength and stability of character to be acquired through habit are here quite indefinite. And it is to be noticed that the powers which illustrate here the greatest energy of habit are precisely those powers whose highest development is a condition *sine qua non* of the attainment of the

ultimate destiny of the creature, as being involved in that attainment. These powers under habit exhibit to us agility and strength combined. Through habit power which has been obtained is rendered permanent, just as through memory knowledge is treasured up, leaving open the way for further development; just as money put out at interest will add each year to the ever-growing principal that which, being blended therewith, will yield further interest. If there be a destiny whose ultimate attainment is in the design of the creature, some such powers of acquisition and expansion are obviously necessary. Only through their means are growth and progress possible. If there were no such means provided there could be no life in the universe; vitality would be reduced to mechanism, for only growth and progress distinguish it therefrom. This necessity of some powers of development as a condition *sine qua non* of real life itself did not escape the notice of Dr. Reid, and is clearly and beautifully expressed by him as follows:—"As without instinct the infant could not live to become a man, so without habit man would remain an infant through life, and would be as helpless, as unhandy, as speechless, and as much a child in understanding at three-score as at three."

The adage which tells us that habit *blunts* feeling is true, as we have already seen, only of certain of our feelings, its effects upon others being quite the reverse. And a fact which renders our argument for final causes still more conclusive, is that between those sensibilities whose powers are exalted and those which suffer a diminishing effect, no known difference can be pointed out capable of explaining the diversity and contradiction seen in the workings of habit, except the difference of their respective ultimate purposes or ends. Those whose highest growth and enlargement are necessary to the creature's perfection, are precisely those which receive at the hands of habit the strongest impetus; while those whose indefinite increase would hinder such perfection are, through the influence of the same law, stripped of their power to injure. In the degree in which they are beneficial and helpful they are allowed free indulgence; however, the moment they overstep this boundary, the moment their further enlargement would be an aggravation, that moment the law of habit interferes to turn aside and disarm the threatened danger. In this way habit is a law of protection and defence, aiding that development and that only whose completion

was intended in the design of the creature by its Author. For example, our bodily organs of sense and movement are instruments through use of which the mind exerts itself to accomplish its ends. Imperfection or injury of an instrument will lower its utility; and consequently, if the body is faithfully to fulfil its functions, it must be preserved from external injury and internal irregularity. But, as man is empirically situated, his organism is not so nicely adjusted to its environment as to be absolutely secure from harm. On the contrary it is necessarily exposed to many harmful affections, and even to much abuse of its own functions.

From these injuries, pain and fatigue, by a provision that reveals the wisdom of an all-wise Creator, are commissioned to protect and warn us. This they do by reproof, and by attaching penalties to continued or repeated indulgence; and, while their voice is likely to be heard, they cease not to exert it. But just as soon as their further continuance would be in the necessity of the case useless, or itself injurious, at that point they are destroyed or counteracted by the working of another provision of our nature equally beneficent with the former. We necessarily meet with some hurtful agents at least. No one can escape them. In such a case, if the result of habit, or of repeated impression, were to increase the organic sensitiveness in the same way as it increases the powers of perception and the voluntary powers, then protection against necessary injuries would be to us a dream. Through necessary exposure we would soon possess such extraordinary capacities of suffering that every feeling would be an agony, every offensive smell would become an intolerable stench, every touch would sharpen into a sting, and every ray of light would quicken into burning fire. Against such evil as this habit comes to our aid as an angel of protection, abating our sensibility to excessive heat and cold, and the painful effects of other hurtful agents. This it does as nicely and as exactly as the exigency could require, as accurately as if some beneficent and all-wise director superintended the working out of results. What we cannot avoid we are enabled to endure, habit kindly throwing the protection of its insensibility over our suffering sense. It is in the same way that certain of those pains of emotion, unavoidable in the ordinary run of life, are restrained and prevented from injurious excess. They are allowed to continue to a certain degree, namely, as long as they are regulating and beneficial; but just as soon as their further indulgence

would be injurious the voice of habit interferes to prevent that growth which would without it be unavoidable. And thus we find that our bitter disappointments and anxieties are after a while calmed down, through the beneficent operation of laws that enter into our very constitution, and in such manner as even to render greater our appreciation of after enjoyments. And in the same way, even those bitter bereavements which come to us through loss of some object of tender affection, which must for a time run their course in paroxysms of grief, are gradually abated in the healthy constitution until, after lingering for a while, grief and lamentation give way to cherished memory, and the most cruel anguish shades gradually into a tender melancholy that has even its element of pleasure. Grief fades away, but the "pleasures of memory" are still ours, and the love remains unchangeable, and the ordinary interests of life come back, and its duties take on again their customary attractiveness, bringing at last a joy which at first would have seemed a mockery. In this way the tears of the mourner are wiped away, while the affections of his heart are still true; he is preserved true to affection, and yet capable of duty; and those unavoidable accidents of bereavement are deprived of their power to destroy through the very sensibilities which most feel their influence.

It remains to treat of the law of habit in relation to our moral nature. Its importance in this connection cannot be over-estimated. When its energies are directed in the line of virtue, it is as an army of power to aid in withstanding temptation. It strengthens and makes sure our resistance, and it renders comparatively easy of acceptance the most arduous commands of duty. This it does by adding to the virtuous tendency and weakening opposing forces, each victory helping to further conquests. He who has made a practice in his daily life of preferring the higher to the lower, he who steadily repels the base promptings of the lower impulses, will in time find that they will cease to rise in opposition, and may even be brought into helpful agreement with the promptings of his better nature. Issuing victorious from the hard conflict in the beginning, he goes on without limit to greater and more important deeds and sacrifices, gives to life itself one grand and inspiring purpose, and finally forms a character that will last eternally. His frequent victories in time instil into his whole character their accumulating and permanent consequences. The stability of virtue is thus founded upon the

principle of habit. However, the principle is as powerful for evil as it is for good. Through it the tendency to evil may grow, and become fixed, and vice may become the absolute despot of the soul. Abuse of our faculties may become their only use. The growth of moral good and evil depends upon the operation of one and the same law, which, in virtue of our freedom, gives into our own hands the regulation of our life and character. The spirit of the outcast and abandoned has been developed through exercise as well as that of the saintly and pure. Man, as he comes from the hand of the Creator, is endowed with powers. In their actual use he is free and unconstrained. Through this law of habit, which rivets the consequences of action indissolubly upon the agent, he is the "architect of his own destiny." The proverbs which tell us "Practice makes perfect," and "Habit is a second nature," contain a vein of deepest truth, namely, the recognition of the stability and assurance that habit gives to moral tendencies. Without this assurance we could have no confidence in character, and without this confidence in character, this faith in human nature, the very foundation would be withdrawn from the institutions of society. For example, without it men would not become parties to any schemes except such as bring immediate results. The medium of exchange would lose its value; business agreements would be mere shams; in fact all the apparatus of commerce would become paralyzed and useless. In the same way everything belonging to men as constituting societies, distinguished from men as merely individuals, would be deprived of that upon which it could alone rest. It is this confidence in the special direction of tendencies due to previous exercise therein that causes a man's reputation to be accepted in legal courts as evidence of his innocence or guilt, a man's reputation being but his own shadow projected upon his pathway by the light of his past life. And it is this experience of the abiding character of the results of habitual action which constitutes the foundation of all our trust that the training which we give the present will develop in the future the results desired. Men will live, in fact *must* live, as they have learned to live; what men choose continually they finally become, just as unchangeably and as certainly as if the Creator had originally made them so.

This law of habit, in this way, warns us of the terrible fact that the tendency to evil, through continued practice, shall grow and finally be confirmed, that abuse of our moral faculties shall, through

indulgence, become at last their only use; that our lower blind and animal propensities shall become, if allowed freedom from restraint, irresistible; and that in fact whosoever committeth sin selleth himself into *slavery*. If this were not the case; if continued practice of evil produced no abiding consolidation of results in character, then the basis and stability of our virtues would to the same extent be shaken, for they rest upon the same foundation. We may not be cognizant of the growth of these results. Consciousness fails to reveal it, just as it fails to reveal organic growth. We fail to recognize the end toward which we are drifting. We do not realize that the moments we spend carry us forward silently but irresistibly to death. We cannot see that each successive day is marked by steps either in our growth or decay. These facts are revealed and certified, however, by observations taken at distant points in time. In the same way, through the "robust consciousness of liberty," we are deluded into believing that we shall always be able to govern ourselves, and that although the path of reckless indulgence may have been trodden for years we shall, after they have lapsed, be as free to choose our course as we were before that path was entered upon. We are confident that our strength of soul will remain unbroken, and that at any time we choose we can quell the surging tide of passion by a word. But we forget that sin is truly bondage, and those faculties whose very life and health consist in their freedom, will remain in spite of everything with all this slavery of habit bound upon them.

> "Never let man be bold enough to say,
> Thus and no farther let my passions stray;
> The first crime past compels us on to more,
> And guilt proves fate which was but choice before."

The wisdom of the provision by which these abiding consequences of good or evil are attached to conduct is as apparent in its adaptibility for highest purposes as that seen in the power of growth with which the intellectual powers and voluntary powers of movement are endowed. The springs of moral action in man are subject to the same law of development as these other powers, in virtue of his nature as a free and responsible agent, in order that a man may reap whatsoever he has sown, that reward may be given unto every man according to his works, that men may by their own free use or abuse of powers build up the fabric of their own destiny.

Our powers of instinct, passion, and emotion, and the power of will whereby we choose ends of action, are given in our constitution ; open possibilities of good or evil lie before us; the working and development of these powers are in the hands of each individual for himself, and, under this nicely adapted law of habit, the permanent consequences of his conduct attach to each individual as his due reward. This court of justice differs from our ordinary tribunals. These are fallible, they are liable to the error of implicating the innocent with the guilty ; they are inadequate to meet all cases demanding redress ; they keep records, which may be lost, and attach penalties according to the standard of a written law, which may be misinterpreted ; their decrees are never instantly carried into execution, but are generally delayed. This law of habit, however, is liable to no such imperfection in its application. It is infallible, as being prescribed by the primary source of all law. Before it the innocent, the guilty, "all men are equal." Its decrees cannot be reversed by appeal, they are carried out instantly upon the act. It immediately rivets into the constitution of every responsible creature the consequences of his action, recording his deeds neither against nor for him, but engraving them in him, in such a way that in the condition of his ultimate attainment may be read not only the just outcome, but also the infallible index of his life.

If the above apprehensions of the subject of habit be correct, some important consequences follow, among which might be mentioned the following :—If the stability and assurance of tendencies rest upon and are proportioned to their exercise, immediate conversions and unpremeditated changes of opinion cannot give a stability, purity, truth and strength of character such as is induced by long-continued practice in well-doing ; and, as a reliable criterion for estimating character, a man's professed creed falls far below his habitual attitude of life.

These considerations suggest to us most important practical lessons, which the educator, whose function it is to train men, intellectually or morally, should never for a moment forget. The nature of *education* can be read in the etymology of the word ; it consists of *drawing out* the powers, causing them to be energized, and directing them aright ; and all our faculties, intellectual, moral or physical, are developed through the same law. It has been said that we may learn the whole secret of education in a gymnasium. Every organ to be

trained is put into faithful exercise, and brought to the state desired, by being vigorously and frequently exerted. The powers of our higher nature are trained in the same way. Our emotional tendencies, our reasoning powers, our virtues, are developed through faithful exercise. Character itself is nothing other than the general result brought about by the course of action an individual has habitually chosen. A weak character, a strong character, a good or bad character, all these express merely different states of development which an individual has reached through habitual action. Each of the conquests, as also each of the failures made by him, stamps itself indelibly upon him, and the tendency at every step is toward a final fixed and immovable state. "The Battle of Life" has become almost a proverb, and its truth comes home to every heart in the consciousness of the inner struggle of contending forces, on the one hand the lower empirical instigations of the flesh, and on the other the moral ideal. In spite of all intelligent perception of the excellency of the moral law, in spite of approval, determination, and endeavour toward the right, the sorry absurdity of good opinions and bad life is often seen.

The rebellious organism and the insurgent passions may defeat all virtuous resolution. Knowledge alone is not sufficient. Theory and doctrine, and the inculcation of precepts, are no doubt well enough, they are in fact necessary in their place, but they are of no use unless supplemented by a practical training. They can never of themselves lead to the uniform habit of right action, and, unless aided by the practice of virtue, will be totally barren of results. There are many who approve of one course, and yet follow another. Their lives are truly battle fields where the struggle of opposing tendencies is still going on, and the struggle will cease only when frequent victory on either side has weakened and dissipated the resisting force, or brought it into regular submission. This necessity of a practical training in order to the attainment of the fixed state (ἕξις), called a virtuous character, is clearly expressed by Aristotle in the second book of the Nicomachean Ethics, where he speaks of men learning to be virtuous by practising virtue, just as they learn to build houses by building them, and to play on the harp by playing thereon.

The education of our voluntary powers of virtuous or vicious action is certainly of far greater importance as determining the destiny of the individual, than the education of the intellect. It is by over-

coming that we learn to overcome, by obeying reason and the dictates of the moral law we learn to obey; and one single act of ours, whether it spring from principles within, or from authority, precept, or example, has a greater direct influence upon the development of character than all the mere theory in the world.

THIRD MEETING.

The Third Meeting was held on Saturday, 5th December, 1885, the President in the chair.

The following were elected members:—Herbert C. Rudge, Esq., A. C. Lawson, B.A.

The President reported that the committee appointed for the purpose of arranging for the admittance of the Natural History Society as a section of the Institute had successfully finished its labors. On motion of Mr. Bain, seconded by Dr. Cassidy, Dr. Ellis, Dr. Brodie, Prof. Loudon, Mr. Pearce and the mover were appointed a committee for the purpose of revising the Constitution and By-Laws for the establishment of sections and for arranging the minor details necessary for this purpose.

The following list of Donations and Exchanges was read:—

1. Canadian Practitioner, December, 1885.
2. Proceedings of the American Society for Psychical Research, Vol. I., No. 1, July, '85.
3. The American Naturalist, December, '85.
4. Proceedings of the American Philosophical Society, Vols. XVI-XXII., Nos. 97-120, and 11 Pamphlets.
5. American Chemical Review, Nov. 28. '85.
6. Journal of the Franklin Institute, Dec., '85.
7. Bulletin of the United States Geological Survey, Nos. 7-14.
8. Bulletin of the Museum of Comparative Zoölogy at Harvard College, Vol. XII., No. 2.
9. American Journal of Science, Dec., '85.
10. Proceedings of the Institution of Mechanical Engineers for March, 1885, from C. S. Gzowski, Esq.
11. Mémoires et Comptes Rendus des Travaux de la Société des Ingénieurs Civils, Juillet, '85, 52 numbers.

Mr. Alan Macdougall, M. Inst. C. E., F.R.S.E., read a paper on "Aërial Navigation."

The paper was an exhaustive treatise on the history of ballooning, or aërial navigation, from the earliest days down to the latest experiments of MM. Krebs and Renard in 1885. The conclusion the reader came to was that, so far as any success had been attained, it was more in the scientific than the commercial solution of the problem. The number of lives which have been lost of late years is not compensated for by any progress made in the practical solution of aërial navigation.

FOURTH MEETING.

The Fourth Meeting was held on Saturday, 12th December, 1885, the President in the chair.

The following list of Donations and Exchanges was read:—

1. Le Naturaliste Canadien, Vol. XV., No. 2.
2. Twenty-fifth Annual Report of the Museum of Comparative Zoology at Harvard College, for 1884-'85.
3. Science, Vol. VI., No. 148.
4. Proceedings of the American Association for the Advancement of Science, 22 Vols.
5. The Iowa Historical Record, Vol. I., No. 4.
6. Proceedings of the Cambridge Philosophical Society, Vol. V., Part 4.
7. Transactions of the Institution of Engineers and Shipbuilders of Scotland, 29th Series, 1885-'86.
8. Proceedings and Transactions of the Natural History Society of Glasgow, Vol. I. (N. S.), Part 1, 1883-'84.
9. Transactions of the Manchester Geological Society, Vol. XVIII., Pt 11.
10. Papers read before the Manchester Association of Employers, Foremen, and Draughtsmen of the Mechanical Trades of Great Britain, 31st March, 1883—28th March, 1885, 18 Pamphlets.
11. Lotos Jahrbuch für Naturwissenschaft, Neue Folge, VI. Band, Prag.
12. Monatsblätter des Wissenschaftlichen Club in Wien, VII. Jahrgang, Nos. 1 and 2, Oct. 15—Nov. 15, '85.
13. Bulletin de la Société de Géographie de Paris, Nos. 1 and 2, 1885.
14. Comptes Rendus des Séances de la Société de Géographie, Nos. 1-17, '85.
15. Correspondenz-blatt der Deutschen Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte, XVI. Jahrgang, No. 10, October, 1885.
16. Verhandlungen der Gesellschaft für Erdkunde zu Berlin, Band XII., Nos. 4, 5, 6, 7.
17. Sechster Jahresbericht der Geographischen Gesellschaft zu Hannover, 1884-'85.

18. Bollettino della Società Geografica Italiana, Ser. II., Vol. X., Novembre, 1885, Anni XIX., Fas. II., Roma.
19. Atti della Società Toscana di Scienze Naturali in Pisa, Memorie, Vol. VI., Fasc. 2, 1885.

Total, 74.

Mr. W. A. Douglass, B.A., read a paper on "Rent—a criticism of Professor Walker's work on that subject."

In this work the Professor explains what he believes to be the correct theory of rent and then criticizes the writings of Carey, Bastiat, Louis-Boileau and George on this subject. He proclaims himself a Ricardian of Ricardians. The general theory of the value of commodities as taught both by Ricardo and Walker teaches that value depends on two conditions—desirability and *scarcity*; but when they treat of land they both introduce a new theory of value, the conditions of which are desirability and *difference*. Why this additional theory is necessary neither explains, nor is such explanation possible, for the general theory, which makes rent or the value of land depend on desirability and scarcity, is quite sufficient. The Ricardian theory assumes that the best lands are first occupied, but as soon as population increases so that resort must be had to inferior lands, then the better lands yield as rent the difference between the productiveness of the superior over the inferior land. While this is true, the growth of land values in cities is due to another cause, viz., the increasing advantage of contiguity giving greater facilities for exchange and subdivision of labour. This force is unnoticed by Walker, and a most astonishing omission made by most writers on this subject is the enormous ground rents of large cities. Most writers confine their attention to rural districts, where the effect of rent as a factor in the distribution of wealth is least manifest. To discuss rent where it amounts to $5 per acre, and not notice it where it amounts to ten thousandfold that sum is one of the most remarkable oversights in the study of Economics.

When explaining the theory of rent Walker points out that while lands may differ much in productiveness, the portion of the product retained by the labourer will be equal on all qualities of land and will be the same as the product on the poorest lands cultivated. If competition be fully active between these locations the above statement may be accepted as correct. Here two considerations may be noticed: First—does not this give the clue to the correct doctrine of

a wage fund? Say lands vary in fertility from 15 bushels upwards, then 15 bushels will be the wages of labour not merely on the free lands, but also on the most productive soils, and rent will take all the product in excess of 15 bushels. Second—Suppose population increases so that society must take in a lower quality of land, say a 12 bushel tract, then wages would fall to 12 bushels while rent will be increased by three bushels. Here we may notice, as pointed out by Ricardo, a movement of antagonism—the reduction of production, labor getting out of that reduced production a reduced proportion while rents increase. And it may be further noticed that increased rents mean not increased wealth but diminished wealth.

After an examination and refutation of the teaching of Bastiat in his Economic Harmonies that rent is payment for service, and after showing that Carey's criticism of the Ricardian theory is founded largely on a misapprehension of that theory, he then proceeds to examine the proposal of George that ground rent should be appropriated by the State. Walker gives his ready concurrence to the proposal of Mill that all future increase of ground rent should go to the State, if it were practicable, but he does not believe that the attempt would pay; but that the State should appropriate present rentals he repudiates as unjust. Here Walker seems to be inconsistent in his teaching. From his exposition of the Ricardian theory we see at once that to allow individuals to appropriate ground rents has the inevitable effect of dividing society into toilers and idlers, imposing the whole toil of the world on one part of the population and allowing the rest to enjoy lives of luxurious idleness; that it establishes an antagonism in society, an increase of population depressing the toilers and enriching the idlers; that it condemns the majority of mankind inevitably to lives of toil and poverty; that it places an everlasting barrier to the progress of a large majority of the race.

Dr. Meredith thought rent was the measure of the difference in productiveness of soils, but a soil near a city produces a greater rent than a soil of the same quality further off; the unearned increment is independent of the owner of the lands; land differs from all other commodities in some respects, and society has a right to modify its tenure; in personalty value depends on the labour put into it, but it is otherwise with land,

Mr. Galbraith said labour is the source of all value, and money is the measure of value; Ricardo's metaphysical distinctions are of no use; in the market natural properties are worth nothing; it is the improvements that give value; the solution of the question as to land and value is to be found in the banking system; our banks convert capital into credit; capital and money are not the same thing.

Mr. Phipps could not see the difference between earning $100 and putting it at interest, and buying $100 worth of land and getting rent for it; it was payment for labour in both cases; he denied the reality of the unearned increment; we must allow men to accumulate property; this right is a security for society; without the desire to accumulate we would be savages.

The discussion was continued by Messrs. Bain, Browning, Marling, and others.

FIFTH MEETING.

The Fifth Meeting was held on Saturday, 19th December, 1885, the President in the chair.

The following list of Donations and Exchanges was read :—

1. Annual Report of the Bureau of Industries, Province of Ontario, for 1884.
2. Boulder Clays, by Dr. G. M. Dawson, Geological Survey of Canada.
3. The Canadian Entomologist for Nov. '85.
4. Monthly Weather Review, Dominion of Canada, for Nov. '85.
5. Science, Dec. 11, '85.
6. Appleton's Literary Bulletin, Vol. IV., No. 6.
7. The Hoosier Naturalist, Vol. I., No. 5, Valparaiso, Indiana, Dec. '85.
8. The West American Scientist, San Diego, California. Nos. 3, 4, 5, 6, 7, 8, 10, Feb.—Oct., '85.
9. The Iowa Historical Record, Vol. I., Nos. 1, 2, 3, Jan.—July, '85.
10. Collections of the Georgia Historical Society, Vols. 2, 3, 4 Savannah, 1842—1878.
11. Proceedings of the Physical Society of London, Vol. VII., Parts 1, 2, July and Oct., 1885.
12. Proceedings of the Royal Physical Society of Edinburgh, Vol. VIII., Part 2, Sessions 1884-85.

13. Proceedings of the Royal Geographical Society for Dec., '85.
14. Scottish Geographical Magazine, for Dec., '85.
    Report of the Council of the Scottish Geographical Society, Sessions 1884-85.
15. Reports of the "Ballad," "Chaucer," and "Early English Text" Societies.
16. Report and Proceedings of the Belfast Natural History and Philosophical Society for Sessions 1884-85.
17. Lectures on the Theory and Practice of Hydro-Mechanics, delivered at the Institution of Civil Engineers, London, Sessions 1884-85.
18. Archivio per l'Antropologia e la Etnologia, Quindicesimo Volume, Fascicolo Secondo, Firenze.
19. Cosmos di Guido Cora, Vol. VIII., Parts VIII., IX., 1884.
20. Electricité: Revue Hebdomadaire for 28 Nov., '85.
21. Naturhistorisches Museum zu Hamburg, Bericht, 1885.
22. Bollettino di Bibliographia e di Storia delle Scienze Matematiche e Fisiche, Tomo XVIII., Gennaio e Febbraio, 1885. Roma.
23. Compte Rendu des Séances de la Commission Centrale de la Société de Géographie, No. 18, Paris, '85.
24. Bulletin du Musée Royal d'Histoire Naturelle de Belgique, Tomes I., II., III., 1882, 1883, 1884-85. Bruxelles.
25. Mittheilungen der Anthropologischen Gesellschaft in Wien, XV., Band 1 Heft. 1885.
26. Catalogue Wisconsin State Historical Society, Vols. 1—6, 1873—1884. Wisconsin Historical Collections, Vol. IX., 1880—82.

Mr. George S. Hodgins was elected a member.

Mr. Wm. Houston, M.A., read a paper on "The Village Community in Modern Politics," of which the following is a summary :—

The term "Village Community" has now amongst writers on political science a well-understood meaning. The institution connoted by it is of very ancient origin, being traceable in its essential features as far back as investigations have yet been carried with anything like definite results. It is also very wide spread, being common to at least all the Aryan peoples. It would have been surprising if a social institution so ubiquitous and persistent had not left numerous traces of its influence on the modern political institutions of even highly civilized Aryan nations, and as a matter of fact it has done so. To call attention to some of the modern "survivals" of the Aryan village community is the purpose of this paper. The proper method of investigation in a matter of this kind would be the inductive one. Existing political institutions, especially such as are of a local character, should be analysed, and the history of their various essential features should be traced back until we arrive at

the most original forms. But as this method cannot advantageously be applied within the limits of a single paper, I must begin at the other end of the series—that is, define the ancient* village community, and briefly point out some modern institutions that are clearly traceable to it.

A few words on the bibliography of this question. From a comparatively early period in the British occupation of India the village community was noticed by the East India Company's officers, but its essential features were not well understood, and this want of perception led to many disastrous blunders in their administration. Sir Henry Maine, one of the most eminent of English publicists and jurists, was the first to discern the real character of the organization of native Indian society. Prior to his Indian experience he had, through the investigations of Nasse and others, become acquainted with the traces left by the village community on the political and social institutions of the Teutonic countries of Europe, including England. With the eye of genius he soon discerned that the Indian "village" and the British and Teutonic "village" were in their essential features identical, and this at once suggested to him that they must have had a common origin. In a series of lectures on "Village Communities East and West," delivered at Oxford in the year 1871, he enunciated his theory and thus gave an entirely new and most fruitful impulse and direction to historical investigation and the science of comparative politics. Since that time the "Aryan village in India and Ceylon"—that is, the modern Aryan village as seen in those countries to-day—has been elaborately described by Sir John Phear. Seebohm, Gomme, Hearn, Coulanges, and others have followed the subject up comparatively and systematically, while various descriptive writers have incidentally thrown much light on the communal institutions of the countries described. The information contributed in the latter way by Mr. Wallace in his account of Russia was peculiarly valuable and timely, for the Russian "mir" delineated in his pages is beyond all question substantially identical with the English "township" and the German "village."

It is not easy to define, or even briefly describe, the "village com-

* The term "ancient" must not be understood absolutely in this connection, for to this day the village community exists in India, and even in some parts of Europe, in exceedingly primitive forms. Indeed the term "primitive" expresses more accurately than "ancient" the idea intended to be conveyed.

munity," for it took widely differing forms in different countries and at different periods in the history of each country. A comparative study of these forms, however, shows that a typical Aryan village is marked by several easily recognized features, of which the following are the most important:—(1) Community of land-holding, (2) customary law, (3) assembly-government in the community, (4) patriarchal authority (*patria potestas*) in the family, and (5) caste. Of these the last two may be passed over with a mere mention, for though they profoundly affect the constitution of modern society even in our own country they do so in ways that are not usually regarded as "political." A "village community," then, may be described as a composite political unit made up of a number of "households," each of which is presided over by a patriarch. The affairs of each household are managed by the household itself under the authority of the *paterfamilias*, no outsider having any right to so much as enter its precincts unbidden. The land included within the village boundaries is divided up amongst the households, each plot being held by the whole household in common, and individual ownership in land being unknown. An additional area of land outside is held by the households in common, no household owning any one portion, and the area being allotted and re-allotted from time to time in accordance with traditional customs, and under the collective authority of the heads of households. All affairs relating to the community as such are transacted under the same authority, for representative government is as absolutely unknown as individual property in land. There are no enacted laws, and no prescribed punishments. Custom is the only law, and assassination and "boycotting" are the only sanctions. If a member of a household resists the patriarchal authority, that authority is left to deal with him. If a member of the community violates its customs, he is put to death when the offence is serious enough, and in other cases is tabooed, or isolated, or "boycotted."

From the institution of the village community thus imperfectly outlined have been developed our modern municipal government, our administration of justice, and our various forms of land tenure. What institutions of a social kind preceded the village community need not concern us in this inquiry. We need not care whether the village was the result of the fissiparous division of a nomadic horde or of the aggregation into a group of a number of households. It is

sufficient for our purpose to know that over Europe and a large part of Asia it was practically universal, and that in India, Russia, the Slavonic portions of Turkey in Europe, and some parts of Germany, it exists to the present day with its essential features well preserved. Even in Great Britain and Ireland some of these features are quite discernible. The folk-moots, allotments and re-allotments of land, commons, and other local institutions and customs in England; community of tenure of land in Scotland; the sept in Ireland, and the gavelkind in Kent are all survivals of the Aryan village community. The keen and persistent desire of the peasant to own a piece of land—the "land-hunger," as it has been well called—is not a desire of modern growth. It is rather a survival from a time when the peasant had a real share in the ownership of the land, when, though there was no part of it which he could claim permanently as his, there was no part of the common area in which he had not as much proprietary interest as his neighbor. Less than two hundred years ago there were large areas of commons scattered over England. Much of this land has been enclosed and handed over to private owners under the authority of Acts of Parliament. It is doubtful whether the people of the various localities, the real owners, were ever reimbursed for their loss; it is quite certain that the sense of their loss has never died out, and that this feeling is strong enough to give effect to the clamour for allotments, facetiously designated as a demand for "three acres and a cow." Even the practice of "boycotting," now so frequently resorted to in Ireland, is not a modern device, but a survival, telling us of a time when the ordinary method of punishing a man for practices obnoxious to his neighbors was to "send him to Coventry."

In the days of Charles I., the village community had more of its featur in a state of sound preservation in England than it has now. Worthy of special notice is the government of local affairs by means of local assemblies of the people. This custom was transplanted to New England by the Puritan exiles, and on the virgin political soil it grew and flourished. The well-known New England "town meeting" is the direct offspring of the Old England folk-moot. In the Puritan colony each little district managed its own local affairs by means of public meetings in which each head of a family had the same authority as every other, and in many of them a portion of the public domain was held in common and occasionally, if not periodi-

cally, re-allotted. In course of time some of the "towns" grew so large as to be unwieldy under the general-assembly system, and administration of town affairs by "select-men" filled up the interval between the yearly meetings of the general assembly. At the time of the Revolution, Boston, with 50,000 of a population, was still an old-fashioned town, the leading spirit in its turbulent *rôle* at that time being "Sam Adams, the man of the Boston town-meeting." The transition from town-meeting to representative municipal government was, with a people remarkable for their ingenuity, natural and obvious, and municipal institutions thus organized spread rapidly over the middle and western states, being carried everywhere in embryo by the migrating New Englander, as the seeds of plants are carried by a variety of unconscious agencies. Nearly half a century ago they came into Canada also, and from that time to the present we have been developing this survival of the Aryan village, seldom taking a thought of the antiquity of its origin. Our public nomination of mayor in the municipal election is a "town-meeting," and our submission of money by-laws to a vote of the taxpayers is a relic of the practice of voting the appropriations for the year in a general assembly of the "town" house-holders.

In other ways modern Canadian institutions have been affected by the village community. The Mennonites who took up their abode a dozen years ago on the Manitoba plains brought with them their primitive village organization, and they have shown themselves reluctant to abandon it. A few years later, when the Manitoba legislature created a system of municipal government for that Province, the Mennonites would have nothing to do with it. Instead of each owner building a homestead on his own farm the dwellings were erected in groups, while the land, owned individually, was nevertheless farmed in common.* During the lifetime of the present generation, if not for a longer period, the Canadian student of comparative politics will be able to investigate the "village community" in a very primitive stage of development without leaving his own country.

When the French colonists settled in Quebec they brought with

* The community system seems to have received a fatal blow through a gross breach of faith on the part of one of the owners, on whose lot several people had built their homesteads. He lately claimed all their houses as his because they were on his land, and whether he succeeds in holding them or not each owner is likely to build hereafter on his own property. While the dishonesty is regrettable the impulse given to individualism is not.

them institutions and practices that were almost certainly an outgrowth of the "village community," modified by feudalism. The seigniories may be specified amongst the former; the practice of grouping their dwellings together on the river banks amongst the latter. I am not aware that community of ownership of land prevailed at any time to a large extent, but traces of it are clearly discernible in the French settlements in the Northwest. The right to cut hay and fuel on land not owned by any one individual was conceded to each member of the little settlement, while its internal affairs were managed to some extent at least on the old community plan. Without raising the question, whether the Metis were justified in their uprisings on the Red River and the Saskatchewan, there can be no doubt that each of these *émeutes* was due largely to the dislike of the simple villagers to the introduction of the square-lot system, and to their dread of interference with the river-front arrangement which suited so well alike their habits of life and their stage of political development.

Mr. VanderSmissen related from Immermann's Oberhof an incident showing the strong tenacity with which men cling to ancient institutions.

Mr. Browning, from his recent observation in the North-West, made some remarks on the ownership of land among the Indians. Not being agricultural, but nomadic, they did not exercise the right of proprietorship of the soil. The Crees were the only exception. He gave an account of the ceremonies he had witnessed at the adoption of an individual from another tribe. He then referred to the change made in Scotland by the expropriation of land by the landlords who from the heads of clans became feudal lords.

Mr. Livingston took exception to some of the statements made by Mr. Houston, and gave some instances that came under his observation of the serious trouble caused to settlers by the enforcement of the land regulations of the North-West.

Mr. Boyle replied to Mr. Livingston's remarks.

Mr. Rouse made enquiry respecting the village community in Russia.

Mr. Houston replied that Russia afforded the most perfect example of the existence of the village community.

Mr. Phipps corroborated Mr. Houston's statement respecting the village communities in Russia. He called attention to the absence of reference to the village communities in the documents of the reigns of Henry I., Stephen, and other early English kings; and made some observations on the changes of the tenure of land in Scotland owing to the rebellion of '45.

SIXTH MEETING.

The Sixth Meeting was held on Saturday, 9th January, 1886, the 2nd Vice-President in the chair.

The following list of Donations and Exchanges was read:

I.—CANADA AND THE UNITED STATES.

1. Le Naturaliste Canadien, Dec., 1885.
2. The Canadian Practitioner, Jan., 1886.
3. Science, Vol. VI., Nos. 150, 151; Vol. VII., No. 152.
4. Transactions of the American Society of Civil Engineers, Nov., 1885.
5. Bulletin of the California Academy of Sciences, Nos. 1, 2, 3.
   Illustrations of the Zygænidæ and Bambycidæ of North America, by Richard H. Stretch, Vol. I., Parts 1—9.
   Four Pamphlets on Early Migration, by Charles Wolcott Brooks, 1876—'84.
   Proceedings of the California Academy of Sciences, 2 Pamphlets, 1880-81.
   Catalogue of the Pacific Coast Fungi, 1880.
6. Magazine of American History, Jan. 7, '86.
7. Johns Hopkins University Circular for December, 1885.
8. The Apparent Position of the Zodiacal Light, by Arthur Searle.
9. American Journal of Science, January, '86.
10. The American Naturalist, January, '86.
11. Essex Institute Historical Collections, Vol. XXII., Nos. 4, 5, 6.
12. Third Annual Report of the Bureau of Ethnology, 1881-82, Washington.
13. Journal of the American Chemical Society, Vol. VII., No. 9, Nov. 1885.
14. Journal of the Franklin Institute, January, 1886.

Total, 26 numbers.

II.—GREAT BRITAIN, IRELAND AND INDIA.

1. The Midland Naturarist, Dec. 1885.
2. Proceedings of the Royal Society, Vol. XXXIX., No. 239.
3. The Scottish Geographical Magazine, Vol. I, Nos. 1—3.
4. Monthly Notices of the Royal Astronomical Society, November, 1885.
5. Transactions of the Institution of the Civil Engineers of Ireland, Vol XV.
6. Transactions of the Institution of Engineers and Shipbuilders of Scotland, 29th Sess., 1885-86.
7. Journal of the Royal Microscopical Society, December, 1885.
8. Journal of the Transactions of the Victoria Institute, Vol. XIX., Part 3.
9. Proceedings of the London Mathematical Society, Nos. 250--252.
10. Proceedings of the Asiatic Society of Bengal, Nos. VI., VII., VIII., June—August, 1885.

    Journal of the Asiatic Society of Bengal, Vol. LIV., Part II., Nos. 1, 2. 1885.

Total, 14 numbers.

III.—FOREIGN.

1. Electricité, Vol. 9e. Nos. 49, 50, 51.
2. Annales de l' Ecole Polytechnique de Delft, 1re et 2me Livraison, 1884-5.
3. Annales des Mines, Tome VIII., Part 4.
4. Archives Néerlandaises des Sciences Exactes et Naturelles. Tome XIX. Liv. 3me. Tome XX., 3me Liv.
5. Bulletino della Sezione Fiorentina della Società Africana d' Italia. Anno I., Fasc. 5.
6. Actos de la Academia Nacional de Ciencias en Córdoba, Tomo V., Enta. 1, 2.
7. Cosmos, Nos. 46, 47, 1885.
8. Monatliche Mittheilungen des Naturwissenschaftlichen Vereins des Regierungsbezirkes Frankfurt an der Oder. 3 Jahrgang, Nos. 1—S. April—Nov., 1885.
9. Verhandlungen des Naturhistorisch-Medicinischen Vereins zu Heidelberg. Band III., Heft 4.
10. Commentari dell ' Ateneo di Brescia per l' Anno 1885.
11. Bollettino della Società Entomologica Italiana, 1883, 1884, 1885, 8 parts.
12. Bulletin de la Société de Geographie, 3e Trimestre, 1885.
13. Archivio di Letteratura Biblica ed Orientale. Anno VII., No. 1—11.
14. Journal des Sociétés Scientifiques. Nos. 50 et 51, 1885.
15. (1) Monatsblätter des Wissenschaftlichen Club in Wien, VII. Jahrgang No. 3.
    (2) Beiträge zur den Monatsblättern des Wissenschaftlichen Club in Wien, 15 Octr., 1885.
16. (1) Zeitschrift des Historischen Vereins für Niedersachsen, 1885.
    (2) Leibnizens Entwürfe zu seinen Annalen von 1691 und 1692.
    (3) Afrika auf der Ebsterfer Weltkarte.
17. Le Syllogue Littéraire Grec de Constantinople.

    Συγγραμμα Περιοδικον. Tomes 19'.

    Παραρτηματα. 3 Nos., *τον* T. 19'.

18. Bulletin du Musée Royal d' Histoire Naturelle de Belgique. Tome IV., No. 1.

19. Mémoires de la Société Nationale des Sciences de Cherbourg, Tome XXIX.

Catalogue 2 Partie, 3 Liv. 57.

Total 97 numbers.

The following were elected members: W. H. C. Kerr, M.A., Wm. H. Knowlton, James Goldie.

Mr. T. Nelson Dale read a Paper on "New England Upper Silurian."

Mr. Dale gave a general account of visits made by him to the well-known localities of Bernardston, Mass., and Littleton, New Hampshire, under the direction of Prof. Raphael Pumpelly of the North Atlantic Division of the U. S. Geological Survey.

At Bernardston, Mass., a bed of an impure crystalline crinoid limestone, associated with magnetite, garnets, chlorite, mica, pyrite and limonite, dips under a thin-bedded quartzite and a garnetiferous mica schist which are unconformably overlaid by the Triassic Sandstone of the Connecticut River Valley. The limestone has generally been regarded as Lower Upper Silurian or Upper Lower Silurian.

At Littleton, N. H., a more or less argillaceous crinoid limestone containing Favosites, Halysites, Pentamerus, etc., and associated with slates, some of which contain Trilobites, overlies a more or less schistose Protogene, and is followed by a metamorphic sandstone.

The fossils at this locality are sufficiently numerous to permit an exact determination of the age of the beds. They have usually been regarded as Lower Helderberg.

Both localities are remarkable for the presence of somewhat recent Silurian rocks associated with rocks or minerals showing a high degree of metamorphism; and it would seem that careful paleontological and stratigraphical investigations at these and similar localities ought to throw light on the age of many rocks which, on account of their crystalline character, have been classified as azoic or placed in an uncertain group at the base of the Lower Silurian.

In answer to an enquiry of Mr. J. H. Hunter, whether any specimens of organisms had been found in the gneissoid rocks of the United States, Mr. Dale replied that he was not

aware of any having been found in gneissoid rocks, but trilobites had been found in mica-schist.

Dr. Ellis made some remarks on the occurrence of beds of iron ore with limestone, and wished to know whether geologists had formed any theory as to the origin of ferruginous deposits.

Mr. Dale stated, that some ferruginous deposits might be direct products of erosion, as in the case of the magnetite which frequently occurs in beach sand in the vicinity of crystalline rocks, but that they were probably more often of a largely chemical origin. Geologists usually concerned themselves more about the chemical questions involved in the formation and alteration of ferruginous deposits than with the physical ones.

In answer to a question from Mr. Boyle, Mr. Dale said he had not found any specimens of crinoids over two inches in length ; the greater number of the specimens were much less. As to the species, it was generally considered that they were Upper Silurian.

Mr. Livingston called attention to the remarkable boulder near Mount Washington.

Mr. Dale said that the size and shape of the boulders would naturally be determined by the joints of the rock from which they originated. He illustrated how the rock would be broken into blocks by an experiment with a box of clay subjected to hydraulic pressure.

The President read the Report of the Committee appointed to revise the Rules and Regulations of the Institute, and gave notice that at a special general meeting to be held on 23rd January, 1886, he would move that the Rules and Regulations be amended in accordance with the Report of the Committee.

SEVENTH MEETING.

The Seventh Meeting was held on 16th January, 1886, the President in the chair.

The following list of Donations and Exchanges was read:

1. The Canadian Record of Science, Vol. II., No. 1.
2. Science, Vol. VII., No. 153, Jan. 8th, '86.
3. Transactions of the New York Academy of Sciences, Vol. III., 1883-'84, Do., Vol V., No. 1, October, 1885.
4. Journal of the Cincinnati Society of Natural History, Vol. VIII., No. 4, Jan., '86.
5. Report of the U. S. Coast and Geodetic Survey for 1884.
6. The Magazine of Western History, Vol. III., Nos. 1 and 3, November, '85, and January, '86.
7. Transactions of the Sanitary Institute of Great Britain, Vol. XI., 1884-'85.
8. Cosmos, No. 48, Dec. 28, '85.
9. Electricité, No. 52, Dec. 26, '85.
10. Bullettino di Bibliografia e di Storia delle Scienze Matematiche e Fisiche, Tomo XVIII., Marzo, 1885.
11. Compte Rendu de la Société de Géographie, Paris, Nos. 19, 20.
12. Journal des Sociétés Scientifiques, No. 52.
13. Bulletin de la Société Géologique de France, 3e Séric, t. xiii., '85, No. 6.
14. Bulletin de la Société Géologique de Normandie, Tome IX., 1882.
15. Mémoires du Comité Géologique, Vol. II., No. 1, St. Petersburg.

Total, 17.

Mr. Arthur M. Stow was elected a member.

Mr. VanderSmissen, on behalf of Professor Campbell of Montreal, read a Paper entitled: "Etruria Capta." The First Part of this Paper has been published in Vol. III., p. 144; the Second Part is being revised by the author, and will appear in a subsequent issue.

After reading the paper and giving a brief resumé of the labours of Corssen, Lanzi, Bréal, Deecke and other leading Etruscologists, Mr. VanderSmissen proceeded to give illustrations of a few sepulchral inscriptions in the Etruscan character,

to show the application of the key and the results produced, dwelling particularly on the translations of a few bilinguals, in which the Etruscan characters are accompanied by Latin ones.

Professor Campbell, however, not content with deciphering 101 brief inscriptions, also applied himself, in the second portion of his paper, to the Eugubine Tables, a document hitherto read as Umbrian, though written in the Etruscan character, and containing over 350 lines. This document was found to contain a long and complicated story of an Etruscan and Umbrian revolt, incorrectly related by Livy in the 36th chapter of book XXXIII. of his history of Rome. The remaining portion of these tables, also read as Umbrian, a dialect closely akin to Latin, but written in plainly legible Latin characters, was placed in the hands of Dr. McNish of Cornwall, whose attainments as a Celtic scholar were well known to the members of the Institute, and will shortly be presented to the world as the *oldest Celtic document* extant, being in a language closely connected with the Gælic. They deal with the same events as the Etruscan portions, and tell the same story from a different standpoint.

Mr. VanderSmissen then gave a brief estimate of the contents of the paper, and expressed strong confidence that Professor Campbell's method would ultimately establish itself as true.

In conclusion, Mr. VanderSmissen announced that Prof. Campbell had succeeded in reading, by the help of the same key, some Celt-Iberian inscriptions in a character which was but a variant of the Etruscan, and which had been sent to him by the Rev. Mr. Webster, of Bechienia, in the Basque country.

He regretted that he (Mr. VanderSmissen) had not been able, on account of his University work, to give the subject that attention its importance demands, but hoped to do so

during the coming vacation and asked the co-operation of such members of the Institute as were interested in the subject.

EIGHTH MEETING.

The Eighth Meeting was held on 23rd January, 1886, being also a special general meeting pursuant to notice, the President in the chair.

The following list of Donations and Exchanges was read :

1. Monthly Weather Review, Dominion of Canada, Dec., 1885.
2. Report of the Committee, House of Commons, Canada, on Geological Surveys.
3. Science, Vol. VII., No. 154, Jan. 15, 1886.
4. Transactions of the New York Academy of Science, Vol. 5, No. 2, Nov. 1885.
5. University of Pennsylvania—Catalogue and Announcements, 1885-'86
6. Bulletin of the American Geographical Society, No. 2, 1885, New York.
7. The Electrician and Electrical Engineer, New York, Vol. V., No. 49, Jan. 1886.
8. Electrical Review, Jan. 23, '86.
9. (1) Proceedings of the New Jersey Historical Society (Second Series), Vol. VIII., 1884-85.
   (2) New Jersey Archives (First Series), Vol. IX.
10. Journal of Speculative Philosophy for July, 1885.
11. West American Scientist, Vol, 1, Nos. 3 and 11.
12. Proceedings of the U. S. Naval Institute, Vol. XI., No. 4. (Annapolis, Md.)
13. The Illustrated Journal of Patented Inventions, Vol. I., Nos. 1—31. Nov. 28, 1884—June 26, 1885. Vol. II., Nos. 32—56, July 3, 1885—Jan. 8, 1886.
14. The Midland Naturalist, Vol. IX., Jan., '86.
15. Trübner's American, European and Oriental Literary Record, Nos. 217, 218.
16. Electricité, Vol. 10, No. 1.
17. Cosmos, No. 49.
18. Bollettino della Società Geografica Italiana, Ser. II., Vol. X., Fascicolo 12.
19. Crónica Cientifica, Barcelona. Añ. VIII., Num. 193.
20. Wochenschrift des Oesterreichischen Ingenieur und Architekten Vereines, XI. Jahrgang, No. 1, Wien.
21. Transactions of the Mathematical Society of Charkoff, 1885, Part I.

Total 78.

The Rules and Regulations, as revised by the special Committee, were then considered seriatim, and adopted as follows, to come into force at the next annual meeting :

REGULATIONS AND BY-LAWS OF THE CANADIAN INSTITUTE,

As amended at the Special General Meeting, January 23rd, 1886.

REGULATIONS.

SECTION I.

INCORPORATION.

The Canadian Institute is established under Royal Charter, granted November 4th, 1851.

SECTION II.

OBJECT.

The object of the Institute is the promotion of Pure and Applied Science.

SECTION III.

CONSTITUTION.

1. The Canadian Institute shall consist of Members and Associates.

2. There shall be three classes of members, *Ordinary*, *Life*, and *Honorary* members.

3. Ordinary members shall be persons whose pursuits or studies are connected with the Arts or Sciences, or who are desirous of forwarding the objects of the Institute.

4. Ordinary members may become life members by compounding their annual subscriptions by the payment of fifty dollars.

5. Honorary members shall be persons of high standing, who are eminent for their scientific attainments.

6. The number of honorary members shall be limited to twenty-five.

7. Associates shall have all the privileges of membership, except the right of voting, or taking part in the proceedings at meetings of the Institute or sections, or of receiving copies of the publications of the Institute.

8. For the promotion of the study of special branches of pure and applied science, the Institute shall be divided into such Sections as the Council shall from time to time determine subject to the subsequent approval of the Institute. Each Section shall frame its own regulations and by-laws subject to the approval of the Council.

9. The officers of the Institute shall be a President, a Vice-President, a Secretary, a Treasurer, an Editor, a Librarian, a Curator, and six members of Council, all of whom shall be elected annually by the members of the Institute.

SECTION IV.

THE ELECTION OF MEMBERS.

1. All persons desirous of being admitted into the Institute as members must be proposed at least one week before their election in accordance with a

form to be obtained from the Secretary, which form must be subscribed by at least two members of the Institute.

3. Honorary members must be recommended by at least three members, who shall certify that the candidate is a person eminent for his attainments in science.

3. Every recommendation of a candidate, as an honorary member, must be delivered to the Secretary, who shall submit the same to the Council for enquiry ; and when the recommendation of such candidate is approved by the Council, it shall be signed by the Chairman, and read at the first following ordinary meeting previous to the ballot being taken.

4. All elections of members shall be by ballot and the proportion of votes requisite for the election of any person shall be at least three-fourths of the ballot.

5. Whenever any person is elected a member, the Secretary shall immediately inform him of the same by letter ; and no person shall be considered a member of any class until he has signified his acquiescence in the election, and paid his first annual subscription.

6. If any complaint is brought against a member, the charge shall be considered by the Council in the first instance, and an opportunity shall be given to the accused to clear himself. If the Council consider it desirable, they shall call a special general meeting, of which, not less than a month's notice shall be given ; and in case two-thirds of the members present at that meeting are of opinion that such member should be expelled, the presiding officer at that meeting shall declare him to be expelled.

SECTION V.

THE ELECTION OF OFFICERS.

1. The President, Vice-President, Treasurer, Secretary, Editor, Curator, Librarian, and six other members of Council shall be elected annually by ballot from amongst the members of the Institute, at the general meeting, on the first Saturday in May, and if that day falls upon a holiday, then upon the following Saturday.

2. Nominations for these offices must be made at the ordinary meeting immediately preceding the annual general meeting, and only those shall be eligible who have been so nominated.

3. Any member nominated to an office and not elected thereto, shall be eligible as a member of the Council.

4. At the annual election the Chairman shall appoint two scrutineers, who shall receive the votes of the members, count them, and report to the presiding officer, who shall declare the result to the members.

5. A separate ballot shall be taken for the President, for the Vice-President, and for each of the other officers, except the Councillors ; and a ballot shall then be taken for the remaining six members of Council.

6. If in any case the votes are equal, the decision shall be by ballot.

7. Each section shall elect its own officers at the meeting of section preceding the annual meeting of the Institute.

8. The new Council shall enter upon their duties on the Saturday following their election.

9. Two Auditors shall be appointed at the ordinary meeting held on the third Saturday in March of each year; one by the members, the other by the Chairman.

SECTION VI.

MEMBERS' SUBSCRIPTIONS.

1. The annual subscription of each member residing in or within ten miles of the city of Toronto, shall be four dollars; and of each member residing elsewhere, two dollars. All subscriptions shall be due in advance on the first day of January, and all new members shall pay *pro rata* in advance until the thirty-first day of December next following the date of their election.

2. Every member shall receive a copy of the transactions and proceedings of the Institute published after his election so long as he shall continue in good standing.

3. Every member and associate shall be considered as belonging to the Institute, and, as such, liable to the payment of his annual subscription, until he has either forfeited his claim or has signified to the Secretary, in writing, his desire to withdraw, when his name shall be erased from the list of members.

4. No member or associate shall be entitled to any of the privileges of the Institute whose subscription shall be twelve months in arrear, and the name of any member whose annual subscriptions are two years in arrear may be erased from the list of members by the Council, and any member whose name is so erased shall cease to be a member of the Institute.

SECTION VII.

THE PRESIDENT, VICE-PRESIDENT, AND CHAIRMEN OF SECTIONS.

1. It shall be the duty of the President to carry into effect the regulations of the Institute. He shall preside at all meetings of the Institute at which he is present, and shall regulate and keep order in the proceedings.

2. In the absence of the President it shall be the duty of the Vice-President to preside at the meetings and regulate the proceedings. But in the absence of the President and Vice-President, the members present may elect one of their number to take the chair at such meeting.

3. The Chairmen of Sections shall preside at the meetings of their respective Sections.

SECTION VIII.

THE TREASURER.

1. The Treasurer shall keep an account of all the moneys of the Institute, and of all dealings therewith.

2. All moneys received for, or on account of the Institute, shall be paid over to the Treasurer, who shall deposit the same in one of the chartered

banks in the city of Toronto to the account and for the use of the Institute, unless otherwise ordered by the Council.

3. No money of the Institute shall be paid out except by order of the Council, and cheques shall be drawn in such manner as the Council shall from time to time direct.

SECTION IX.

THE SECRETARY.

1. The duty of the Secretary shall be to take minutes of all the proceedings of the Institute and of the Council, and enter them in the proper books ; to read at each meeting the minutes of the preceding meeting with a view to their verification, and subject to the direction of the Chairman, to bring before the meeting all business matters according to the order established by the by-law in that behalf. He shall also conduct the correspondence of the Institute.

2. The Secretaries of sections shall perform the functions of Recording and Corresponding Secretaries for their own Sections, unless the Section shall have appointed a Corresponding Secretary, in which case the Secretary of that Section shall perform the duties of Recording Secretary only.

3. The duties of the Assistant Secretary shall be defined from time to time by the Council.

SECTION X.

THE EDITOR.

The Editor shall have charge of the publication of the Proceedings of the Institute, in conjunction with an Editing Committee to be nominated by the Council from among its members at the first meeting thereof after the annual meeting. All papers or abstracts of papers read before the Institute and intended for publication shall be handed to the Editor at the close of the respective meetings at which they were read, or as soon as possible thereafter, and the decision as to the propriety or expediency of publishing any paper shall rest with the Editing Committee.

SECTION XI.

THE LIBRARIAN.

The Librarian shall have the care of all books, plans, drawings, and other documents, and shall have the general superintendence of the same, under the direction of the Council. He shall keep a list of all donations to the library in the order in which they are received, with the names of the donors.

SECTION XII.

THE CURATOR.

1. The Curator shall have charge of the museum, and of all models and specimens deposited therein, and shall have the general superintendence of the same, under the direction of the Council ; and he shall keep a list of all contributions with the names of the contributors.

2. The Assistant Curators shall be appointed by the Sections, and shall assist the Curator in the care of the museum and the specimens contained in it, so far as relates to their own departments.

SECTION XIII.

THE COUNCIL.

1. The Council shall consist of the President, Vice-President, the Chairmen of Sections, the Secretary and Secretaries of Sections, the Treasurer, the Editor, the Librarian, the Curator, and six other members, who shall have the direction and management of the affairs of the Institute.

2. The Council shall meet at least once a month during the session, or oftener if necessary, to conduct the business of the Institute.

3. Any two members of the Council may, by letter to the Secretary, require a special meeting to be called, and two days' notice of such meeting must be given to each member of the Council.

4. At any meeting of the Council five members thereof shall constitute a a quorum.

5. The Council shall have power to appoint Committees for special purposes, and such Committees shall report to the Council.

6. The Council shall present at the annual general meeting a report on the state of the Institute, in which shall be given an abstract of all the proceedings, and of the receipts and expenditures during the year ending March 31st next before such meeting.

7. In the event of any office becoming vacant before the annual general meeting, by death or otherwise, the Council shall have power to fill the vacancy; and in the event of any officer being unable to perform his duties, the Council shall have power to relieve him from the performance of such duties for the time being, and to appoint another member to act in his stead.

SECTION XIV.

THE AUDITORS.

The Auditors shall audit the accounts of the Institute for the year ending on March 31st next after their appointment, and they shall present their report to the Council at least one week before the annual general meeting.

SECTION XV.

THE ORDINARY MEETINGS.

1. The ordinary meetings of Sections shall take place at such times as may be agreed upon by the sections, subject to the approval of the Council.

2. The meetings of the Institute shall be at such times as the Council shall direct.

SECTION XVI.

SPECIAL GENERAL MEETING.

1. The Council may at any time call a special general meeting of the Institute on six days' notice in writing thereof to city members, which notice may be given either personally or transmitted by post to the last known address of the member.

2. It shall be the duty of the Council to call a special general meeting of the Institute at any time between October 1st and May 1st on being required in writing by at least twelve members to do so.

SECTION XVII.

THE ANNUAL GENERAL MEETING.

The annual general meeting of the Institute shall be held on the first Saturday in May of each year, at twenty o'clock (eight o'clock in the evening), for the purpose of receiving and considering the Report of the Council on the state of the Institute, and electing the officers and members of the Council for the ensuing year.

SECTION XVIII.

BRANCH SOCIETIES.

Members of the Institute residing at a distance of ten miles from the city of Toronto shall have power to form themselves into branch societies for the purpose of holding meetings and discussing subjects proper to the objects of the Institute, and such branch societies shall be governed by such by-laws as the Council may from time to time enact for such purposes.

SECTION XIX.

ALTERING THE REGULATIONS.

A motion to alter any by-law or regulation of the Institute may be made at the annual general meeting or a special general meeting called for the purpose, and not otherwise; and notice of the proposed alteration shall have been given at two consecutive ordinary meetings prior thereto.

SECTION XX.

THE PROPERTY OF THE INSTITUTE.

1. The whole of the property and effects of the Institute, of what kind soever, shall be vested in the Council of the Institute and subject to its control.

2. Every paper, map, or drawing, which may be presented to the Institute, shall be considered the property thereof, unless there shall have been some arrangement to the contrary, and the Council may publish the same in connection with their transactions, or, with the consent of the author, in any other form. No communication made to the Institute shall be published by any other person but the author without the previous consent of the Council.

3. Every paper presented to the Institute for publication shall be referred to an Editing Committee appointed by the Council. Notices or abstracts of all papers not published in full shall be prepared by the Editing Committee.

4. No papers, plans, maps, or other property belonging to the Institute, shall be taken out of the rooms thereof without the consent of the Council; but every member shall have a right to inspect the same at such hours as the Council may appoint.

SECTION XXI.

DONATIONS AND BEQUESTS.

1. The names of all persons who shall contribute to the library, or the general fund of the Institute, shall be read at the annual general meeting, and such persons shall be recorded as benefactors in the published transactions of the Institute.

2. Every person desirous of bequeathing to the Institute any manuscripts, books, maps, plans, drawings, instruments, geological, botanical, or other specimens, natural curiosities, works of art or manufacture, or personal property, is requested to make use of the following form in his will, viz.:—"I give and bequeath to the CANADIAN INSTITUTE, incorporated by Royal Charter, November 4th, 1851 (*here enumerate and particularize the effects or property intended to be bequeathed*), and I hereby declare that the receipt of the Treasurer of the said Institute for the time being shall be an effectual discharge to my executors for the said legacy."

BY-LAW.

At the ordinary meetings of the Institute, the following order of business shall be observed as closely as circumstances will admit:—

1. The minutes of the previous meeting shall be read and confirmed, and signed by the Chairman; and no entry shall be considered valid until this is done.
2. Nomination of candidates for admission.
3. Business arising out of the minutes.
4. Communications received since last meeting.
5. Donations received.
6. Communications from the Council.
7. New business.
8. Election of Candidates. A ballot shall be taken for the entire body of candidates proposed for admission; if one-fourth or more black balls appear, the ballot shall be taken for each individually; and any candidate shall be rejected against whom appear a number of black balls equal to one-fourth of the number of members voting.
9. The reading of papers.

Dr. Joseph Workman read a paper by Dr. Giuseppe Seppilli of Imola, Italy, on "Hypnotism." This paper has appeared in "The Alienist" for July, 1886.

Mr. VanderSmissen related various instances of hypnotism that had come under his observation, several of which were identical with those mentioned in the paper. The patients imagined themselves in the state suggested by the operator, and acted in character just as if the ideas were brought by the senses from without. Of the reality of the states thus induced there could be no doubt. He enquired whether it would cause death if it were suggested to the mind of the patient that prussic acid had been administered to him.

Dr. Workman thought that it would not. Other cases of hypnotism were related by members similar to those referred to in the paper.

Dr. Cassidy called attention to the curious phenomena exhibited by the Jumpers among the French Canadians, and related a case where a medical gentleman had tested a party of French Canadian "jumpers" in the State of Maine, from which it appeared that it was not necessary to be *en rapport* with the persons, but that simple suggestion on the part of any one was sufficient to produce the phenomena.

Mr. Rouse referred to the marks produced on the body by the action of the mind, as in the case of pregnant women, on whom the figures of fruit, as strawberries, of animals, as the face of a cat, &c., appear. Other instances were mentioned by some of the members. The stigmata on ecstatics were referred to in this connection, and instances given similar to those in the case of Francis of Assisi, Clara di Pugny, Louise Lateau and others, in ancient and modern times, the reality of which could not be doubted. They were supposed to be caused by the person being placed in a state of intense expectancy, the attention being strongly concentrated on some part of the bodily organization.

NINTH MEETING.

The Ninth Meeting was held on 30th January, 1886, the President in the chair.

Messrs. Notman and Bain were appointed representatives of the Institute on the Council of the Toronto Industrial Exhibition Association.

The following list of Donations and Exchanges was read :

1. Le Naturaliste Canadien, Janvier, 1886.
2. Science, Jan. 22, '86.
3. Transactions of the American Institute of Mining Engineers, Vol. XIII., February, 1884 to June, 1885.

4. Contributions from the E. M. Museum of Geology and Archæology of Princeton College, N. J., No. 1, Sept., 1878.
   Bulletin No. 3, May, 1883, Vol. I., No. 1, July, 1884.
   3rd and 4th Annual Reports, June, 1884 and June, 1885.
5. The American Naturalist, Feb. 1886.
6. Monthly Notices of the Royal Astronomical Society, Vol. XLVI., No. 2, Dec., '85.
7. Proceedings of the Royal Geographical Society, Vol. VIII., No. 1, Jan., '86.
8. Scottish Geographical Magazine, Vol. II., No. 1.
9. Historisches Jahrbuch der Görres-Gesellschaft, VII. Band, 1 Heft. München, 1886.
10. Electricité, 9 et 16 Janvier, 1886.
11. Wochenschrift des Oesterreichischen Ingenieur und Architekten-Vereines 8 Januar, '86.
12. Journal des Sociétés Scientifiques, 13 Janvier, 1886.
13. Archivio di Letteratura Biblica ed Orientale, Anno VII., No. 12, Dec., 1885.
14. Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Sitzungen vom 20, 27 Juni und 18 Juli, 1885.
15. Verhandlungen der Gesellschaft für Erdkunde zu Berlin, Band XII. Nos. 8, 9, 10.
16. Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, XVI. Jahrgang, Nr 11, Nov., 1885.
17. Transactions and Proceedings of the Technical Society of the Pacific Coast, Vols. I. and II., 1884 and 1885—14 Nos.

Total 39.

Mr. S. C. Duncan-Clark was elected a member.

Mr. J. Davies Barnett read a paper on "The Mechanical Value and Treatment of Hard and Soft Coal."

To-day wood fuel is so scarce, and in quality so inferior, that it cannot even in Canada be extensively used for industrial purposes. In the year 1851 experiments by the Pennsylvania Central Railway on the evaporation of water showed that one ton of best soft coal (Pittsburg) was only equal to $1\frac{3}{4}$ cords of best hard wood; but afterwards, as the use of coal became better understood, the accepted relative proportion was 2 to 1; and, of wood of the general average quality now attainable, it will take $2\frac{1}{4}$, and even $2\frac{1}{2}$, cords to do the work of one ton of good soft coal, if the coal is properly handled.

Our native peat—bulky and loose in texture—is out of the competition as a solid fuel; due, primarily, to the short season in which it can be cured naturally, or to the extensive plant required, if cured artificially.

Possessing—as peat does—so large a proportion of volatile combustible matter, it will in Canada eventually be used by conversion on the spot into gaseous fuel, conveyed through pipes, and consumed where required in some form of regenerative furnace, or exploded in the cylinder of a gas-engine.

Therefore, the manufacturer's choice in fuel, this year, is between the two coals—anthracite (hard) and bituminous (soft); and the first question that arises is. What is their relative value as fuels, say for making steam? and does the larger percentage of carbon in hard coal justify its current high reputation and the top market price?

Our answer is no! certainly not; and the general opinion (sometimes strongly stated), that pound for pound hard coal is the better fuel, is due to a crude comparison of elementary assays, rather than to practical tests carried out under every-day working conditions.

Analysis shows as high as 94 per cent. of fixed carbon in American hard coal, in comparison with 70 to 80 per cent. of fixed and volatile carbon in soft coal; and, as the oxidation of this carbon is the main source of all furnace heat, there would seem to be a good basis of fact to support the common opinion.

Such inference, however, neglects to take into consideration the physical (molecular) condition of the coal.

Heat being vibration, the more dense and compact the atoms of the fuel, the greater is the percentage of the whole amount expended (commercially wasted) in raising the remainder to that state of freedom in which it can swing freely, or, in other words, the utilizable calorific value of carbon per unit weight varies inversely as its density. This holds good for every form of carbon, so that, as for instance in the diamond, the known condition in which molecular compression is greatest, its calorific value is very low.

Another reason why coal should not be valued and purchased on analysis as we would purchase metallic ore, is, that the law of union under which the various and variable substances forming coal originally united, and now separate—or recombine in distillation on the fire-grate,—is not seen clearly enough to permit of its power being gauged by simple analysis; and there are experiments that lead to the conclusion that C and H united as in some coals have higher calorific powers than when uncombined. This is so difficult to conceive—seeing that in combination they possess no apparent explosive power—that Messrs Kestner and Meunier's experiments,

extending from 1868 to 1871, with their uniform results proving either higher powers in combination, or the incorrectness of the generally accepted formula, are not accepted as reliable.

For information and figures, giving the results of continued experiments, enabling comparison to be made between the evaporative duty of Pennsylvania hard and soft coals, our thanks are due to T. N. Ely, General Superintendent Motive Power, Pennsylvania Railway, and to F. E. Wootten, General Manager of Philadelphia and Reading Railway.

On the Pennsylvania Railway, for *local* passenger trains, it takes to haul one coach per mile, 10.44 lbs. of soft coal and 13.85 lbs. of hard coal, being an increased consumption of 30 per cent. of hard coal, to do exactly the same work.

On *through* passenger runs, per car mile, 8.64 lbs. of soft and 11.55 lbs. of hard, an increase in consumption of 29 per cent. These figures are reliable—under the given conditions, and with ordinary proportions of fire-grate—being averages covering four months' work, and on the through runs, with five engines burning each class of fuel.

If, however, the boiler is arranged so as to give several hundred per cent. increase in fire-grate area, the actual difference in duty performed has been reduced by Mr. Wootten to nine-tenths of a pound of water evaporated per pound of fuel, hard coal recording 6.1 lbs., and soft coal 7 lbs. Thus, it requires almost 15 per cent. more hard coal to do the same evaporative work, even with this excessive increase in grate surface.

It should not, in our consideration, be forgotten, that the first cost of the locomotive type of boiler to consume hard coal is increased from 10 to 25 per cent, dependent on the excess of grate area allowed; and its total lease of life, when using hard coal, is variously stated at from eight-tenths to six-tenths of that of a boiler using soft coal, but in all other respects doing similar daily work.

No doubt there are boilers in which hard coal will give a higher evaporative duty than in locomotive practice, as also will soft coal; but the circumstances controlling the test must always be fully considered in making any direct comparison of figures, and, if possible, the conditions made equal and similar, otherwise it is possible for peat, used under favouring circumstances, to give a higher evaporative result per pound than coal used under unfavourable conditions.

In the careful tests of native coal, made for the English Government by Sir H. de la Beche and Dr. (now Sir) Lyon Playfair, there were eleven examples of soft coal that gave higher evaporative results than the single good anthracite tested, although this particular hard coal, in addition to having the highest per cent. of carbon, had also 3.46 per cent of hydrogen, being about three-fourths of the average amount of hydrogen in the various soft coals tested. This was very much in its favour, as the calorific value of hydrogen—by weight—is more than four times that of carbon; however, its specific gravity was 1.375, being heavier than any other coal, native or foreign, then tested; and, it is, we think, only in the fact that its particles were so closely packed together, that the explanation of its comparatively low power can be found. A general average, taken over a large number of samples, shows American anthracites to weigh 400 lbs. per cubic yard heavier than British anthracites.

Outside of metallurgical operations, hard coal for manufacturing purposes has apparently nothing but its cleanliness to recommend it; and, presumably, it is for this benefit that the Toronto Water Works pays with satisfaction fuel bills that are unduly heavy.

Having thus narrowed our subject down to the consideration of the exclusive use of bituminous coal, we will briefly review the four different practices (which include the main modern theories) covering its economical combustion, using the names of the several advocates: Crampton, Mallett, Howden and Siemens, to identify their systems.

1st. CRAMPTON.—For the easier understanding of this system, we will premise by stating that the known *forms* in which fuel exists are three:—First, solid, either as lumps or dust; second, fluid, as oils, either flowing or in the form of spray; and, third, gaseous, either simple or mixed, say with oxygen, so as to be more or less explosive.

When fuel is in the lump form, oxygen can come into contact with but a very limited portion, viz.: the outside, or surface of each piece. This, when the lumps are large, results in slow combustion, and the passage of a wasteful excess of cooling air through the furnace; hence, careful stokers (and careless ones, when in competition,) break the pieces small before putting coal on the fire, and for the same reason that we use chips in starting a fire, and choose small wood when a quick fire is required for an early breakfast. But if (as in the Crampton method) the coal is reduced to dust, then steadily and

uniformly fed into the furnace, by blast, with the air supply limited to little more than that absolutely required for chemical combination —say 13 lbs. of air per pound of solid fuel—perfect and smokeless combustion and an intense heat are attained, with the additional advantage that a refuse fuel of low price can be utilized, with corresponding economy.

Even with this form of fuel, the oxygen has but surface contact with the dust, as with the lumps; but the surface, per unit weight, is increased so enormously that the speed of burning closely approaches that of explosion.

An increased evaporation of 22 per cent. has been obtained by the use of pulverized coal; in part due to the very small excess of air requiring to be warmed, and in part to the higher temperatures attained. Not only for the evaporation of water is high temperature an advantage, but, as the speed of heat transmission through metal plates increases (approximately) as the difference between the squares of the different temperatures on the fire and water sides of the plates, the speedier the transfer, the less is the amount of absorbent surface to be provided. Therefore, the dust-fuel system permits the construction of a smaller boiler to develop the same horse-power, but it has the disadvantage of requiring mechanical stoking and mechanical disintegration of fuel. Mr. T Crampton very early took a long step in advance of current ideas and methods in the use of soft coal, and the limited adoption of his patent in daily practice is probably due to the little time so busy and successful an engineer could devote to its advocacy; and also to the fact that the working plant required was somewhat elaborate for small horse-powers, and for large establishments, a further step in advance of his practice was soon afterwards taken by Dr. W. Siemens, who converted coal waste, shales of low quality, and other low priced fuels at once into the gaseous form (carbonic oxide), using this gas—which, although not luminous, possesses large calorific power—as fuel for all industrial purposes. The gaseous form of fuel infinitely increases the possible surface and closeness of mechanical contact between fuel and oxygen before combustion, and readily permits the absolute control of the amount of air supplied.

2nd. MALLETT.—Before more fully describing the recent "Siemens" developments, E. J. Mallett's theories and arguments deserve consid-

eration, although comparative figures from practice are not attainable. Making a clear distinction between combustion of carbon (coke) and the formation of flame, he emphasizes the statement that heat is increased, while smoke and light are lessened, by the burning of any flame in an atmosphere at high mountain elevations, or—what amounts to the same thing—with air at less than normal barometric pressure, and asserts that one of the first requirements for perfect combustion is air at low tension; and to readily attain it at ordinary levels, he dispenses with chimney draught, and substitutes fan-suction at the forward end of the furnace or boiler.

Through tubes that form the furnace grate-bars air, partially warmed in its passage, is drawn by the fan-suction into the combustion chamber, in front of a perforated fire-brick wall (or septum) dividing the combustion chamber from the furnace proper; and large amounts of this warmed air are permitted to enter the chamber after each supply of fresh coal, the volatile matter of which at once undergoes rapid distillation on touching the incandescent coke, with the natural effect of cooling down the fire; but to avoid any additional cooling, and consequent formation of smoke, the supply of air usually flowing into the ash-pit, and thence through the fire-grate, is completely cut off; one lever, controlling the upper and lower damper slides, being so connected, that when a liberal supply of air is passing through the hollow grate-bars and diffusing itself forward of the septum wall, the ash-pit is sealed air-tight; the amounts of air delivered being steadily varied, and eventually reversed in relative quantity, as the lever is drawn over, fully opening the ash-pit damper when there is nothing but coke to burn on the grate.

Analogy, drawn from the Bunsen burner, is used as an argument for dividing and distributing the incoming warm air at numerous points; the openings in the septum wall being so arranged as to give at once the most complete intermixture of the liberated hydrogen and hydrocarbon gases, with the warmed air entering through the numerous hollow grate-bars.

The theory of his feedwater heater, or "Athermous Superheater"—although only indirectly connected with combustion—is of interest, and is based on Tyndal's statement, that dry air freely permits through itself the passage of radiant heat without loss of heat by absorption; whereas saturated or even moist air is a rapid and effective absorbent of radiant heat. Conversely, the radiating power of

all gases—and this heat radiation is what we desire to utilize commercially—is increased proportionately to its absorbent power; therefore, to take all possible calorific value from the escaping gases, they are after leaving the boiler flues, moistened down to dew point by hot water-spray through a rose-jet, and also by admixture with the exhaust steam from the fan-engine, and then passed over a sufficient number of coils of metal pipe (heat absorbents) through which the feed water is moving on its way to the boiler.

It is claimed that the products of combustion, when thus saturated, part with their heat so completely that a portion of the feed water is converted into steam.

Mr. Mallett claims that he has arranged his system to meet locomotive requirements, the exhaust steam from the main cylinders, instead of educing blast, being used partially to warm fresh air for coach ventilation, and partially condensed in the tender tank, thus warming the feed water. We regret that experimental results cannot be given showing the practical value of this novel attempt at economical and smokeless combustion of soft coal.

3rd. HOWDEN.—His method, as illustrated in a boiler of the single return-flue type, has the back head-sheet boxed up, forming a reservoir, through which all the air required is forced (under compression) by a fan, and it is warmed in its course past the head-sheet and around the smoke-flues that traverse this chamber from smoke-box to chimney. From this chamber the air exit is by passages leading both to the upper part of the furnace and to the ash-pit, with their actual amount of opening controlled and constantly varied by the stoker, through the movement of levers on the outside, thus giving him the independent control of the amount of compressed air supplied, either above the solid fuel or below it; air-tight doors preventing any escape from the inside except by way of the chimney, which need be but of short length.

Opening the furnace door to admit fresh coal automatically closes all these plenum air passages, thus preventing the excessive inflow of cold air, so destructive to seams and joints, when (as in those otherwise most successful crafts, the British torpedo boats,) there is air pressure in the closed boiler room. It may be well here to remark that all attempts at forced combustion are with the object of burning

a greater number of pounds of fuel per square foot of grate; thus economizing space and developing the greatest horse-power from the smallest expenditure of capital in purchase of boiler.

Large consumptions per square foot of grate have not, until recently, proved economical in coal per horse-power developed, due principally to the choked air supply, natural furnace draught being unable to draw in sufficient to burn all the carbonic oxide evolved from the deep mass of hot carbon without the temperature in the chimney being so high as to waste the heat by throwing it out into the atmosphere unabsorbed, or a chimney of excessive elevation and cost was used.

Mr. Howden recently, before the Institute of Naval Architects, claimed to have secured per pound of Scotch coal an evaporation of 10 pounds of water (from 212°), consuming 30 pounds of coal per square foot of grate per hour. This, using a compound cylindered engine, developing a horse-power per 20 pounds of steam, gives 15 horse-power per square foot of grate, with but a fraction over two pounds of coal per one horse-power—a good showing.

4th. SIEMENS.—His system is by the partial combustion of cheap coal in detached converters (with insufficient supply of oxygen) to change this solid fuel into gaseous fuel (C_2O); conveying it thence by pipes to the different furnaces and boilers throughout the workshops or town, where combustion is completed, and it is burnt from oxide to acid (CO) by the addition of one more part of oxygen. The air ducts in his regenerative furnace, being so arranged that the heat otherwise wasted is utilized in raising the temperature of the inflowing air, before it reaches the mixing chamber, almost up to igniting point, and the absence of open grate, and control over the comparatively small amount of air required, results in the highest working temperature yet attained. When solid fuel is used and intense temperatures are required, comparatively small grates are necessary; therefore, in the earlier Siemens practice, it was inferred that in burning gaseous fuel (C_2O) a small combining chamber (with close walls and low roof) was also necessary, this having the natural result of bringing the flame into close contact with the walls, as well as with the material to be heated.

Later experiments have proved the complete fallacy of this idea, Mr. F. Siemens having discovered that by simple radiation from

flame, and convection of the completely burnt products of combustion, the most intense temperatures can be transferred in all manufacturing processes, with surprising economy in fuel, with increased length of life in furnace, and in metallurgy and glass-making, &c., with a greater percentage of finished product per unit of crude material used.

This commercial success is obtained by making the combustion chamber or furnace so very large that the flame cannot touch either walls or material to be heated, and thus its activity is not quenched when but partial combustion has taken place, as is the case if it touches any solid substance, whatever be the temperature of that substance.

This is a complete reversal of the old-fashioned and still prevalent idea that, for instance, a boiler should be set as close to the fire as possible, so that the flame may inpinge directly on the evaporating surface, or on the material to be heated.

Mr. Siemens last year, at the Chester meeting of the Iron and Steel Institute, said: "The interruption of the process of combustion by "the interposition of solid bodies always tends to injure, or even "destroy them.

"But, besides the circumstance that solid bodies are injured by "flame, it can be easily shown that when flame is brought into con- "tact with any solid body, it is more or less quenched according to "the substance, size, and temperature of the body. A very simple "experiment in proof of this, and one which is familiar to most "people, is the following:—Take any ordinary illuminating gas "flame, such, for instance, as a bat's wing, and place a glass rod or "tube into the middle of it; the flame will immediately burn dull, "and a large quantity of lamp-black will be deposited on the piece "of glass. This action is most marked when the rod is cold, but "takes place, though in a less degree, at any temperature, for the "reason that the material to be heated is necessarily always at a "lower temperature than the flame, also owing to the disturbance "in the combustion caused by contact of the solid substance with "the flame."

His experiments "establish the following important fact, namely, "that a good flame, or, in other words, perfect combustion, can only "take place in an open space, or in one of sufficiently large size to "allow the gases to burn out of contact with solid material."

In conclusion, the author would note that these four methods, considered together, show that the problem of bituminous coal combustion is receiving its modern solution by the admission of air forward or above the grate; under control as to the amount delivered, to suit the needs of such an ever varying fuel as crude soft coal proves to be.

Thus, instead of combustion being confined to the fire-grate, or being a factor of grate surface, or style or proportion of grate (as implied in many patented and peddled nostrums for so-called "smoke-burning") a most effective use can be made of solid mineral fuel, as shown by Mr. Crampton, without *any* grate, or, as established by Mr. Siemens, if gaseous fuel is used, with the only grate required miles away from the combustion chamber.

It is now clearly recognized that coal is not a simple substance to be treated in a simple manner, and capable of but one or two combinations with oxygen, but that the air needed for its complete combustion is to be supplied in the ever varying proportions respectively demanded when hydrogen, the various hydro-carbons, carbonic oxide, and fixed carbon (coke) are being burnt; and that the air must be supplied at the different localities in the furnace or combustion chamber, where these products of the raw fuel are most effectively oxidized, and, other things being equal, the warmer the air supplied and the less in quantity it exceeds the minimum amount required, and the more freedom given for the flame to burn out free of all contact with solids, the higher will be the resultant industrial economy, and the less shall we be troubled with the smoke nuisance.

A brief discussion followed, in which Mr. Alan Macdougall made some remarks on the value of such knowledge from a sanitary point of view, as the incomplete combustion of coal as shown by the cloud of smoke that hangs over some of our towns, did not add to the public health.

The President, after expressing his interest in the subject, asked on what the statement was based that hydrogen and carbon combined as in coal seemed to have a higher calorific power than when uncombined.

In reply to Mr. Macdougall, Mr. Barnett pointed out how much easier it was to avoid smoke and soot from stationary

boilers as used in towns than it was to get rid of the same nuisances in railway locomotive practice, the rapid combustion and large consumption per square foot of grate surface, amounting in some cases to as high as 80 or 90 lbs. per hour, made perfect combustion in the small fire-box of a locomotive a difficult end to obtain. However, the locomotive fire-boxes of Messrs. Wootten & Strong, with their, comparatively speaking, enormous grate surfaces and slow combustion, were a step in the right direction, time being necessary for perfect combination in combustion.

In reply to Dr. Ellis, he said the full details and results of Messrs. Kestner & Meunier's extended experiments that seem to contradict Dulong's formula, were to be found in the "Bulletin de la Société Industrielle de Mulhouse," 1868, 1869, 1871; in "The Annales de Chimie," 4th series XXX., 5th series II., XXI., 6th series II.; and in the "Comptes Rendus de l' Académie," 2me Série, 1869, and they were understood to have been carried out in the direct production of steam in a boiler and not in minute laboratory experiments.

M. L. Gruner had endeavoured to explain away the apparent anomaly between formula and experiment, and a partial translation and condensation of his paper from the French had been reproduced by R. P. Rothwell in the "Engineering and Mining Journal" of 1874.

Mr. M. L. Rouse then read a paper on "The Analogy between Consonants and Musical Instruments," of which the following is an abstract:

Taking pains to distinguish between a truly aspirated consonant and a consonant with *h* prefixed to it (the suffixing of *h* producing no blending at all), he showed that aspiration always consisted in bringing the lower organ of speech (tongue or lower lip) into the right position for uttering the simple sound, and then flattening it a little and breathing over it. And by this definition he added two aspirated consonants to the already received category—namely, the Continental rolling *r* and the Irish *l*, which is heard when a native Irishman utters the words *milk*, *help*, *hill*, &c., and is also prevalent among the French. Eliminating, then, all compound sounds, he

arrived at the following table of consonants, which, save in the above respects, differs little from Morris's :—

	FLAT.		SHARP.		NASAL.
	UNASPIRATED.	ASPIRATED.	UNASPIRATED.	ASPIRATED.	
MUTES:					
LABIALS	b	v	p	f	m
DENTALS	d	'd	t	't	n
BACK-PALATALS OR GUTTURALS ..	g	'g	k	'k	ng
PHARYNGEAL	h				
SPIRANTS:					
LIQUIDS	r	'r	l	'l	
SIBILANTS	z	'z	s	's	

NOTE.—'d = *th* in *thine*; 't = *th* in *thin*; 'g = *g* in *lough* (Ir.); 'k = *ch* in *ich* (Ger.);* 'r = Continental rolling *r*; 'l = Irish *l* heard in *milk*, *help*, &c.; 'z = *z* in *azure*; 's = *s* in *shine*; ng = *ng* in *ring*.

He then compared with this the natural classification of musical instruments, which he claimed to be as follows :

	FULL-TONED.	SLENDER-TONED.	REED.
BEATEN:			
WOOD	WOOD UPON WOOD, *Xylophone.*	METAL UPON WOOD, *Saw.*	WOODEN, *Clarionet*, &c.
METAL	WOOD UPON METAL, *Harmonicon.*	METAL UPON METAL, *Bells*, *Musical Box*, &c.	METAL, *Harmonium*, &c.
STRING	HAND UPON STRING, *Harp*, *Guitar*, &c.	STRING UPON STRING, *Violin*, &c.	STRING, *Æolian Harp.*
MEMBRANE	*Drum.*		
BLOWN:			
WOOD	BLOWN FROM THE SIDE, *Flute*, &c.	BLOWN FROM THE TOP, *Flageolet.*	
METAL	BLOWN FROM THE SIDE, *Organ.*	BLOWN FROM THE TOP, *Trumpet*, &c.	

NOTE.—The aspiration of consonants seems to correspond in its prolonging effect to the use of the pedal or swell.

* In my lecture I classed the sound of *ch* in the Scotch *loch* with its sound in the German *ich*. But the criticism of Mr. VanderSmissen led me to see that in the former word it has the same pronunciation as the *gh* in *lough*, and, furthermore, that after the four deeper vowels, long and short, the flatter guttural is always given, while after the four higher ones the sharper guttural (cf.: *buch G.*, *loch G.*, *loch S.*, *dach G.*, *urgh! E.*, *pech G.*, *bücher G.*, *ich G.*).

A complete set of organ reed pipes would be a more typical metal reed instrument than a harmonium, since it would contain the beating reed, which strikes the sides of the apertures, whereas the harmonium contains the free reed which vibrates clear of the sides.

The best proof that an aspirated consonant does not consist of *h* prefixed to a plain one, is the fact that *h* may be actually uttered directly before an aspirated consonant. Thus, to impose silence, we may either exclaim gently *sh!* or more vigorously *hsh!* and in the game of draughts, or checkers, we may blow upon a removed piece with *f!* or with *hf!* our action, indeed, being called *huffing*.

TENTH MEETING.

The Tenth Meeting was held on 6th February, 1886 the President in the chair.

The following list of Donations and Exchanges was read:

1. The Canadian Practitioner, February, 1886.
2. The Canadian Entomologist, Dec., 1885.
3. The Electrical Review, Jan. 30 and Feb. 6, '86.
4. American Journal of Science, February, '86.
5. Johns Hopkins University Circular, Jan. '86.
6. Science, Vol. VII., No. 156.
7. Proceedings of the American Antiquarian Society, Vol. IV., Part I., N.S.
8. Mineral Resources of the United States, 1883-84.
9. Transactions of the New York Academy of Sciences, Vol. V., No. 3, Dec. '85.
10. Journal of the Franklin Institute, Feb. '86.
11. Electrician and Electrical Engineer, Feb. '86.
12. The American Catholic Quarterly Review, Jan. '86.
13. Sandberg on Rail-Joints and Steel Rails.
14. Proceedings of the Physical Society of London, Vol. VII., Part III., Jan. 1886.
15. Transactions and Proceedings of the Botanical Society of Edinburgh, Vol. XV., Part II.
16. Palestine Exploration Fund—Quarterly Statement, Jan. '86.
17. Illustrated Journal of Patented Inventions, No. 57, Jan. 22, 1886.
18. Trübner's American, European and Oriental Literary Record, Nos. 217, 218.
19. Imperial Federation, Vol. I., No. 1, Jan. 1, '86.

20. Cosmos, 18 Janvier, 1886.
21. Compte Rendu des Séances de la Commission Centrale de la Société de Géographie, No. 1, '86.
22. Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils, Août, 1885.
23. Bulletin de la Société Royale de Botanique de Belgique, Tome 24me Fascicule 2me, 1885.
24. Cronica Cientifica—Barcelona. Año IX., Num. 194.
25. Monatsblätter des Wissenschaftlichen Club in Wien, VII. Jahrgang, Nr. 4.
26. Wochenschrift des œsterreichischen Ingenieurs und Architekten-Vereines XI. Jahrgang Nr. 3.
27. Journal des Sociétés Scientifiques, 6 et 20 Janvier, 1886.
28. Jahrbücher der K. K. Central-Anstalt für Meteorologie und Erdmagnetismus 1884, N. F. XXI. Band, Wien.
29. Atti del Museo Civico di Storia Naturale di Trieste, Vol. VII., '84.

Total 31.

Mr. R. F. Stupart read the following paper on "The Eskimo of Stupart Bay:"

My paper this evening treats more especially of the Eskimo and their mode of life as observed by myself during a twelve months residence among them on the shores of Hudson's Straits, but, in addition, I have thought it advisable to give a brief outline of a portion of the cruise of the steamship *Neptune* in the summer of 1884, and also of a boat voyage made by myself and three men from Prince of Wales' Sound to Fort Chimo during the latter part of last August. The Canadian Hudson's Bay Expedition of 1884 and 1885 was, as you are all aware, sent out to report on the feasibility of establishing a commercial route to Europe from the Canadian North-West *via* Hudson's Straits. Six observing stations were established at different points along the shores of the Straits, the duties of observers being to watch the movements of the ice and tidal currents and to take meteorological observations. In addition to this, the ordinary work, I made a series of magnetic observations; I had two observatories, one in which I made absolute determinations of the declination, force, &c., while in the other were placed the differential instruments, which were read every four hours, and during days of much disturbance every five minutes. The discussion of results here obtained is, of course, foreign to my subject to-night.

The date of the earliest mention of the Eskimo is about 990 A.D., when some Icelanders exploring Greenland came across men with skin-boats. The Eskimo have therefore inhabited the Western

Continent for at least 1000 years. It has generally been supposed that they originally came across Behring Straits from Asia, but the race is one of which very little is known. Although scanty in numbers, they wander over a larger extent of territory than do any other people. They alone among savage races occupy both the old and the new world; they inhabit the shores of the Arctic Sea from Siberia to Greenland and Labrador, and throughout this vast extent of country the language, appearance and occupation of the natives are very similar. Of course their habits have at some points been modified by contact with the whites; it could scarcely be expected that the untutored savages who inhabit the shores of Hudson's Straits and the Arctic Coast line should entirely resemble the more favored portions of their race, who have been, to a certain extent, educated by the Moravian brethren on the Labrador coast or by the Danish missionaries in Greenland.

In appearance the Eskimo somewhat resemble the Chinese and Tartars; they are generally small in stature, the average height of a man being about 5 ft. 1 in. or 2 in., but I have seen a few who were as much as 5 ft. 9 in. or 10 in. Their features are broad and flat, the hair is very coarse, invariably jet-black and quite straight; few of them have much hair on the face, but there are exceptions. In color they are about as dark as the Indians, but the layer of dirt and oil, which as a rule covers both face and body, makes it rather hard to determine the exact shade.

Sir John Lubbock, in a treatise on the Eskimo, says that the language is akin to the North American Indian in structure. This may be the case, but the two languages are certainly different in sound. The opportunities afforded me of learning the language were very limited, as I and my men were dumped down at the post among the natives but a very short time after the interpreter was taken aboard the ship at Nachvach, on the north coast of Labrador. During the short time I spent with him I obtained the Eskimo words corresponding to certain English sentences, which I thought might come in useful; for instance, "What is the name of this?"—"shoo-now-nah," "Bring me some fox-skins,"—"Terry-gyn-yer-mik-p-u-mo-ouma." By means of the former I was enabled to obtain from the natives themselves the names of a large number of things of which I made a vocabulary, and by first guessing at and afterwards asking the meaning of the sentences in most common use among

them I was able, after a few months, to understand them and also to make myself understood.

The costume of an Eskimo usually consists of two suits, the inner always of deer-skin, with the hair next the body, and outer deer-skin in winter, and seal-skin in summer, with the hair out. The men and women dress much alike—a coat, trousers and seal-skin boots; the coat, or "Koalatuck," as they call it, is put on over the head; that of a man has a hood attached large enough to cover the head, if necessary, whilst the hood attached to the woman's coat does double duty, being used both as a covering for the head and as a place in which to carry the babies. The woman's coat has also a long narrow tail behind which ordinarily just touches the ground but is sometimes looped up.

Among the Eskimo, ornaments are not numerous, neither is there a great variety; the outer coat of both men and women occasionally has a border of white bear-skin, but is more often devoid of ornamentation. Sometimes the inner coat, which in the igloos and in warm dry weather is often alone worn, is trimmed with walrus teeth, which are sewn on, an inch or so apart, round the lower edge, or it is trimmed with a fringe made of deer-skin. Glass beads can be obtained from the Hudson's Bay Company at Ungava, and some of the women belonging to the richer Eskimo families are the happy possessors of necklaces and of strings of colored beads which are sewn on to the front part of the inner coat; other favorite ornaments are common metal spoons, with the handles cut off; these sometimes, to the number of seven or eight, are attached vertically at equal distances to the front part of the coat. Women are often, but not invariably, tattooed; a few lines are made on chin and forehead, the former diverging from the lower lip, the latter from the upper part of the nose.

The *Neptune* sailed from Halifax on July the 22nd, 1884. On her way north she touched at the Moravian Mission Station, Nain, on the coast of Labrador. Before the anchor was down we were boarded by the missionaries and many Eskimo. The former were, I fancy, somewhat disappointed at finding that we were not the mail steamer, as they were expecting news from home, but the natives were evidently much pleased at our arrival, and examined the steamer from stem to stern with delighted curiosity. The Eskimo population of Nain is about 200; they live in about 45 log and mud huts, which

are clustered together on a small plateau near the mission buildings. Most of the people are small in stature, and my impression is they were quite as dirty as the completely uncivilized people I afterwards met to the northward, but it may be that a month later I was more accustomed to seeing dirty people. Our ship remained at Nain for a whole day, and as I spent the greater part of the time ashore, I was able to fully inspect the station and also to form some idea of the work performed by these missionary traders of the North. The natives living here are like all other residents of the Labrador coast, generally employed in trapping, hunting and fishing; all the furs, skins and oil they obtain they bring to the missionaries, who, in return, supply them with ammunition, tobacco, and a limited quantity of flour and pork. Attached to the station is a school-house, and be it said to the credit of the missionaries, almost all the natives of sufficient age can read and write in their own language. There is also a chapel, in which service is held every evening. The choir is composed of the families of the missionaries and of the natives, and is assisted by an old-fashioned organ and by eight or ten violins played by music-loving Eskimos. Although the sincerity of the evangelizing efforts of these Moravians has often been called in question, I think that any one witnessing one of the services in the quaint old chapel at Nain will confess that a good work is being done. The gardens are a most pleasing feature of the place; potatoes, turnips, lettuce, spinach and onions are grown, but require an immense amount of attention, as they all occasionally require to be artificially protected from frost.

On August 1st we touched at the Hudson Bay Station, Nachvach, 90 miles south of Cape Chudleigh. Here we obtained an interpreter, who subsequently proved of great value, when we got among the natives on the shores of the Straits. August 5th—We anchored in a little harbour just inside Cape Chudleigh, the Commander of the expedition having determined to here establish an observing station. Codfish were so abundant at this place that we actually, in a very short time, were tired hauling them into the boat. There was an Eskimo family living at a distance of 8 or 10 miles from where the ship was anchored, but I did not see them. Those of the expedition who did pay them a visit describe the tent and its occupants as being villainously dirty, and all seem to have considered it advisable not to venture too close. We left the harbour, called Port Burwell after

Mr. Burwell, the officer in charge, on August 8th, and steamed northward across the Straits. A little snow fell that evening. August 9th.—It was blowing too hard to effect a landing on Resolution Island, so in the afternoon we stood off shore hoping for a fair day on the morrow. The fates were, however, against us. Sunday, Aug. 10th.—At early morning it was blowing a gale from the eastward, and before noon the wind chopped round and blew still harder from the west, and during the remainder of the day we were lying too and making no headway. On Aug. 11th we passed through many miles of loose ice, but none of it was of sufficient size to seriously impede our progress. Late in the afternoon we entered a small inlet in the large Upper Savage Island, where it was decided to establish another station, the officer in charge being Mr. W. A. Ashe, of Quebec. We had scarcely entered the inlet when an Eskimo put out to us in a kyak. He told us, by means of the interpreter, that there were several families camping near by; they had shot two reindeer that day, and their headquarters were near an American trading station, which we knew existed some 30 miles to the westward. On the following day we were visited by about a dozen of the natives, who walked off to us on the ice which had closed in round us with the flood-tide. Some few of them could speak a little English, and possessed a few articles of European clothing. However, from what I saw of them, I should judge that, morally speaking, up to that time they had not benefited by their contact with the whites. Aug. 16th.—Early in the afternoon we left Ashe Inlet in a snowstorm, and steamed slowly south. About 6 p.m. we passed an enormous berg, probably from Fox Channel; it shewed about 50 feet out of water and was fully a quarter of a mile in length. At dark the engines were stopped, and we lay to until daylight, when we again started. At about 10 o'clock we entered a field of loose ice which extended almost to the coast; many walrus were seen playing about among the blocks of ice. Shortly before 1 o'clock we neared a long rocky point, and Lieut. Gordon proposed building my observatory on it if he could find anchorage in the bay beyond. Viewed from the ship the site certainly did not look inviting, but before long we were anchored in a small bay, open only to the S.E., from the end of which a valley, which at places looked green, extended far back into the country, bounded on either side by high rocky hills. After dinner I went ashore with my men

to have a look around. I found a stream of good water and a first-rate site for a house, while, from the top of the rocks, a good view of the Straits could be obtained. We also found traces of reindeer, foxes and ptarmigan. On returning to my boat I found Lieut. Gordon, the officers of the ship and most of the men were ashore. Before long we saw a group of Eskimos, principally women, accompanied by dogs, approaching us over the brow of a hill; they were shouting "Chimo, Chimo," and were evidently very anxious to trade with us. They looked very good-natured and very dirty, and called "tobaccomik, tobaccomik." On obtaining some black tobacco and matches they howled with delight and hugged it. In a short time our interpreter, Lane, who had been down the coast in his kyak, put in an appearance and explained to the people that we were going to build a house; when they heard this they threw up their hands and fairly shrieked with delight.

During the stay of the *Neptune* at my station, which was from Sunday till Friday, the Eskimos were continually loitering about. There were at this time four families living in tents about two miles distant to the westward and several more families still further away. Sunrise each morning brought the majority of them to the place where our men were building the house; they generally had some small articles for trade, such as sealskin mittens and boots, for which they almost invariably wanted tobacco. Scarcely ever did they offer to assist in carrying up the material for the house or the coal, and if by chance any of them did lend a hand, they expected to be well paid with tobacco and matches. The sealskin tents (called by them "too-picks,") in which these people live from about the middle of May to the beginning of November, vary from about twelve to twenty feet in length; they are spread on a ridge and are further supported by several upright and slanting poles; the latter have, as a rule, been obtained from a long distance to the southward. I do not think any wood large enough for tent-poles can be obtained within 250 miles of Prince of Wales' Sound. The skins of which the tents are formed are those of the large harp-seal; the hair is scraped off, and they are stretched out in the sun by means of pegs driven into the ground. The beds are ordinarily laid in the inner end of the tent, but sometimes when there are many occupants also extend round the sides. A layer of dry moss is first spread on the ground and over this are spread deerskins and sealskins, which have been softened by working

them with the hands and teeth. The Eskimo of Hudson Straits seem to have no method of tanning skins.

The ship left us Aug. 22nd, and we all settled down to work getting things into shape, I and my assistant, Mr. Bennett, adjusting the instruments, the men making the house as snug and comfortable as circumstances would admit of. During the latter part of August and early part of September the weather was generally unsettled, with a preponderance of easterly winds and a good deal of light snow. Aug. 23rd and 25th were the only really warm pleasant days we had; on these days there was bright sunshine, and the temperature rose to between 45° and 50°, but clouds of mosquitoes ("Kitorraya," the natives call them) rather interfered with the enjoyment of the fair weather. Until after the 6th of Sept. there was a good deal of drift ice off the coast, and whenever the wind was from the S. E. our little bay was quite blocked up with it. Almost every day we were visited by a large number of women and children, who continued bringing all sorts of things to trade for tobacco, but we saw but little of the men, who were generally out hunting in their kyaks.

On Sept. 23rd the *Neptune* returned from her trip across Hudson Bay. She remained a day and a half, and during the time she lay at anchor every man, woman and child who could possibly get there was either loitering about near the house or hovering round the ship in kyaks, calling out for tobacco and matches. From the time the ship left us, on the 24th Sept., until about the middle of November, we were not much troubled by the natives. They were still living in their toopicks, and I fancy that almost all of them having obtained a fair amount of tobacco from the men on board the ship were contented to leave us in peace for a time. On Oct. 24th the temperature fell to zero, and the Bay and Straits as far as I could see were frozen over.

Without seals and deer, the Eskimo could not exist. Their food is seal's meat and venison, both generally eaten raw but occasionally cooked; their dress is of the skins of seals and deer; their habitation is for at least a portion of the year formed of sealskin, and their boats are of the same material.

The kyak is a most ingenious contrivance, and, I believe, peculiar to the Eskimo. A framework of small wood is formed, from 15 to 20 feet long, about 18 inches broad in the middle, tapering to both ends, and not over a foot in depth; the whole is covered with seal-

skin with the exception of a space in the centre just large enough for a man to sit in. As to stability it would compare favourably with a small Indian birch-bark canoe. It is propelled by a double-bladed paddle, in fact in much the same manner as a Rob Roy canoe. I have often read that the Eskimo can, if capsized, right his kyak again; I have never seen it done, nor have I ever come across anyone who has seen it. Perhaps this skilful feat has been forgotten. I certainly think it would require an immense amount of practice, and I can scarcely imagine anyone, unless by accident, taking a bath in water of temperature near the freezing point. The "umiak," or woman's boat, is much larger than the kyak, and has a flat bottom. It is made of slender sticks fastened together with whalebone and covered over with seal-skins. It will sometimes hold as many as twenty or thirty people, is propelled by rudely made oars, and is steered with a rudder.

During November it became evident, from the number of new faces we saw, that the natives from other parts of the coast were congregating in our neighborhood. About the middle of the month my two men paid a visit to the encampment, and found that instead of five scattered tents there were about ten snow igloos, all close together. As each igloo is generally inhabited by from ten to twelve people, this meant a population of over a hundred. In building their snow igloos the Eskimos take advantage of the fact that, owing to the intense cold, with no thaws and continual drifting, the snow becomes quite hard and compact and can be cut into blocks and slabs. The igloos are generally built on the shore, not far from high water mark; a tolerably level spot where the snow is, say, about a foot and a half deep, is chosen. The builder first marks out a circle of about twelve feet in diameter; he then goes to work with a long knife, called by the Hudson Bay Co. a snow-knife, and hollows out the circle, cutting the snow into blocks about a foot square or of a rectangular shape of say 1 × 1·5 feet, and from 4 to 6 inches thick. With the blocks thus obtained, together with others cut near by, a circular wall is built by putting one block on top of another. As the construction proceeds the wall is made to gradually curve inward until finally an almost perfect dome is formed of about 12 feet diameter and 8 feet high in the centre. The door, a hole about 2 ft. broad and 3 in height, always faces the southward. The inner half of the igloo is built up with blocks of snow to the height of about 2½

feet, and on the raised part is spread a lot of dry moss and sea-weed to form the beds. Two smaller igloos are built to the south of that in which the people live and do double duty as porches and kennels for the dogs; there is also generally a small igloo built with an opening into the porch, which is used as a storehouse for any surplus supply of meat they happen to have. The number of people inhabiting an igloo varies from about 8 to 14; it ordinarily comprises an elderly man—the head of the family—and his wife and one or two married sons with their wives and children. It seemed to me that the boys far exceeded the girls in numbers, but of this I cannot be certain.

The worldly possessions owned in common by the members of a family are not numerous. They ordinarily consist of a tent for summer use, a few small tin-pails, used for melting ice during the winter, one or more lamps, according to the number of women in the tent each grown-up woman having a lamp, a few stone dishes and pots, and some skins used as bed-covering. Each individual, as a rule, has two suits of clothing; a man generally but not invariably owns a kyak, a muzzle-loading gun, obtained in trade with the Hudson Bay Co., together with caps, powder and bullets, knives and a spear, a lance-head with a long coil of walrus-line and a bladder used as a float for the harpoon-line, when a seal or walrus is struck. A woman has a semi-circular knife used for scraping skins, a few needles, some sinew for thread, a bone thimble, and, if lucky, some ornaments in the shape of beads. Belonging to each family is generally a team of from five to ten dogs and two sleighs, called by them commatiks, one of which, about 8 feet long, is used with all the dogs when moving their quarters, and the other, just large enough for one man, is drawn by two dogs and is used for hunting on the ice. The dogs are generally a trifle smaller in size than our English setter and in color vary almost from black to a dirty yellow; they have sharp pointed snouts and bushy tails which curl over the back; they are vicious and savage but, I think, great cowards. The Eskimo would be lost without dogs, all travelling is done by means of them, and they are good scavengers. An igloo and its vicinity is always filthily dirty, but were it not for the dogs it would be ten times worse.

The men spend the greater part of their time hunting. In summer they sleep but little; in winter they often hunt during the short period of daylight, but they sleep a great deal. On the women

devolve the cares of the household, they make all the clothes and boots, melt ice over their lamps and do whatever little cooking there is to be done. They all go in for some amusements, a sort of foot-ball is played on the ice; wrestling is a favourite amusement with the men. The children romp and play about, in fact have games very similar to those played by white children. It is quite marvellous the amount of cold these people can endure, they are inured to it from infancy. Many and many a time I have known women spend a whole day loitering about near the house with the temperature 10 and 20 below zero, their necks uncovered, nothing on their heads, and stark naked babies sprawling half out of the mother's hoods; how the children stand it I cannot tell, but that the poor little youngsters do feel the cold I am convinced, as they often cry most piteously. Both men and women sometimes are cold; they would often stand at my door and beg for admission saying they were cold. E-ke is their word for cold.

The marriage laws are very simple, in fact as far as I could learn the woman, without form or ceremony, takes up her abode in the igloo of her intended. Neither are the funeral obsequies elaborate, the body being carried to a distance from the tents and covered with stones. On top of the grave are placed the man's hunting implements together with a cup and a knife. This would seem to imply that they have some idea of a future state; but what their religion, if any, really is, I was unable either to discover from the natives or to learn from the Hudson's Bay Company, men who have lived among them for years.

Two days after Christmas I paid a visit to the Eskimo igloos; I and one of my men started at seven o'clock in the morning, long before daylight, and walked across the ice, following the path beaten by the natives in their daily visits to the house; the temperature was 23° below zero, and it was blowing fresh and drifting in our faces. After having walked about two miles we met two Eskimos; one of them, an old man named Pugweek, put his hand over my cheek, giving me to understand that it was freezing. In about a quarter of an hour we arrived at the snow houses, all of which were quite new, and removed about half a mile from those the natives occupied during the early part of the month. Let me describe some of the people. I first visited Pugweek's residence; stooping down and entering almost on hands and knees I found myself in a passage about twelve

feet long, dogs were lying and running about in all directions and until quieted by their master seemed rather disposed to resent my intrusion. Having passed through the passage, I crawled through another hole and found myself in the dwelling of and among an Eskimo family. The stench was frightful. Cries of "Chimo," intermingled with those of "tobaccomik," greeted my entrance. On the right of the raised portion of the house squatted Pugweek's wife. She might have had on more clothing, but I presume she had not yet made her morning toilet. She was very ugly, astonishingly dirty, and had no teeth. I gave her half a plug of tobacco, for which she said Ne-cook-a-mik, and immediately asked for matches—"matchemik." Pugweek's sister, Polin-a-chuor, was squatting close by; she too set up a howl for tobacco and I gave her a piece. She proved the most inveterate beggar and greatest nuisance among the women. Children of all sizes were lying on the bed covered up with dirty skins, they too asked for tobacco, but did not get any.

I afterwards discovered in a very practical way that Pugweek was a great thief. I also discovered that about 1860 he had taken part in the massacre of a boat's crew. The Hudson's Bay Co.'s ship "Kitty" was wrecked near Cape Wolfstenholme; out of a crew of about seventeen, ten were killed by the Eskimo while endeavoring to land from the wreck, the remainder, escaping down the coast in a boat, were massacred while asleep by the Eskimo of Prince of Wales' Sound. Two others of the murderers besides Pugweek were my near neighbors, Cowjut and Ne-bo-cart. These men are not permitted to visit the Hudson's Bay post at Ungava.

The next igloo I went into was that belonging to Cowk-to-wayo, a quiet old man who had welcomed us when the steamer first arrived; we all then thought that he was a chief among his people, but I subsequently discovered that there is no chief; all members of a family to a limited degree owe obedience to the head of that family, but as far as I could learn no common chief is recognized by different families; the most successful hunters are as a rule the men who are most respected.

Cowk-to-wayo's igloo was very like that of Pugweek. The old man was sitting next to his wife, a very talkative little woman, who evidently thought that the one thing worth living for was smoking, and further that the whites having been sent to Hudson Straits to keep the Innuit (Eskimo) supplied with tobacco, it was my bounden duty to

see that she was never in want of it. A son, Kish-a-watch-Kia, and his wife Poon-elly and several young children, besides two fairly good-looking daughters, aged 14 or 16, were living with the old man. I gave each a pipeful of tobacco. Poon-elly's baby, which was sprawling over its mother's shoulder, began to cry, and, I suppose by way of a treat, the mother took the short clay pipe from her own mouth and placed it in her baby's. I thought the poor little thing would have choked, but have no doubt that being now a year older, it can duly appreciate a whiff of tobacco smoke.

I visited all the igloos in turn, those of Cowjut, Padliat, Neecook, Owbrook, Ne-bo-cart, Eat-wor-buckeye, Atchick, and several others; last of all I paid a visit to the igloo of U-a-luck, a man whom I always called and considered to be my special friend. U-a-luck is a mighty hunter, very good looking and well built; height 5 feet, 7½ inches; very broad in the chest and a perfect Hercules as regards strength. From the very first he evinced a desire to imitate the whites (Cublunac) in every way possible. He tried to master English and learned many words. I have no doubt but that when he next visits Fort Chimo he will say, please—give—me—a—pipe, and receiving it, will say, thank-ou. U-a-luck's wife, Chi-u-cudelow, is a good-natured looking middle-aged woman; she has two children by her present husband and two by a former. U-a-luck also has a boy by a former wife. His mother and grandmother, together with a second wife and two children, complete the family. I was informed at Ungava that in the winter of 1883 Ualuck, after a visit to the post, when gone about twelve miles on his homeward journey, had found that his grandmother was a great inconvenience and straightway left her out in the snow. The Hudson's Bay Chief was informed of this and sent after Mr. Ualuck, telling him that he must take care of the old lady. In the spring Ualuck was the happy possessor of three shirts, a blue, a grey, and a white, all of different lengths; he generally wore these over all, the longest one underneath, by which means he could show a portion of each; later on he had five shirts and his costume then became ludicrous in the extreme.

Having completed my round of visits, Ualuck hitched up his dogs and drove me home, accompanied by half the population. Arrived at my shanty they all seemed to think that, they having entertained me in their houses, I ought to return the compliment, but I failed to see it in the same light as they.

In the beginning of February the Eskimo again moved their dwellings, Ualuck, Owbrook and Cowjut building close to my house, and the others at points not far distant. About the middle of the month three heavily laden commatiks arrived from about 150 miles, to the westward, the people wishing to trade. I told them to go to Ungava as I had but little powder and tobacco; they refused, however, to go, preferring rather to take small prices, and five temporary igloos were in the course of an hour erected close to the observatory. They remained five days and then departed.

During the winter I occasionally went seal hunting with the natives. We used to start out about nine in the morning with a commatik and five or six men. It was very cold work sitting round a space of open water watching for the seals, the temperature perhaps 25° below zero. With my little Ballard rifle I could often pick off a seal at two or three hundred yards; their guns were only good at a very short range, and they thought my breech-loading rifle a marvellous machine.

As the spring advanced, seals and walrus became scarce, and by the beginning of April many of the people began to show signs of hunger and came begging food from me.

On April 11th the first bird, a bunting, appeared. On April 12th Ualuck, Owbrook and Annoushook left to hunt deer; in nine days they returned with three carcases. A few days afterwards they again went away and, in a fortnight's hunting, secured six deer. During May many families were thoroughly famine-stricken. On May 18th a man named Narluck tried to break open the storehouse; failing in that he began rolling away a barrel of pork which had been buried in the snow outside the house. Unfortunately for him one of our regular observations was always taken at 3 a.m., and one of my men on going out discovered what was taking place. We gave the man a thrashing, and I told him that if he tried to break my storehouse-lock again I would shoot him. He gave but little trouble after this, but always looked ripe for mischief. About this time, also, a woman and a boy arrived from the West; they could scarcely crawl along on account of weakness from starvation. They reported that out of seven in their igloo five had died of starvation. Our neighbors happened to have some venison, and the poor wanderers immediately began feasting. Early on the following morning, May 24th, I think it was, a man came to tell me that the boy was pu-une-i-acput, which

means "no good." I went over to the igloo and found that the youngster had, after weeks of starvation, eaten enough for two or three boys; he died a few minutes after I arrived. No one seemed to care; another boy took the body on his back, carried it back about a quarter of a mile, put it down and covered it up with stones.

Towards the end of May, at a distance of about two miles from my house, was a snow igloo in which resided an old man and his wife, a son and his wife, a sister and three children. This was the poorest family I ever knew; their worldly possessions consisted of the clothes they wore, a rusty gun—half the barrel had been cut off—only a few charges of powder and shot, two tin-pails, one of which had a hole in it, and a few dirty deer-skins for bedding. They literally had nothing to eat. On May 19th the young man and his wife were out on some rocks on a shoal about three miles out in the Straits, gathering sea-weed, which they often eat when food is scarce; it was low water at the time, and a large block of ice which had been left high and dry by the tide fell on them. The woman was crushed to pieces and the man fearfully bruised. I heard of the accident, and with one of my men and some of the women from the neighborhood, went to the scene of the disaster; the man was moaning piteously, and lying just where he had been thrown down. The tide was rising, and now partially covered the remains of the woman. Some women and children were sitting about wondering, I presume, what ought to be done, but doing nothing. I put the invalid on a sleigh and told some of the girls to pull him to his igloo while I went home for some bandages. Off they started in one direction, I in another, old women accompanying me. When about a quarter of a mile apart I heard the girls calling, and leaving the sleigh on which the man was lying moaning in agony, they came leisurely towards us; it turned out they wanted a pinch of snuff from one of the older women, who had a good supply. This showed me how devoid these people are of all sense of feeling for the misfortunes and suffering of their neighbors.

Sixteen deaths occurred among our neighbors during the spring, and I believe that fully thirteen were caused by starvation.

By the second week in June we had fully 150 natives living within half a mile of the house; they bothered us very much; they insisted on peering in at the windows; it was very annoying having half a dozen dusky faces at each window. We had long since been short of

black tobacco—the natives had none and were longing for a smoke. We could not leave the house without being assailed with cries for tobacco and questions as to when the steamer would arrive. Polulick is the Eskimo word for steamer. Not being able to obtain tobacco they would beg for the ash out of our pipes; this they used as snuff, which they consider the next best thing to tobacco for smoking.

The summer wore on. I had expected the steamer about July 10th; by 15th she might have forced a passage, but the ice did not really move until 18th. July passed and no steamer. By August 4th there was scarcely a piece of ice visible—all seemed clear. I discussed the pros and cons of the question with my assistant and the men, and we unanimously concluded that should relief not arrive by August 21st we would start for Ungava in the boat. It would have been impossible to have remained another winter. Very little provisions and no fuel was left. The winter might set in in September, and as I could not be certain that the Hudson Bay officers at Ungava could keep four men for a whole year, time had to be allowed for a boat voyage to Nain, on the Labrador Coast. We of course inferred that the steamer had come to grief and had perhaps been wrecked.

During my stay on the shore of the Straits I saw many beautiful Auroras, which in nearly all cases were accompanied by great magnetic disturbances. The mean temperature of the year was 12.5; that of January was 23° below zero, and of July 43° above; the lowest temperature registered during January was 35° below zero, and the highest 5° below. The daily range of temperature was at all times small, but more especially in the winter months. The mean temperature for February was, compared with other winter months, very mild, probably unusually mild, the mean temperature being but 3° below zero; the same month in Toronto the mean temperature was the lowest, but one, that had occurred in forty-five years. Scattered drift ice was plentiful in the Straits until the end of the first week in September, 1884; from that until the end of October we saw a few "bergs," but no field ice. On the 24th October the Straits froze over, and few days after that date navigation would have been well nigh impracticable. On the bays and inlets of the sea, ice formed to a thickness of 5½ feet. Until after July 18 last summer we saw scarcely any signs of water in the Straits, but by August 4th the ice had almost all disappeared. We crossed the ice in the bay on July

26th, when it was all honeycombed and in a rotten condition; it went out with the ebb-tide on the morning of July 28th. The most severe storm we experienced occurred on March 21st, the temperature being 20° below zero, and the wind blowing at an average rate of 62 miles per hour, with squalls of over a hundred.

BOAT VOYAGE TO UNGAVA.

Friday, August 21st.—Left station at 4.30 a.m. No wind; rowed all day, course S. by W.; failed to make the land on other side of Bay; lay out all night; calm water.

Saturday, August 22nd.—Started to row again at 8 a.m.; occasionally light air from N. E. and E.; took many hours to recover ground lost by drifting last night; at 6.30 p.m., got into cove where I hope shall be comfortable till morning; not sheltered from E. and N.; heavy surf on rocks.

Sunday, August 23rd.—We lay quiet last night, and this morning, as the wind was unfavourable for rounding far-off point, I contented myself with bringing my boat to an inlet where she would be safe, storm as it may. We are now lying between precipitous cliffs, and within 100 yards of a waterfall of certainly 400 feet, and I think more, in height. At entrance of inlet I estimated the cliffs to be about 2000 feet. The wind keeps easterly and is fresh, threatening rain; weather cold and raw; I intend making a push to-morrow at daybreak.

Monday, August 24th.—Went out this morning but found the wind strong and dead ahead, so put back. I sprained my foot badly this afternoon; any one may imagine my present frame of mind; I am chilled through and through; weather is cold and a drizzling rain is falling; my foot tortures me; four days out and only progressed about 30 miles; quite 250 miles to go.

Tuesday, August 25th.—The easterly wind died out this morning, leaving a heavy sea; started with a light N. W. wind and a terrible jumble of a sea, which made two men sick. About 3 p.m. the wind increased to a fresh breeze, and having come some 15 miles I am now anchored for night in a little cove and under a cliff of nearly 1500 feet; by swell that is rolling in I judge that it is blowing almost a gale outside; the clouds are drifting fast from the N. W.; weather very cold.

Wednesday, August 26th, (noted some days after).—Left anchorage at daylight. When we got clear of cove and bay, found it to be blowing half a gale from N.N.W., and heavy sea running. Kept her full and by until about 7 o'clock in order to round a headland ; got very wet ; sheet in hand ; man bailing all the time ; sometimes had to luff to squalls ; 7 to 8.30 wind on quarter ; now thought we were clear of large bay and course would be about S.S.W. ½ W. down Ungava Bay shore, so kept her away almost dead before it. After about an hour's run it began to dawn upon me that I was running into another long bay as faintly through the mist I could see land abeam on port side, and at times thought I could discern it ahead many miles distant. Thinking it better to be on the safe side I determined to round the Point to E.N.E., and again hauled my wind, laying up for a small island off Point. What a sail that was, 8 miles, close-hauled, a very strong breeze and heavy sea ; the water poured in. I had to keep a man bailing all the time ; everything was soaking wet in no time. Near the Point wind and tide made a tremendous sea, so heavy, indeed, that for some time after passing the Point I was afraid of keeping away for fear of being swamped. We now had the wind almost dead aft, and until about 4 p.m., and made good way. From 4 to about 6.30 it was abeam and blowing a moderate gale ; we fairly hummed along and shipped lots of water. I thanked my stars I had obtained a new mast ; the old one would not have stood with half the wind. Anchored for night in a cove ; landed and tried to dry some of the things. The two men slept ashore, Bennet and I on board ; about 3 a.m. boat grounded, luckily no rocks ; at this place managed to make a fire of moss and cooked some Johnson's fluid beef ; this hot drink went well after the thorough soaking we had got.

Thursday, August 27th.—Started again when boat floated at 5 a.m. ; wind moderate from N.W. ; had made good about 10 miles when fell calm. 9 a.m—Passed some Eskimo tents, three men came out in kyaks and wanted to barter for powder and tobacco ; they said in going by commotik to where we had come from we would have to sleep two nights. We rowed until late in afternoon and then obtained a good harbour, anchoring behind an island in a perfectly sheltered spot. Waters in these parts alive with seals and porpoises ; saw one immense walrus ; I had a shot at him, and hit him hard, but did not kill him.

Friday, August 28th.—We grounded last night again for about two hours; tide like a mill-stream. Started at 5 a.m.; tide coming in; foolishly did not keep near shore and got into current; took two hours going less than a mile, sail set, wind fresh and fair, three men rowing; wind moderately fresh and fair all day; made run of, I suppose, 40 miles, but by dark had failed to find harbour; had to anchor in an exposed place; saw two Eskimo; they say 8 days by commatik from this to Ungava.

Saturday, August 29th.—Under way again at daylight; scarcely any wind all day; by rowing and sailing may have made 15 or 20 miles; shore continues low. No harbour again to-night; turned in about 7 o'clock. Half an hour after one of the men called out that boat was half full of water, and so it proved; everything wet, instruments, chronometer, bags—everything. In trying to find plug-hole shoved both my arms with shirt and coat-sleeves into water. Slept in wet things as I had not a change; miserable night. How the plug came out I cannot imagine.

Sunday, August 30th.—Wind light from E.; no use trying to get on, so sought a harbour in order to dry some of the things. Found what seemed to be good one; 25 feet water at flood-tide, but a few hours after anchoring we were high and dry with no water to be seen in any direction; day raw and cold, threatening rain; very unsuccessful as to drying clothes. Tide came in again at 7 o'clock; just getting dark; saw boat safely anchored, and turned in prepared to turn out again about one o'clock in order to see that she landed on a sandy spot when the tide went out. At 2 a.m. she grounded satisfactorily, and I slept soundly until the water returned at 8 a.m. Tide here runs like a sluice; spring tides, I suspect, about 40 feet.

Monday, August 31st.—Under weigh at 8 a.m.; good N.N.E. wind all day; must have made between 40 and 50 miles. No harbour at night; anchored in two fathoms at low water, about a mile from shore; spent sleepless night, as wind freshened from N.E., and sea began to rise. At 11 p.m. thought myself in fix, but wind again fell light.

Tuesday, Sept. 1.—Started at daybreak; very light N.W. wind until about 10 o'clock; after this it freshened from N.E. with a threatening sky and occasional showers. Determined to seek a harbour early, so headed for a point which I judged could be made by 4 p.m. What a very lucky hit; this Point had a beacon on it, and

proved to be at the entrance to the Ungava River. Round the Point we came to a cove on the shore of which was a log-fishing shanty, A man—a white man—the first we had seen since last September. came out to us in a boat. He proved to be an employee of the Hudson Bay Co., and was attending a salmon net. He informed us that the Hudson Bay Co's steamers *Labrador* and *Diana* were both at the post, which was 25 miles up the river. He showed us where to anchor, telling us it was useless trying to ascend against the ebb-tide. We went ashore to his shanty; he cooked us some fresh salmon and gave us some hot coffee with biscuit and butter. Never in my life had I enjoyed a meal so much before; never do I expect to enjoy one more thoroughly in the future. I turned in after this delightful supper, but did not close my eyes.

The south side of Prince of Wales' Sound is high and precipitous. In a fjord where I lay, 22nd to 24th, fair anchorage about two miles up near a waterfall of over 400 feet.

From Cape Hope to about lat. 60°; high land back in interior, but coast line low; rocky islands, reefs and shoals for many miles out.

On 30th passed inside some much larger and bolder islands, Ackpatok lying outside, and from this to Ungava River the shore seemed more open and clear of reefs. We saw a few bergs on 26th and again on 28th. I consider that the west coast of Ungava Bay is quite unfit for purposes of navigation, owing to the numberless reefs and rapid tidal currents. The spring tides are over 30 feet in northern portion and about 60 feet near the mouth of the Ungava River. We saw a few natives at different points along the coast.

I append the following list of Eskimo words, which I picked up, with their English equivalents:—

English.	*Eskimo.*	*English.*	*Eskimo.*
One	At-ousik	Coat	Koal-a-tuk
Two	Ma-cook	Skin	Kesheke
Three	Ping-ushoot	Small seal	Netchik
Four	Sheetimut	Large seal	Oog-duke
Five	Dudlimut	Seal oil	ook-chuk
Six	Pinga-she-ook-took	Island	Kik-it-tuk
Seven	do. atousicklou	White bear	Nan-ook
Eight	Sheetimaooktook	To-day	Ooblumie
Nine	do. atousiclou	Yesterday	Ik-buk-chuk
Ten	Dudlimaooktook	Me	Oovenir
No	Ow-kuk	You	Igvete
Yes	A-hi-lah	Yet	Suly
I don't know	Ah-chuke	Only	Keshani
Water	E-muk	House	Igloo

English.	*Eskimo.*	*English.*	*Eskimo.*
Ice	Nee-luck	Tent	Toopik
Deer	Took-too	Gun	Cook-e-ook
White people	Cublunac	Powder	Ogjid
Eskimo	Inhuit	There	Tomahny
Snow	Ah-poot	What	Chu-ah
Rain	Cheila-lou	Duck	Meet-uk
Fog	Duck-took	Gull	Now-yer
Broken ice	Chik-oo	Ptarmigan	Ah-hag-yer
Spring	Oopin-uk-chuk	A hill	Kuk-kuk
Summer	Oopin-ark	Land	Noon-ah
Autumn	Ook-e-ark	Sun	Chuk-in-uk
Winter	Ook-e-ook	Moon	Tukir
Good	An-an-uk	Sister	Na-yung-a
Bad	Pu-ūn-eakput	To-morrow	Cowkput
Death	To-ko	Day after to-morrow	Cowk-put-a-lou

ELEVENTH MEETING.

The Eleventh Meeting was held on 13th February, 1886, the President in the chair.

The following list of Donations and Exchanges was read :

1. Journal of the New York Microscopical Society, Vol. I., No. 8.
2. School of Mines Quarterly, Vol. VII., No. 2.
3. Science, Vol. VII., No. 157.
4. From the New Jersey Historical Society :
   (1) New Jersey Archives. First Series, Vol. I. to VIII.
   (2) Proceedings of the New Jersey Historical Society. First Series, I., III., IV., VI. to X. Second Series, I. to VII.
5. Harvard University Bulletin, No. 33.
6. Electrical Review, February 13, 1886.
7. Appleton's Literary Bulletin, No. 43.
8. The Chemical News, January 29, 1886.
9. Imperial Federation, February 1, 1886.
10. Transactions of the Manchester Geological Society, Vol. XVIII., Parts XII. and XIII.
11. Cosmos, 25 Janvier, 1886.
12. Electricité, 23 Janvier, 1886.
13. Revuede Linguistique et de Philologie comparée, Tome 19me, Fascicule 1er.
14. Bullettino della Sezione Fiorentina della Società Africana d' Italia, Vol. I., Fas. 6°.
15. Wochenschrift des oesterreichischen Ingenieur und Architekten Vereines, 22 Januar, 1886.
16. Annales des Mines, 8me Série Tome VIII, 5e Livraison de 1885.
17. Atti della R. Accademia di Belle Arti in Milano, 1884.
18. Journal für Praktische Chemie, 1886, No. 1 u. 2, Leipzig.

19. Beiblätter zu den Annalen der Physik und Chemie, 1886, No. 1.
20. Journal des Sociétés Scientifiques, 27 Jan., 1886.
21. (1) Notice sur l'École centrale des Arts et Manufactures, 1883, Paris.
    (2) Programme des Conditions pour l'Admission des Eleves.
    (3) Arrête Ministériel, 24 Mai, 1862.
22. Atti della Società Veneto-Trantina di Scienze Naturali residente in Padova. Vol. IX., Fascicolo I., II.

Total, 48.

The following were elected members: H. Piper, Adolphus Baxter, and Anthony McGill, B.A.

The President, on behalf of Mr. A. C. Lawson of Ottawa, read a paper entitled: "Some Instances of Gneissic Foliation and Schistose Cleavage in Dykes and their bearing upon the Problem of the origin of The Archæan Rocks."

The phenomenon of gneissic foliation and schistose structure in rocks is so many-sided in its character, and so far reaching in its bearing upon the elucidation of important problems in archean geology, that a comprehension of these physical characters, sufficiently adequate for the formulation of an acceptable theory explanatory of their origin and development, is one of the great desiderata of the geological science of to-day. Such a comprehension can only be arrived at after careful and intelligent sifting of evidence gathered by much patient research in many fields. That we are as yet far from having accumulated sufficient evidence upon which to base a reliable and consistent hypothesis will be conceded by all geologists who have gone, hammer and compass in hand, into the archean field and faced the problems there presented. In the whole range of geology, whether we regard it from a purely philosophic or a strictly economic point of view, there is no more important general question to be solved than that of the original character and present structure of the archean system of rocks; and for the solution of that question one of the great rëagents that is lacking, is, I believe, a good working hypothesis, or, if necessary, two distinct hypotheses that will give us the most highly probable explanation of these two phenomenal rock structures, viz. gneissic foliation and schistose cleavage.

They are both so familiar and commonplace to all geologists that objection may be made to classing them as phenomenal, but so long as they are without a rationally consistent explanation they may fitly

be so termed, since the more these rocks are studied the more is one impressed with the actual mystery that as yet veils their natural history from our view. There have been, indeed, many speculations on these problems of foliation and cleavage, and provisional theories, such as the existing state of knowledge warranted, have been accepted. But speculations devoid of a broad foundation of accumulated facts, and theories that have survived their usefulness, become in time pernicious encumbrances, instead of aids, to the advance of science, and must yield always to more and more substantial beliefs, as vigorous and intelligent investigation proceeds.

In the working out of archean geology the theory of metamorphism has been a powerful stimulant to research and has given us many valid results which entitle it to hold a place of the greatest respect in the history of the science. It has, however, fallen short of its aims in the two chief objects which it has ostensibly sought to accomplish, viz.: (1) the formulation of a consistent and acceptable account of the original character of the archean rocks; (2) the furnishing of a key that will enable us to solve their present structural complications. The great truth the theory of metamorphism has established for science is the fact, that there is *a* metamorphism to which all rocks are susceptible; but its attempt to find in this metamorphism the complete explanation of the profound problems of the old crystalline rocks, is a delusion which must sooner or later be abandoned by geologists as freely as it has been firmly and generally believed in. It is difficult to find a definite enunciation of all that the metamorphic theory of these rocks means. The general proposition, however, that it endeavours to sustain is, that the archean rocks were originally ordinary sedimentary strata which by a process of mineralogical changes or "metamorphism" have become altered into the highly crystalline rocks we know to-day. This proposition, which was once generally accepted, is now fast losing its hold upon geological belief, if we except, perhaps, that of the conservative English school. The many and fundamental objections to the theory have never been satisfactorily reasoned away, while much of the evidence in its favor is based upon assumption. I do not propose to attack the metamorphic explanation of the archean rocks in general, but simply to call attention to two assumptions which the theory both implies and finds support in, advancing such facts as I have been able to observe, which tend to prove the

unreliable nature of the propositions assumed to be true. These propositions are :

(1) That gneissic foliation is a proof of bedding.

(2) That cleavage or schistose structure is peculiarly developed in sedimentary rocks.

I shall endeavour to show by an array of instances to the contrary (1) that gneissic foliation is no proof of bedding; and (2) that both gneissic foliation and schistose cleavage may be developed in true igneous rocks. The instances referred to are taken from the Lake of the Woods region, where I have had some opportunity of studying the archean rocks in their various aspects.

On an island in Sabascosing Bay, Lake of the Woods, a band of black hornblende schist runs through the gneiss. The lamination of the schist, the foliation of the gneiss and the line of contact are coincident in direction, striking 150°, and the common dip is to the north-east. The line of junction is crossed by one branch of a forked dyke half a foot wide, as represented in the accompanying diagram (Fig. 1) :—

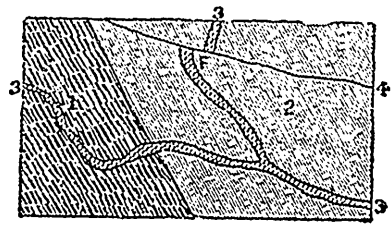

FIG. 1.

Laminated gneissoid dyke cutting gneiss and hornblende schist. Island in Sabascosing Bay, Lake of the Woods.

1. Coarse textured gray gneiss.
2. Black hornblende schist.

These two rocks are in conformable contact with a common strike of 150° and dip to north-east.

3. Dyke about ½ ft. in width, faulted at F, granitic in composition, but presenting a well-marked gneissic lamination in structure.
4. Fault cutting schists and dyke.

A small fault crosses the schist and has caused a dislocation, the extent of which is seen by the movement of the dyke along the line of fracture. The dyke is granitic in its composition, containing feldspar, quartz and mica, *and has a well-marked gneissic foliation of the crystals parallel to the containing walls of the dyke.*

On a small island in the central portion of the lake, situated about two miles north of the mouth of Astron Bay, the rock, which is here a coarse dioritic or ash-bed agglomerate schist, is traversed by a granitic dyke striking 40°, with the cleavage and longitudinal axes of the agglomerate fragments in a nearly vertical attitude. The ground plan of the dyke is given in the accompanying diagram (Fig. 2).

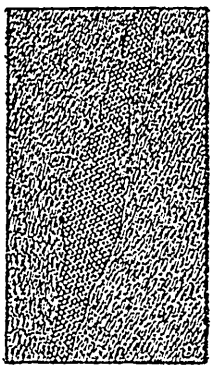

Fig. 2.

The dyke is of irregular width, has a ragged edge, which at places includes portions of the schist, and is, therefore, taken to be an actual intrusion. Its width varies from one to four feet, and about 21 feet of its length is shown. It is of a dark gray color, is coarsely crystalline, and has the composition of a highly feldspathic granite, but *the crystals have a well-marked foliated arrangement parallel to the strike of the dyke.*

Two and a half miles south-west of Yellow Girl Point, Lake of the Woods, lies a small island about four chains in length from east to west and about two in width. The island is composed of evenly laminated hornblende and micaceo-hornblende schists striking east and west with a northerly dip at a very high angle. At its widest part, the schists of the island, which are quite bare and well exposed, are cut by a curved north and south striking dyke about 15 feet wide, whose relation to the schists is shewn in Fig. 3.

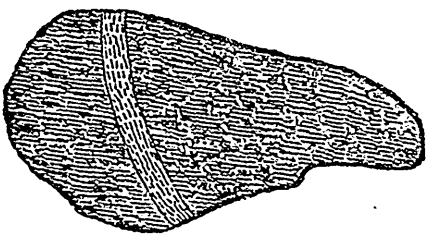

Fig. 3.

The schists abut sharply on the dyke on both sides and there is no appreciable difference in the strike of the schists on one side from that on the other. The rock of the dyke is syenitic in composition, being composed of a preponderance of a pale yellowish pink orthoclase with a black variety of hornblende and some quartz, plagioclase and mica. *The dyke presents an unmistakable gneissic structure* which is best developed along its sides, the rock being more undifferentiated and granitic in the central portions.

The island lies a little to the north of a larger island (Beacon

Island), the north shore of which is occupied by hornblende schist and finely laminated quartzose mica schists, while the southern half of it is occupied by a mass of flesh-tinted rock of the composition of a syenitic granite, but in which, in places, there is developed, in the same rock mass, a very distinct though coarse gneissic foliation, with gradations between what would be taken as a true granite and the unmistakable gneiss, which preclude the possibility of any hard line being drawn between them, both being in fact the same rock—a granite. The gneissic foliation is due to a structural differentiation, which, so far as observation would permit of judging, is more especially peculiar to that portion of the mass nearest the contact with the schists. The dyke on the small island shewn in the figure is probably an off-shoot from this granitic mass.

Along the junction of the Huronian hornblende schists with the Laurentian gneiss on the islands at the mouth of White Fish Bay, may be seen some remarkable instances of *intrusions which have all the physical aspect of a regular gneiss*. The most striking of these is figured in the annexed diagram (Fig. 4), which illustrates the condition of things seen on an island called the West Pointer at the mouth of the bay.

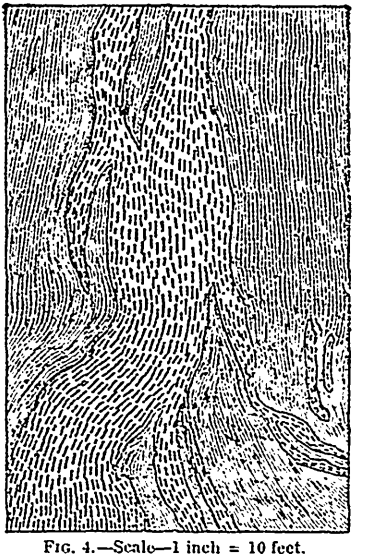

FIG. 4.—Scale—1 inch = 10 feet.

The northern and larger moiety of the island is occupied by the hornblende schists of the Huronian, and the southern by coarse grey gneiss. About the middle of the island the irregular intrusion of gneiss shewn in the figure breaks through the hornblende schists. The intruded rock resembles closely the regular gneiss to the south of the line of contact and its foliated character is quite as well defined. The irregular nature of the fissure through which this gneiss has been injected is such, that it cuts across the schists at some places and runs with its strike in others. The foliation of the contained gneiss is approximately parallel to the walls of the fissure. In one place this foliation and the

general axis of the dyke have a coincident strike of N. 55° W., while the schists which abut sharply on the dyke have a strike of N. 80° E.

The intrusion is, I believe, identical with the gneiss of the Laurentian to the south, and is a striking proof of the plastic or viscid condition in which these rocks must have once been, either as an original state or as induced at the time of folding. The belief that this intrusion of gneiss is the same as the Laurentian gneiss of the region to the south, and that it is simply a portion of the latter that has been injected in a molten state within the rocks in which it is now found, is based not only on the similarity of the rocks, but also on the nature of the line of contact at this point, which in the conditions represented in Fig. 5 gives us another proof of the once viscid condition of the rocks.

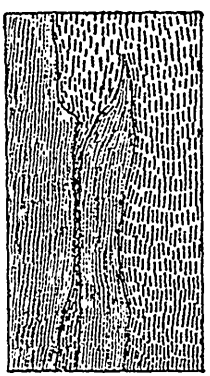

Fig. 5.

The gneiss and the schists here are the same in every way as those described in the preceding figure which occur only a few yards to the north. The wedging of the two rocks one within each other in the way represented finds its readiest explanation in ascribing a plastic or viscid condition to the rocks at the time of this folding under enormous pressure. This condition of things along the line of contact is, it may be mentioned, somewhat abnormal, the rule being that the hornblende schist presents an even line of junction with the gneiss, strictly conformable, so far, at least, as parallelism of the planes of foliation of the gneiss, cleavage and bedding (not necessarily sedimentary) of the schists, together with transitional alternations of beds of gneiss and schist may be taken as indicative of conformability.

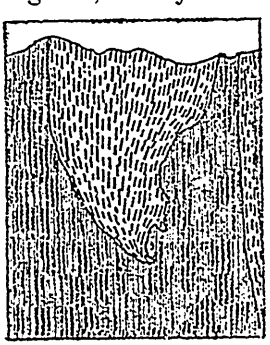

Fig. 6.

Another instance of intrusive gneiss breaking through schists is seen on the extremity of Rendezvous Pt. in Long Bay. Here, as seen in Fig. 6, an irregular wedge of distinctly foliated gneiss juts in from the shore line within the schists, presenting all the characters in its contact with the adjoining rock of an intrusive mass.

It is a coarsely crystalline gray gneiss. A little to the south is a narrow band of gneiss striking with the schists, of which it would be difficult to say whether it was a dyke or an interbedded stratum. Its origin is probably the same as that of the larger and more distinctly intrusive mass to the north of it. The aspect of the rock surface on the point in question is shewn in the annexed Fig. 6.

At the extremity of Spear Point, on the route between Rat Portage and French Portage, the mica schists, which constitute the rock of the point, are cut by an irregular dyke of a porphyritic dioritic rock, striking N. 60° E., with the schists as shown in Fig. 7.

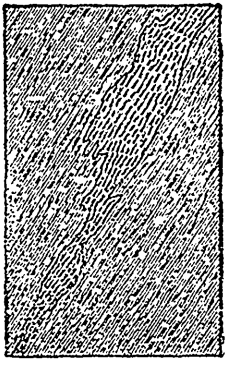

Fig. 7.

The dyke has a very ragged edge and its intrusive character is undoubted. It varies in width from two feet to a very few inches. The dyke weathers a yellowish white, and presents a surface finely pimpled with thickly disseminated crystals of feldspar, which have been more resisting than the matrix of the rock to weathering agencies. These crystals show a distinctly foliated arrangement, and give the rock the aspect, though it has not the composition, of gneiss. The foliation is parallel with the general strike of the dyke, and in addition to its gneissic structure is quite schistose.

The mica schists which occupy the north end of Hurricane Island are cut obliquely by a ragged-edged dyke of whitish yellow weathering dioritic rock, which is distinctly schistose. The mica schists have a strike of N. 60° E., while the dyke and its planes of schistose fracture strike about N. 40°E. The following Fig. 8 shows the relation of the dyke to the schists on the ground plan.

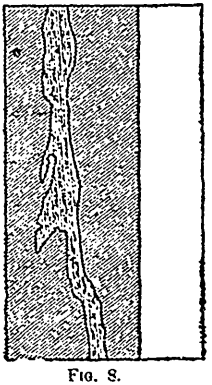

Fig. 8.

On the west shore of Sabascosing Bay the gneiss at one point is cut by a band of hornblende schist, of which neither the dyke-like character nor the schistose structure can be doubted. It is from one and one-half to two feet wide, and strikes N. 50° W. across the gneiss, the direction of whose foliation is N. 75° E. The dyke lies, as is shown in Fig. 9,

between two other dykes of fine-grained gray granite, one nine feet wide on the north-east side and one one foot wide on the south-west side. All these dykes fault the rock, as is seen by the non-correspondence of the gneiss at points directly opposite each other, and by the slight torsions of the nearly vertical planes of foliation.

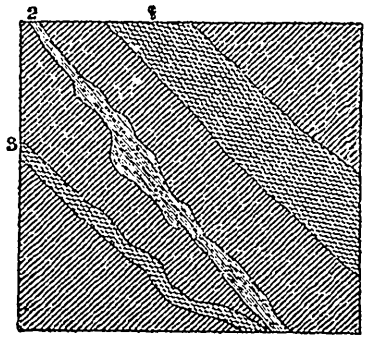

FIG. 9.

Schistose dyke, between two granitic dykes, cutting and faulting gneiss Sabascosing Bay, Lake of the Woods.

1. Granite dyke, 9 feet wide.
2. Dyke of laminated and schistose amphibolite rock—hornblende schist.
3. Granite dyke, about 1 foot wide.

On the north-west corner of Oak Island there cuts the hornblende schists a very schistose dyke of a rock, composed of hornblende, mica and feldspar, containing brecciated fragments of a highly feldspathic gray granite (Fig. 10). The dyke is from two to four feet wide, and traverses the schists across their strike. The included fragments are not numerous, but present the aspect of true brecciated inclusions.

FIG. 10.

These instances appear to prove conclusively that a gneissic foliation may be developed in a granitic rock that was at one time viscid or flowing enough to be injected within fissures of other rocks; and also that a schistose structure may be developed in igneous intrusions. Omitting for the moment all considerations as to the causes to which this foliation and schistose cleavage may be ascribed, these conclusions have an important bearing upon the possible original

character of some of the archean rocks, especially if by careful research and accumulation of evidence it be found possible to extend them from the special to the general. If from admitting the development of a gneissic foliation in an undoubted igneous rock we admit the possibility of the great Laurentian system of rocks which are granites or syenites in composition but gneisses in structure, having been in a fluid state, we take a great step towards removing the necessity for a theory of metamorphism which ascribes a sedimentary origin to these rocks. It may, indeed, be urged that the metamorphic theory admits a once viscid condition for these rocks and that this state was only the extreme of metamorphic action, but the moment the theory admits this it removes at once its *raison d'être* and becomes a far-fetched and cumbersome hypothesis to explain phenomena that can be accounted for in a far simpler way. For it is absurd to admit the development of a gneissic foliation in a granitic magma whose fluid condition has been brought about by the action of heat on once solid strata, and to deny the possibility of a similar differentiation in the original granitic magma or fluid, which is generally conceded to have constituted the first surface of our globe. The development of a foliation in a magma which is such *ab origine* is as easily conceivable as that in a magma which is only such secondarily, and is far simpler as a scientific hypothesis, in the fact that it avoids the necessity of imagining an immense process of sedimentation of a most peculiar character, and leaves us as far as ever from the beginning in attempting to trace out the history of the earth's crust from the time of its molten state.

As a general rule, however, the exponents of the metamorphic explanation of the archean rocks do not carry their contentions quite so far as this. The Laurentian gneisses, they say, are sedimentary rocks, which, though in the process of metamorphism they have been reduced to a plastic condition, have never been rendered so completely homogeneous as to lose all traces of sedimentation, which traces are manifest in the parallelism of the planes of crystalline foliation; further, that many granites are but gneisses that have undergone this extreme stage of metamorphism and so had these traces of sedimentation quite obliterated. This of course puts the question on much more debatable ground; but if it can be shown that, in true igneous rocks, which, if our ordinary conceptions of intrusive phenomena are to stand, must have been in the condition

of a fluid magma, a distinctly gneissic structure may be developed, as I have shown to be the case in the instances cited, then the argument that gneissic foliation is an indication of bedding is terribly shaken; and if, further, by extending observation, the foliation of gneisses generally can be shown to be due to similar forces operating on similar material, the metamorphic theory must go to the wall as a needlessly far-fetched and complicated hypothesis. I am well aware that the metamorphic theory is not altogether based on the structure of gneisses, nor do I deny that there is a metamorphism to which rocks are susceptible, but as an explanation of the origin of the Laurentian gneisses it seems to be very weak, particularly where it seeks for support in the assumption that foliation in these rocks is proof of sedimentation.

If we consider for a moment the probable causes of the differentiation of a granitic magma into a foliated gneiss, such as occurs in dykes of gneiss, we shall find that pressure was in all likelihood the most important force at work; further, that this pressure was due not to external disturbance but to internal changes; that it was, in fact, the pressure due to the expansion of the injected material during the process of solidification within confining walls practically rigid. Wadsworth has pointed out in his Lithological Studies the high probability of rock magmas following the rule found to hold in many of the economic metals. These expand rapidly during the actual process of solidification, so that when solid, but at a temperature only slightly below the point of fusion, they have a lower specific gravity than when in the fused state; though in cooling from this temperature the solid contracts so much as at the normal temperature to have a specific gravity higher than that of the molten fluid. An expansion of this kind in a dyke solidifying by crystallization can be readily imagined to have had a very potent influence upon the arrangement of the nascent crystals. The pressure would of course be equal in all directions if the magma were a perfect fluid. As crystallization proceeded, however, the pressure would act more and more in directions perpendicular to the planes of resistance, *i.e.* to the walls of the dyke, and as a consequence the crystals would be forced to assume positions in which their longest diameter would be parallel to the lines of least resistance. Such an explanation of the development of a gneissic structure in dykes may be extended with some probability of truth to the gneisses of the Laurentian, par-

ticularly those usually referred to as granitoid gneiss. The crumpling and folding of the archean rocks is generally ascribed in text-books to a process of contraction, due to the cooling of the earth's crust or to the contraction of the interior molten globe, and the consequent collapse upon it of the less rapidly cooling crust. This explanation is probably the true one to account for the folding of post-archean strata, and much of the disturbance that affects the archeans themselves is doubtless due to the operation of such forces. But if it be admitted that the Laurentian gneisses ever so far resembled intrusive gneiss as to have been in the condition of a molten magma, then we have a prior and more important force to take into consideration, viz., the expansion of solidification at the time when the rock was passing from the fluid to the crystalline state. Such an expansion would be amply sufficient to throw the solidifying but yet plastic rock into the violent folds and contortions in which we to-day find the fundamental gneiss wherever it is exposed the world over. The same expansive pressure would, as in the case of the dykes, have a decided tendency to arrange the precipitated crystals in a more or less definite way with their longest diameters parallel to the line of least resistance, *i.e.* parallel to the axes, whether straight or curvilinear, of the folds. This tendency to gneissic arrangement would be aided by the pulling and flow that would necessarily be induced by the folding of such a partially crystalline still plastic mass. This seems to me to be the most plausible hypothesis to account for the origin of the granitoid gneisses of the Laurentian, and it is certainly more in harmony with the phenomena we find in the archean field than a theory which holds that they are the altered remains of once aqueous sediments. The marvellously intricate contortions and intermingling of the gneiss seen not only on natural exposures in the Lake of the Woods region, but also in some railway cuttings between Port Arthur and Winnipeg, leave room for no other conception than that the gneiss must have been in a perfectly viscid condition. It is not at all probable that the explanation advanced to account for the origin of the granitoid gneisses is true of the more finely laminated and bedded gneisses that appear to occupy a higher position in the Laurentian system. This lamination can, without serious objection, be ascribed to regularity of crystalline precipitation, a stratiform arrangement due to difference of specific gravity in different portions of the original magma, and to

the variation of the fusion point of crystallizing minerals according to the proportion of other minerals present, all of which forces would have freer play near the surface, where the composition of the magma would be less constant and the superincumbent pressure be less.

The contraction which these rocks have undergone must have taken place at a period subsequent to their assumption of the solid state, and would, therefore, naturally have an immensely less chance of exerting a modifying influence upon the arrangement of their component crystals than forces at work while it was yet plastic. The results of such contraction are probably seen in the innumerable fissures that traverse Laurentian rocks, and are now filled with pegmatite granite and other intrusive material. The fact that, as a rule, there is an extremely small amount of dislocation attending these fissures favours the view that they are due to contraction of the solid rock rather than to any kind of upheaval or similar disturbance. It is, moreover, to be observed that the crumpling and folding of the original surface of the earth, due to the expansion of solidification, would, by the natural balance of physical forces, be prevented from extending to excessive depths. The pressure due to the weight of the upper portions of the globe's forming crust would at a certain depth counterbalance the pressure of expansion, and long before this point was reached the tendency to folding would be checked. The solidifying magma would expand quietly and uniformly in all directions till equilibrium was established, when, the resistance from above being equal to that in other directions, there would be no tendency to differentiation in the arrangement of the crystals. The resulting rock would be the granite, into which gneiss is often seen to graduate when denudation has exposed the lower portions.

If we now pass on to consider the question of schistose cleavage, we find that the instances cited show that such a cleavage may be developed in igneous or intrusive rocks. This schistose structure appears to be closely allied to gneissic foliation, though a rock may be distinctly gneissic, and yet not at all schistose under the hammer. Both are probably due, so far as dykes are concerned, to the same causes. It is scarcely necessary to remark that there are two kinds of cleavage, one due to a parallel arrangement of the foliated minerals in the rock, produced very probably by the operation of the same forces as those to which the foliation of gneiss is ascribed, and

which may, therefore, be properly said to be allied to it; and another which crosses the strike of the lamination and seems to have been developed in the rock as a species of fine jointing after its assumption of a hard solid state. Both kinds may often be seen cleaving the same rock, but only the former will now be considered briefly, as it is that which prevails in the upper or schistose portion of the archean system. That such a schistose cleavage may be developed in igneous rocks is shown by its occurrence in intrusive dykes. It is not, however, only under the conditions in which dykes occur that this cleavage may be developed in igneous rocks, for on a larger scale I have repeatedly observed perfectly massive and homogeneously textured rocks of a diabasic or dioritic composition merge into a schistose variety of the same composition and aspect, without a break to create a doubt as to the identity of origin of both. Further, I have noticed that even granite, which is unmistakably intrusive, may exhibit a rough but quite well-marked schistose fracture. This is well seen on the northern skirts of the Echo Bay (Lake of the Woods) intrusive mass of granite, which breaks through a diabasic rock, and near its contact with the latter becomes less coarsely granular and roughly schistose.

If, then, a schistose cleavage may be developed in a truly igneous rock, the mere fact that the higher portions of the archean system are characterized by such a schistose cleavage, even though it be parallel for the most part with the stratiform arrangement or bedding of the rocks, is no reason whatever in support of the belief that these rocks were once aqueous sediments.

In answer to a question of Mr. Rouse respecting the expansion of rocks in cooling, Dr. Ellis referred to a number of substances that expand in the act of solidifying, and entered into an explanation as to the cause of the expansion in such cases.

Mr. T. Nelson Dale stated that the views of the paper agreed with those of Professor Hitchcock, the State Geologist of New Hampshire, who regarded large masses of gneiss in the White Mountains as of igneous origin, but that there were cases where gneiss was undoubtedly of metamorphic origin; thus Beudant, one of the old French geologists, cites a case of

a dyke of igneous rock which, in its passage through a bed of argillite, had metamorphosed contiguous portions of it into quartz, feldspar and mica. If the rock in such a locality retained traces of its original bedding, or if the crystalline particles assumed a parallelism in the direction of least resistance, we should have metamorphic gneiss. Mr. Dale had visited, during the previous summer, a locality in Massachusetts where fine-grained gneiss was inter-bedded with mica schist, both evidently of metamorphic origin. The paper was an instructive one, and would promote just views on the subject. The upshot of the present difference of opinion on the origin of gneiss would probably be that it would be determined that gneiss might be either of igneous or of metamorphic origin.

Mr. VanderSmissen introduced Mr. C. N. Bell, of The Manitoba Historical and Scientific Society, who gave an interesting account of the Mounds of Northern Minnesota, Manitoba, and the Rainy River Valley, and of the contents of those at the opening of which he assisted. He exhibited a photograph of a copper hook found by Mr. Richardson, a C. P. Railway surveyor, at the bottom of a deep pocket in the Laurentian rocks, 30 feet below the surface, on the bank of the Pic River. In answer to a question from Mr. VanderSmissen, he gave some figures as to the cost of the exploration of these mounds.

Mr. Boyle moved a vote of thanks to Mr. Bell, which was seconded by Mr. Bain and carried.

TWELFTH MEETING.

The Twelfth Meeting was held on 20th February, 1886, the President in the chair.

The following list of Donations and Exchanges was read :

1. Le Naturaliste Canadien, Vol. XV., No. 8.
2. From Cornell University, Ithaca, N.Y.:
   (1) Annual Reports of the President for 1881, 1883, 1884, 1885. None published for 1882.

(2) Bulletin of Cornell University (Science), Nos. 1 and 2.
(3) Second and third Reports of Cornell University Experiment Stations, 1882-83, 1883-84, 1884-85.
(4) Notes on the Geological History of Cayuga and Seneca Lakes, by C. W. Foote.
(5) Ithaca and its Resources, Kurtz, 1883.
(6) Library Bulletin of Cornell University, Vol. I., Nos 1–13.

3. Science, Vol. VII., Nos. 158 and 159.
4. The Iowa Historical Record for January, 1886.
5. Bulletin of the California Academy of Science, No. 4, January, 1886.
6. The Chemical News, February 5, 1886.
7. Illustrated Journal of Patented Inventions, No. 58, February 5, 1886.
8. Scottish Geographical Magazine, Vol. II., No. 2, February, 1886.
9. Journal of the Quekett Microscopical Club, Series II., Vol. II., No. 14, February, 1886.
10. The Lancet, London, January 23rd, 1886.
11. Midland Naturalist, No. 98, February, 1886.
12. Proceedings of the Royal Geographical Society, Vol. VIII., No. 2, February, 1886.
13. Records of the Geological Survey of India, Vol. XVIII., Part 4, 1885.
14. Electricité, 30 Janvier, 1886.
15. Wochenschrift des oesterreichischen Ingenieur und Architekten Vereines, Wien, 29 Januar, 1886.
16. Gazetta Chamica Italiana, Palermo, Anno XV., 1885, Fascicoli I.–IX.
17. Bulletino della Società Geografica Italiana, Ser. II., Vol. XI., Fasc. I., Gennaio, 1886.
18. Bulletino di Bibliografia e di Storia delle Scienze Matematiche e Fisiche. Tomo XVIII, Aprile, 1885, Roma.
19. Società Storica per la Provincia e Antica Diocese di Como, Vol. 5° Fasc, 17°.
20. Compte Rendu de la Société de Géographie, 1886, Nos. 2 et 3, Paris.
21. Mémoires de l'Académié des Sciences, Inscriptions, et Belles Lettres de Toulouse, Hintième Série, Tome VII., Premier et Deuxième Semestre, 1885.
22. Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils, Septemtre, 1885.
23. Journal des Sociétés Scientifiques, 3 Févirer, 1886.
24. Zeitschrift für Physiologische Chemie, X. Band, 1 u. 2 Hefte, Strassburg.

Total, 56.

The following were elected members: Rev. J. F. McCurdy, Ph. D. D. J. Gibb Wishart, B.A., M.D., Thos. J. Burgess, M.D.

Mr. David Boyle read a paper on "The Persistence of Savagery in Civilization."

The key-note to this paper was struck in the following sentence:—"As pre-natal life appears to present us in epitome with a history of the development of our race from a merely animal point of view,

so does our existence, in its various stages, from the cradle to maturity, exemplify the steps in man's advancement from the condition of the untutored savage to that of a civilized being."

The writer claimed that nearly every one of our "manners and customs" betrays its lineage with some aboriginal proclivity, some instinct, or some acquired tendency which had for its main object the securing of a supply of food.

On this basis Mr. Boyle accounted for the stone-throwing proclivity on the part of boys; and with advancing years, for their indulgence in the use of pea-shooters, slings, bows and arrows, revolvers and rifles.

Cruelty to animals, cocking-mains, pugilism, and man-bull fights were traced to the same savage source. Sports and games were regarded as improved forms of old hand-to-hand encounters.

Music and dancing were rhythmical arrangements of sound and motion, but connected with the celebration of victories in war, dancing especially still showing mimic capture and recapture by contending parties.

Fondness for raw meat and for putrescent vegetable matter led the writer to the love of the human race for stimulants, and he asked whether it would not "be rash to say that the desire for intoxicants had not its origin in some instinctive and impelling longing to satisfy a want in the human organism?"

Of the jack-knife carver on every available surface, the remark was made: "He is a nineteenth century survival of Cave Man, and refrains from committing murder only because he has a wholesome regard for the terrors of the law."

Personal adornment and love of display were the results of evolution from the days of paint and feathers.

In concluding, the writer said, "The customs of modern society, the refinement, the æstheticism of the present day are but evolutionized forms of those natural expressions of instinct and of crude sentiment that are so characteristic of savage life wherever it exists. . . . That many of our proclivities bear so strong a resemblance to savagery, is not only a proof of the "Descent of Man," but goes a long way to show how exceedingly brief has been his so-called civilized condition compared with the endurance of his primeval state. . . . To acknowledge the prevalence of crime, is simply another

mode of stating that civilization has not yet reached its highest attainable form."

Mr. C. N. Bell, of Winnipeg, read a paper on "The Mound Builders in Canada."

The scientific journals of the day are over-flowing with articles on the mound builders. Some writers take decided ground in claiming for the builders a remote antiquity, while others are equally positive in asserting that they were the immediate ancestors of our modern Indians. One becomes rather bewildered on finding that prominent champions of the above opposing theories rearrange themselves under different standards when the question arises as to where the Mound Builders came from. While some stoutly maintain that they were an offshoot from Central American stocks, many are confident that they came from the north. An immense number of data are produced as evidence in support of each one of these theories, but one fact seems to have been at least partially overlooked by writers. It is more than passing strange that no systematic attempts have yet been made to follow up towards the north the broad lines of mounds and other earthwork remains left by the mound builders. An immense number of mounds exist in Northern Minnesota and Dakota north of the valley of the Mississippi, and yet little has been done to survey or explore them. Two gentlemen in St. Paul lately informed me that they had surveyed some thousands of mounds in Minnesota, principally, however, south of the source of the Mississippi, but the northern districts were yet virgin soil for the archæologists. Any information therefore that is forthcoming which extends northward the known limits of the mound builders' remains will be extremely interesting and valuable. Comparatively few archæologists are aware of the fact that the Mississippi River mound system merges into one ranging up to Lake Winnipeg, if not farther. In 1867 two of the ordinary burial mounds of the truncated cone form were discovered on the right bank of the Red River in Manitoba, or, as it was then called, the Selkirk settlement. Some interesting remains were taken from them, including human and animal bones and skulls; ornaments of shell, bone and stone; implements of stone, and pottery, all of which (like too many of our Canadian archæological treasures) were exported to enrich foreign museums. Little or no interest was taken in this matter for a num-

ber of years, and it is only lately that the Historical and Scientific Society of Manitoba and private individuals have learned of the rich field for research that lies at their doors. As the country becomes settled, reports flow in of the existence of mounds in different parts of the North-West It is definitely known that earthworks of various forms are grouped on many of the streams falling into the Red and Assiniboine Rivers, and the announcement was lately made that at least one mound stands at the north end of Lake Winnipeg, or roughly speaking, in N. lat. 54°, W. long 98°. It may be well to trace one connected line of mounds from down on the Mississippi River to Lake Winnipeg. The Red River of the North takes its rise (by one branch) in Lake Traverse or, roughly speaking, N. lat. 46 degrees, W. long. 97 degrees, and following north falls into the southern end of Lake Winnipeg. There is a connected line of mounds from Lake Traverse to Lake Winnipeg. Lake Traverse is connected by a sluggish creek with Big Stone Lake, which is drained to the south by the Minnesota River, the latter emptying into the Mississippi River, near the city of St. Paul, Minnesota. Mounds are found in numbers along the Minnesota River, from the Mississippi to Big Stone Lake, and there are several groups with an earthwork fortification at the valley situated between Big Stone Lake and Traverse. Hundreds of mounds in this district have been surveyed by Mr. T. H. Lewis, of St. Paul. It will thus be seen that there is a continuous line of mound from the Mississippi, below St. Anthony's Falls, to Lake Winnipeg, following that line of water courses, from the Gulf of Mexico to Hudson's Bay, which divides the North American continent into two great halves, east and west. A brief description of a group of mounds at St. Andrew's, Manitoba, 18 miles north of the city of Winnipeg, will serve to show that in general character they are almost identical with one class of those of the Ohio and Mississippi, as reported on by Messrs. Squier and Davis and other archæologists of the United States. One mound was 8 feet high, 75 feet long, and 65 feet wide. It was covered with a clump of oak trees, ranging up to about 4 feet in circumference, and thickly matted with small underbrush and roots. Under his supervision a trench was sunk from the apex to the base on one side of the centre, and running partially around it. First was encountered a layer of decaying vegetable matter, then the general material was a rich loamy earth, evidently gathered from the immediate vicinity, though

no pits or excavations were found. As the cutting was, made patches of charcoal, ashes, and burned clay appeared, mixed irregularly throughout the soil to a depth of four feet. Below this level the ashes and charcoal were more regularly disposed in streaks, and in places the earth seemed to be burned, requiring the use of a pick to loosen it. At this level, also, the remains of some oak timber were uncovered at the west side of the mound, which covered the remains of a human being, interred in a sitting position. The wood was in such a state of decay that it crumbled to dust in the hand, though often showing the lines of fibre and growth, the dust being of a bright red color. In the upper section of 4 feet, amongst the scattered patches of ashes and charcoal mixed through the loam, were found a number of skeletons, evidently "intrusives," as some of them were in a comparatively fair state of preservation, the smaller bones only having disappeared. They had all been buried with the faces upward and were unaccompanied by ornaments or other manufactured articles. It was at once evident to me that they were later interments than the original remains found at the bottom of the mound. There is recorded the fact that during an epidemic of smallpox, about the year 1780, the Indians along the Red River buried their dead in the mounds in this locality, and which were not made by themselves. Without doubt, these "intrusives" found by me were the bodies of the smallpox victims, the Indians departing from their usual mode of scaffold burial to avoid contagion. The late Senator Donald Gunn was informed of this circumstance by an old Indian who had been a resident of the district at the date mentioned. On the level of the natural surface of the ground a platform or layer of round boulder stones was found, beneath a smooth burnt clay floor, apparently dipping lightly towards the centre, which I was unable to uncover at the time, and cannot accurately describe, but it very closely answers the description of the "clay altars" of Squier and Davis. The skeleton of a man of rather above the ordinary stature was found in a sitting position surrounded by several piles or bundles of bones, each surmounted with a skull. These bundles seemed to consist of the main bones and skull of one individual to each pile, and had evidently been brought there for reburial about the central figure. These remains were very much decomposed, crumbling into fragments on exposure to the atmosphere. Some of the bones of the right foot of the sitting skeleton were found in a lump of clay, but these were the

only ones, with the main bones of the legs and arms and skull, which were preserved, though much care and trouble was taken. The skull is now in possession of Dr. Daniel Wilson, of Toronto. These remains were on the level of the surrounding ground on the west side of the mound and facing the east. The following articles were found near the sitting figure. About the position of the breast a polished seashell gorget, probably cut from the *Busycon perversum*. It is four inches in diameter with a circular hole in the centre of one-half inch diameter, and two small holes in the rim for suspension purposes, which show a well worn furrow or groove worn into the shell by the friction of the cord or thong. Like the skull, the gorget is stained with a mineral paint of a red color, but no attempt has been made to engrave designs on its beautifully polished surface. Two well-finished tubes of steatite, each hollowed out and having a raised rim at one end, were taken from about the waist. The tubes show that they were finished inside by cutting, as the stripe left by the tools may be seen. A tiny earthen pot came from the side of the skeleton, but it crumbled to pieces when taken from the earth. It appears to have been filled with red ochre or some such material, as the cup was stained red, and there was a crusted deposit inside. A few shell beads were found scattered through the earth of the lower level. Those secured were very much decomposed,, and split into thin scales or crumbled into chalky lime when exposed. The shells of the common mussel, which abound in the river close by, appeared at different levels, but they were generally much decayed. These shells have been found inside pots discovered in the mounds, and were evidently at times used as spoons and ornaments. A few hundred yards from the above mound was another, which has been opened and found to contain human and animal remains, earthen pots, rough stone mauls, deer horns, and a pin or hanging ornament $5\frac{3}{4}$ inches long and $\frac{3}{4}$ of an inch thick, formed from the columella of a sea shell, probably of the *Busycon perversum*. This pin is identical with some in the collection of the Smithsonian Institution, notably with one found in a mound in Tennessee. There was also taken from this mound a gorget or breastplate, $9\frac{1}{2}$ inches long and 3 inches wide, with the ends curved. The material is very dry and brittle, and it is difficult to say exactly what it is, but in all likelihood it is a turtle shell. The marks of a scraper appear on the concave side, while the other is polished smooth and the surface indented with several lines running parallel with its length.

They are not in the form of any particular design. A peculiarity in the construction of this mound was a double layer of limestone flags, separated by a few inches of burnt earth, which was encountered about half way down from the apex, and covering the remains of the original interment at the base. In the vicinity of these mounds, which were situated on a ridge about 500 yards back from the Red River, he found an old camp site, with quantities of "Kitchen-midden," including fragments of pottery, shell and stone heads, partially worked and completely formed arrow heads and scrapers, hammering stones, two stone axes, roughly formed, beaver, buffalo and deer bones, etc. The markings on the pottery were no doubt made by indentation, though in cases the finger-nail marks are discernible. The designs consist of combinations of lines and dots or holes. On comparing the design on one rim fragment taken from the river bank with that on a complete cup taken from a mound within the limits of the city of St Paul, Minnesota, I find that they are almost alike. The materials used in making the pottery were evidently clay, with pulverised shells and decomposed granite, all of which are to be had in abundance in the immediate neighbourhood. A ridge of limestone tapped with drift gravel and boulders here crosses the Red River and supplied raw material for the manufacture of flint implements and weapons. I am unable to learn that any article of European manufacture has been found in the Manitoba mounds. What is strange also is the fact that no article of copper has come to light from these mounds, though, at a distance of 200 miles eastward, on the Rainy River, where a number of mounds have been opened, a majority of the articles found are of that metal, which was probably obtained at Lake Superior, as a direct canoe route from Rainy River leads to opposite Isle Royale where many ancient copper mines have been found. Over 20 mounds have been identified on the banks of the Rainy River, part of them being in the territory of the United States, the river here forming the boundary line between it and Canada. One mound situated at the junction of a southern feeder with the Rainy River is fully 45 feet in height and most likely the largest of the whole mound system. It has been dug into in many places and the large number of relics taken out and carried away and scattered from one end of the country to the other. One mound at the head of Rainy River contained the remains of a structure of logs, about 8 feet square, which showed the action of fire. It had evidently sur-

rounded and covered the original interments. A number of relics were found in this tumulus. But few of the mounds in this region remain intact, and steps should be taken immediately to preserve the small number left. The builders of these mounds were doubtless of a different branch from those of the Red River, and communicated directly with the Mississippi by the streams and lakes which practically form a through canoe route. The country to the direct north of the Rainy River has not been explored, so far as I can learn for mound remains, but the broken character of this section, which is of Laurentian formation, rather inclines me to imagine that none will be found there, because the rule is to find the mounds in the most fertile agricultural districts. Lead, mica, asbestos, gold and silver are found in the rocks of the Lake of the Woods, close at hand to the Rainy River, but there is no record of any of these minerals having been unearthed from the mounds. It is true one piece of ore taken from the hand of a skeleton in the Great Mound has been identified by Dr. Bryce as arsenical iron. Many mounds are situated on the streams flowing from the west into the Red and Assiniboine Rivers, and during this week I have received a communication from a friend who has spent some time in the District of Alberta, in which he stated that "the country is rich in mounds." When it is known that numbers of mounds have been located on the Upper Missouri it is not surprising that they also appear on the streams from the Rockies to the north. Thorough exploration is required to give an exact idea of the geographical areas covered by the northern branches of the mound systems of both the Mississippi and Missouri. That the systems of the Red River and Missouri approach each other closely I proved during the past summer. Groups of the first extend to the headwaters of the Pembina and Souris rivers, which are comparatively close to the Missouri and on the old main trail between the Red River and Missouri, which was the route taken by war parties of the Crees, Assiniboines, and Ojibways from the neighbourhood of Lake Winnipeg, and in more modern times by the Red River half-breed buffalo hunters. Living about Lake Winnipeg, the Mound Builders must have known of the Nelson River, leading directly to tide water in Hudson's Bay, and of the great Saskatchewan flowing from the Rocky Mountains with its northern feeders interlocking with those of the Mackenzie. There is much food for thought and investigation in all this, and the subject is well worthy of consideration as serving

to throw light on important points connected with the peopling of North America—whether the Mound Builders were Indians or a different race of men. The remains of the Mound Builders vary in character and structure in different recognized geographical areas, as, for instance, the pyramidal mounds of the Southern States, the embankments of the Ohio, the stone graves of Tennessee, and the effigies of Wisconsin. It may be taken for granted that even if one race of people with customs in the main identical, climatic influences alone would modify and alter the habits of the Builders. The presence of manufactured seashells in the mounds of Manitoba, which probably came from Southern California or the Gulf of Mexico, will give a clue to the range of the trade. Not only have specimens of the *Busycon perversum* been taken from the mounds on the Red River, but several shells of the *Natica* and *Marginella* appeared in a mound on the Rainy River, a distance of fully 1,500 miles from their native water. The Manitoba Mound Builders probably had some other medium of exchange than copper, which does not seem to have been used then (judging from its total absence so far as now known), and it is extremely probable that the fine fur of the north was sent south to regions which, though possessing a milder climate, were subject to variations of temperature that necessitated the use of warm clothing at certain seasons. In short, fur was no doubt the article exchanged for the sea shells of the south. While agriculture may have been engaged in, and the presence of mounds in the most fertile districts suggests that it was, no traces of stone spades, or "furrowed patches," such as have been discovered further south, have yet come to light in or near the mounds opened, of which record has been filed. Like the Mandous, the Builders may have used the shoulder-blade of the buffalo as a spade. In a short paper of this kind it is impossible to enter into many details, and I have been compelled to omit many interesting data which have been secured by field work in the North-West.

Mr. J. H. Hunter enquired whether there was any theory in regard to the age of the mounds.

Mr. Bell did not like to offer any. It was very difficult to tell their age. Most mound-diggers have refused to give any date. Much depends on the nature of the soil adjoining them. In the case of trees, the number of rings was not a certain

guide. In regard to the Manitoba mounds, there is sufficient historical evidence that at least 200 years have passed since their erection.

Mr. Browning described some graves he had seen in the North-West, and enquired whether there was any theory as to the mode of burial among the Indians.

Mr. Bell replied that all the northern tribes adopted the scaffold mode of burial. Since the arrival of the whites they have gradually adopted their mode of burial.

Mr. Hunter enquired whether there were any legends connected with them.

Mr. Bell—None whatever.

The President presented the thanks of the meeting to Mr. Bell for his valuable and interesting paper.

THIRTEENTH MEETING.

The Thirteenth Meeting was held on 27th February, 1886, the President in the chair.

The following list of Donations and Exchanges was read:

1. Monthly Weather Review, Dominion of Canada, Jan. 1886.
2. Electrical Review, Feb, 20th, '86.
3. Annals of Mathematics, University of Virginia, Vol. II., No. 1, Sept. '85.
4. Journal of the Chemical Society, New York, Vol. VII., No. 10, Dec. '85.
5. The American Naturalist, March, '86.
6. Journal of the Anthropological Institute of Great Britain and Ireland, Vol. 15, No. 3.
7. Proceedings of the Royal Society, Vol. XXXIX., No. 240.
8. The Chemical News, Feb. 12, '86.
9. Cosmos, 8 Février, '86.
10. Rendiconti del Circolo Matematico di Palermo, Marzo 1884, Marzo 1885.
11. Jahresbericht der Geographischen Gesellschaft von Bern, 1884, 1885.
12. Bulletin de la Société Impériale des Naturalistes de Moscou, Tome LXI. Nos. 1 et 2, 1885.
13. Electricité, 6 Février, '86.

14. Archivio di Letteratura Biblica ed Orientale, Anno VIII., No. 1, Gennaio 1886.
15. Mittheilungen der Anthropologischen Gesellschaft in Wien, XV. Band, II. Heft.
16. Annales de l'École Polytechnique de Delft, 3me et 4me Livraisons.
17. Mémoires de la Société Nationale des Antiquaires de France, Cinquième Serie, Tome 5*me*, Paris, 1884.
18. Wochenschrift des österreichischen Ingenieur-und Architekten, Vereines XV., No. 6. 5 Februar '86.

Total 19.

The following were elected members: Sydney B. Sykes, Robert A. Smith and Percy A. Bath.

A sale of Periodicals from the Reading Room was then held.

FIRST SERIES—Begun August, 1852; concluded December, 1855; 41 numbers, 3 vols. 4to.

SECOND SERIES—Begun January, 1856; concluded January, 1878; 92 numbers, 15 vols. 8vo.

THIRD SERIES—Begun 1879.

NOTES.

1.—The First Series has for title, "The Canadian Journal: a Repertory of Industry, Science and Art; and a Record of the Proceedings of the Canadian Institute." The Second series has for title, "The Canadian Journal of Science, Literature, and History." The title of the Third Series is, "Proceedings of the Canadian Institute." Parts 1 & 2, Third Series, are entitled "The Canadian Journal: Proceedings of the Canadian Institute."

2.—By inadvertence, No. 85 (November, 1873) of the "Canadian Journal," 2nd Series (Vol. XIV.) immediately follows No. 79. There is, however, no *lacuna* between these two numbers, as is shown by the fact that the paging is consecutive.

3.—Societies wishing to exchange back numbers of their Proceedings can be supplied with complete sets of the Publications of the Canadian Institute, except Vol. XV., No. 5, Second Series, and Vol. I., Part 1, Third Series.

4.—Members having either of the above, Vol. XV., No. 5, Second Series, April, 1877, or Vol. I., Parts 1, 3 & 5; Vol. II., Parts 1 & 2; Vol. III., Part I, Third Series, and being willing to part with them, will please communicate with the Assistant Secretary.


CANADIAN INSTITUTE
ESTABLISHED 1849