Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY,

FOR THE

SESSION 1884-85.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET.
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Belfast Natural History and Philosophical Society.

ESTABLISHED 1821.

SHAREHOLDERS.

1 Share in the Society costs £7.
2 Shares ,, ,, cost £14.
3 Shares ,, ,, cost £21.

The Proprietor of 1 Share pays 10s. per annum ; the proprietor of 2 Shares pays 5s. per annum ; the proprietor of three or more Shares stands exempt from further payment.

Shareholders only are eligible for election on the Council of Management.

MEMBERS.

There are two classes, Ordinary Members, who are expected to read Papers, and Visiting Members, who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in the succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due first November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto ; also of access to the Museum for himself and family, with the privilege of granting admission orders for inspecting the collections to any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 12 till 4 o'clock. Admission for Strangers, 6d each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

BELFAST

Natural History and Philosophical Society.

ANNUAL REPORT, 1885.

The Annual Meeting of the Shareholders of the Society was held on the 14th May, 1885, at three o'clock, in the Boardroom of the Museum, College Square North. The following were present:—Professor Cunningham, M.D.; Messrs. R. L. Patterson, J.P.; F. D. Ward, J.P.; James Henderson, W. H. Patterson, *Hon. Secretary*; John Brown, *Hon. Treasurer*; Robert Steen, Ph.D.; William Swanston, John Hind, Jun.; and Joseph Wright.

On the motion of Mr. Wright, seconded by Mr. Henderson, the chair was taken by Mr. R. L. Patterson.

The Hon. Secretary (Mr. W. H. Patterson) having read the advertisement calling the Meeting, submitted the Annual Report, which was as follows:—

The Council of the Belfast Natural History and Philosophical Society have now to present to the Members their Report of the working of the Society during the year now ended.

The Winter Session was opened on November 4th, 1884, with a paper on "The Construction and Use of Induction Coils," by Mr. John Brown. The second paper was read on the evening of December 2nd, by Mr. Robert Young, on "Old Japanese Art," and was illustrated by a series of very fine bronzes and other specimens, lent for the occasion by Mr. Henry Matier, and other gentlemen. The next paper was read on January 6th, 1885, by Mr. James Musgrave, on "A recent visit to America, including the Yellowstone Park and Colorado." The next paper was read on February 3rd, by Mr. Thomas Workman, the title was "Eastern Reminiscences." The paper for the next evening was read by Mr. John H. Greenhill, on the 3rd March, the subject was "Electric Lighting and Transmission of Power by Electricity." The attendance on this occasion was so large that many persons were unable to gain admittance to the lecture-room; Mr. Greenhill, therefore, kindly consented to repeat the lecture. This was done on Thursday, the 5th of March, before a very numerous audience. The next evening of meeting was March 24th. This was extra to the programme arranged at the commencement of the Session. The readers were Mr. John Brown, who made a communication on "A Stalactite formed by a Vapour;" and Mr. Wm. Workman, who read a paper on "The Ventilation and Heating of Churches and Drying-rooms." The last paper of the session was read by the Rev. Robert Workman, on "Land Tenure and Culture in Ancient Ireland," on April 14th.

The work of re-arranging the Museum collections has, during the past year, been confined to the extensive series of mineral specimens. This valuable collection has been classified according to the system adopted in "Dana's Manual of Mineralogy," and, with a few exceptions, each specimen has been furnished with a label stating name and locality. Some of the minerals recently received from the British Museum have been inserted into their proper places, and it is intended that the remainder shall in like manner be incorporated with the general collection. This will have the undesirable effect of still further increasing the present overcrowding; but in the absence of additional cases there is no more satisfactory method of displaying these specimens, which include several noteworthy additions to the existing stock.

A list of donations to the Museum, and of reports and other publications for the Society's library, is to be printed with the present Report. The Council would thank the various donors for their valuable gifts, and would call particular notice to the series of Eastern weapons and works of ornament, presented by Captain Robert Campbell, of the "Slieve Donard." The members will recollect that in the previous years Captain Campbell was also a donor of a number of interesting objects, collected by him while on his voyages at foreign ports. It is by taking an interest in this way of a practical nature in the Museum of the town with which they are connected by birth or residence, that persons can cause local collections to be substantially benefited. The Council would be gratified if other persons who have opportunities would follow Captain Campbell's example.

On Easter Monday the Museum was opened to the public at at charge of twopence for adults and one penny for children, and the attendance was, as usual, very large.

Your Council now retire from office, and this Meeting will be asked to select fifteen Members to form a new Council.

The Belfast Natural History and Philosophical Society, in account with Treasurer. For Year ending 1st May, 1885.

Dr. | **Cr.**

EXPENDITURE.

	£	s.	d.
To Cash paid Insurance Premiums	£11	5	0
,, ,, Printing Report	7	6	0
,, ,, Advertising	4	12	8
,, ,, Printing and Stationery ..	5	2	10
,, ,, Repairs	4	0	6
,, ,, Tea, etc.	1	0	6
,, ,, Rent till 1st May	25	0	0
,, ,, Collecting Subscriptions ..	6	6	4
,, ,, W. Darragh, Salary till 1st May	48	0	0
,, ,, S. A. Stewart, Salary till 1st May, less six months' leave ..	25	0	0
,, ,, Expenses on Easter Monday ..	7	7	0
,, ,, Coal, Coke, and Gas	14	4	8
,, ,, Postage	2	9	3
,, ,, Small Accounts	3	7	1
To Balance	10	6	9
	£175	8	7

RECEIPTS.

	£	s.	d.
By Balance in hands	£0	17	3
,, Interest on York St. Loan	19	12	9
,, Subscriptions	83	9	8
,, Donations	4	10	0
,, Proceeds of One Share sold	7	0	0
,, Transfer Fees	0	7	6
,, Contribution from Philo-Celtic Society, 1883-84	3	12	6
,, Contribution from Naturalists' Field Club, 1884-5	5	5	0
,, Contribution from Medical Assoc., 1884-5	3	10	0
,, Entrance Fees at door till 1st May ..	15	11	3
,, Do Easter Monday	31	12	8
	£175	8	7
By Balance	10	6	9

Examined with Vouchers, and found correct,

Wm. H. Patterson, } *Auditors.*
Samuel Andrews, }

J. Brown, *Hon. Treasurer.*

DONATIONS TO THE MUSEUM, 1884-5.

From The Natural History Museum, South Kensington.
380 specimens of minerals.

From Mr. George Donaldson, Belfast.

Portion of a plank taken out of the barque Rose on her return from the West Indies, and found to be completely perforated by the teredo.

From Charles Murphy, Esq., Rathfriland.

Four ancient querns formed of granite.

From John Moore, Esq., Moore Fort, Ballymoney, and Hawks Bay, New Zealand.

Two skins of Huias (wingless birds) ; one specimen of Jade.

From Joseph Wright, Esq., F.G.S.

A set of fossil sponge spicules from Ben Bulben.

From W. H. Patterson, Esq., M.R.I.A.

Portions of an ancient urn found at Dundrod, County Antrim.

From Captain Robert Campbell, Master of the Ship "Slieve Donard."

Two Malay shields, three Malay spears, one Malay walking-stick, one Japanese walking-stick, one Chinese walking-stick, two Japanese bronze candlesticks, one Chinese opium pipe, one Chinese tobacco pipe, one Chinese fancy dress sword made of cash, one Japanese fancy bowl with lid, three foreign bird skins, one Malay hat as used in the field.

From Rev. W. H. Lett, M.A., T.C.D.

Portions of antlers of deer, found in gravel at Maralin.

From Belfast Naturalists' Field Club.

Ancient boat with square stem and stern, formed out of an oak tree ; found at Lough Mourne, County Antrim, when the lake was drained in 1883.

LIST OF BOOKS RECEIVED, 1884-85.

BATH.—Journal of Microscopy. Vol. 3, part 9, January, 1884; and Rules, January, 1884. *The Editor.*

BELFAST.—Guide to Belfast, &c., by Dr. Esler *The Author.*

Naturalists' Field Club, Proceedings for 1879-80, 1881, 1882. *The Club.*

Jardine's Humming Birds *T. J. Mulligan.*

BERLIN.—Verhandlungen der Gesellschaft für Erdkunde. Band 11, nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 1884; band 12, nos. 1, 2, 3, 1885. *The Society.*

BOSTON.—Science Observer. Vol. 4, 43, 44, nos. 7, 8, 1884; vol. 4, nos. 9, 10.

Society of Natural History, Proceedings. Vol. 22, parts 2 and 3, 1883-84 *The Society.*

BREMEN.—Abhandlungen vom naturwissenschaftlichen Verein. Band 8, 2nd heft, and band 9, 1st heft, 1884.

BRESLAU.—Zeitschrift für Entomologie; Neue Folge Neuntes Heft, 1884.

BRIGHTON.—Brighton and Sussex Natural History Society, Annual Report, 1884. *The Society.*

BRUSSELS.—Société Entomologique de Belgique. (Comptes Rendus). 1884. *The Society.*

Comptes-Rendu des Séances. Series 3, nos. 44, 45, 46, 1884. *The Society.*

Société Royal de Botanique de Belgique. Bulletin, 1884. *The Society.*

BUENOS AYRES.—Accedemia Nacional de Ciencias en Cordoba (Republica Argentina).

Tomo 6, entrega 2, 3, and 4, 1884.
do. 7, do. 1, 2, and 3, 1884.
do. 8, do. 1, 1885.

BUENOS AYRES.—Boletin de la Accedemia Nacional de Ciencias en Cordoba (Republica Argentina). Tomo 6, entrega 1ª, 1884. *The Academy.*

CALCUTTA.—Memoirs of the Geological Survey.

Palaeontologica Indica. Series x, vol. 3, parts 2, 3, and 4, 1884.

Records. Vol. 17, parts 2, 3, 1884.

Geological Survey of India, Memoirs. Series 6, vol. 1, part 4. The Labyrinthodont, from the Bigoro Group. Series 10, vol. 3, part 5. Mastodon Teeth, from Perim Island.

Series 13, vol. 1, part 4, fascicule 3. Brachiopoda.
Do. 13, vol. 1, part 4, fasciculus 4. do.
Do. 14, vol. 1, part 5, do. 4. The fossil Echinioida.
Do. vol. 21, parts 2 and 3.

Report, vol. 17, parts 4 ; and vol. 18, part 1. *The Survey.*

CAMBRIDGE, U.S.A.—Bulletin Museum of Comparative Zoology. Vol. xi., no. 10, part 3. "Acalephs," 1884.

Museum of Comparative Zoology. No. 2, 3 and 4, 5, 6, 7, 8, and 11 of Geological Series, vol. 1, 1881 to 1884.

Annual Report, 1883-84. *The Museum.*

CARDIFF.—Report and Transactions Naturalists' Society. Vol. 15, 1883. 1884. *The Society.*

DAVENPORT, U.S.A.—Proceedings Davenport Academy of National Science. Vol. 3, part 3, 1879-81. 1883.

Elephant Pipes in the Museum. 1885. *The Academy.*

DANZIG.—Schriften Naturforschenden Gesellschaft.

Neue Folge Sechsten Bandes Erstes Heft. 1884. *The Society.*

DUBLIN.—Royal Dublin Society, Scientific Proceedings.

Vol. 1, series 2, parts 20, 21, 23 and 24, and 25.
Vol. 3, series 2, parts 1, 2, and 3.
Vol. 3, new series, parts 6 and 7.
Vol. 4, do. parts 1, 2, 3, and 4. *The Society.*

EDINBURGH.—Royal Physical Society, Proceedings 1858-59, 1859-60, 1860-61, 1861-62, 1874-75, 1875-76, 1876-78, 1878-79, 1879-80, 1880-81, 1881-82, 1882-83, 1883-84. *The Society.*

ELBERFELD.—Jahres Berichte des Naturwissenschaftlichen Vereins, sechstes Heft. 1884.

EMDEN.—Achtundsechszigster Jahresbericht Naturforschenden Gesellschaft, 1882-83. 1884. *The Society.*

ESSIA.—Essex Field Club, Transactions. Vol. 3, part 8 ; and Appendix, no. 1. *The Club.*

FLORENCE.—Bulletino della Societa Entomologica Italiana.
Anno sedicesimo Trimestri, 1 and 2. 1884.
Trimestri, 3 and 4. 1884., and
Atti Anno, 1882 to 1883. *The Society.*

GENOA.—Giornale della Societa di Letture e Conversazioni Scientifiche. Anno 8, fasc. 8 and 9. 1884.
Societa di Letture, &c.
Anno 8, fasciculus 12.
Anno 9, fasciulus 1 and 2, 3, 4 and 5, and 1 Supplement. *The Society.*

GLASGOW.—Proceedings Philosophical Society. Vol. 15, 1883-84. 1884. *The Society.*

Natural History Society, Proceedings. Vol. 2, parts 1 and 2 ; vol. 3, parts 1 and 3 ; Vol. 4, part 1. *The Society.*

GORLITZ.—Naturforschenden Gesellschaft. Vol. 18, 1884.

HAMBURG.—Naturwissenschaftlichen Verein.
Abhandlungen. Vol. 8, parts 1, 2, and 3. *The Society.*

LAUSANNE.—Bulletin de la Société Vaudoise des Sciences Naturelles. 2nd series, vol. xx, no. 90, 1884.
2nd series, vol. 20, no. 9, 1885. *The Society.*

LEIPSIG.—Sitzungsberchte der Naturforschenden Gesellschaft Zehnter Jahrgang, 1883. 1884. *The Society.*

LIVERPOOL.—Museums of Natural History, by the Rev. H. H. Higgins, M.A. *The Author.*

LONDON.—Memoirs of the Astronomical Society. Vol. 48, part 1, 1884. *The Society.*

Journal Royal Microscopical Society. Series 2, vol. 4, parts 3, 4, 5, and 6, 1884; vol 5, parts 1 and 2. *The Society.*

More Leaves from the Journal of the Life in the Highlands, by the Queen. 1884. *The Publishers.*

Proceedings Zoological Society. Parts 1, 2, 3, and 4.

List of Fellows, to June, 1884. 1884. *The Society.*

Illustrations of British Fungi, by M. C. Cook, M.A. 4 vols, and 13 parts, no. 18 to 31. *Lord Clermont.*

Diurnal Birds of Prey, by J. H. Gurney. *The Author.*

Asclepiad, by B. W. Richardson, M.D., F.R.S. *The Author.*

Stoechiological Medium, by J. F. Churchill, M.D. *The Author.*

A Guide to the Mineral Gallery, British Museum, South Kensington. *L. Fletcher.*

MANCHESTER.—Transactions Geological Society, Session 1883-84. Vol. 17, parts 16, 17, and 18. 1884.

Vol 18, nos. 1, 2, 3, 4, 5, 6, and 7. *The Society.*

Medical Chronicle. Vol. 1, no. 1.

MILWAUKEE.—Natural History Society, Proceedings, 1885. *The Society.*

NEW YORK.—Bulletin American Geographical Society. Parts 1, 2, 5, 6, 1884. *The Society.*

Microscopical Society Journal. Vol. 1, no. 2, 1885. *The Society.*

American Geographical Society, Bulletin. No. 3 and 4. *The Society.*

PHILADELPHIA.—Proceedings Academy of Natural Sciences. Parts 1, 2, and 3, January to April, 1884. *The Academy.*

PISA.—Atti della Societa Toscana di Scienze Naturali. Vol. 4, 3 parts, 1884-85 *The Society.*

ROMA.—Atti della R. Accademia die Lincei Anno 281, Serie Tereza. Vol. 18, fascicolo 11, 12, 13, 14, 15, 1884. *The Society.*

Reale Accademia dei Lincei Atti, 3 Series. Vol. 8, Fas. 16 Atti ; 4 Series, vol. 1, Fas. 1, 2, 3, 4, 5, 6, 7, 8, 9. *The Society.*

SONDERSHAUSEN.—Irmischia. No. 1 and 2, 5, 6 and 7, 8, 9, 10, 11, 12. *The Editor.*

STOCKHOLM.—Das Gehororgan der Wirbelthiere. Von Gustaf Retzius. Part 2. *The Society.*

TRIESTE.—Bolletino della Societa Adriatica di Scienze Naturali, Volume Ottavo, 1883-84.

VIENNA.—Mittheilungen des Ornithologischen Vereines, 1 Jahrgang. Nos. 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 1884.

2 Jahrgang. Nos. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 1885. *The Society.*

Verhandlungen der K. K. Geologischen Reichsanstalt. Nos. 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 1884 ; No. 1, 2, 3, 4, 5, 6, 1885. *The Society.*

Verhandlungen der K. K. Zoologish-botanishen Gessellschaft. Band 33, 1884 ; and Band 34, 1885.

Brasilische Suägethiere, 1883. *The Society.*

Verhandlungen der K. K. Zoologishen Reichsanstalt. Nos. 4, 5, 6, 7, 8, 9, 10, 11, 1884. *The Society.*

WARWICK.—Proceedings Warwickshire Naturalists' and Archæologists' Field Club, 1883. *The Club.*

WASHINGTON.—Geological Survey.

Second Annual Report, 1880-81. 1882. *The Survey*

Report of the Commissioner of Agriculture for 1883.

BELFAST
NATURAL HISTORY AND PHILOSOPHICAL SOCIETY,
SESSION 1884-85.

4th November, 1884.

Professor Everett in the Chair.

John Brown, Esq., read a Paper on

THE CONSTRUCTION AND USE OF INDUCTION COILS,

Illustrated by Examples and Experiments.

The reader exhibited a large coil of his own construction, with others of various types made by Mr. John Edgar and Mr. John H. Greenhill. The principles and action of coils, and the advantages of the disc method of building up the secondary were explained, as well as the most efficient disposition of a given amount of secondary on a given magnetic cone.

Some of the uses of the Induction Coil were illustrated by the illumination of a beautiful set of Crookes's tubes lent by Dr. Everett, the firing of submarine mines by the secondary current, etc.

2nd December, 1884.

James Wilson, Esq., in the Chair.

Robert M. Young, Esq., B.A., read a Paper on

OLD JAPANESE ART.

Mr. Young divided his paper into different sections. The first was devoted to a short sketch of the history of Japan from the time of the Emperor Jimmu, 660 B.C., to the year 1868, when the country was opened to foreigners, and that marvellous series of changes was inaugurated which has transformed the country from being the most backward to the position of the most civilised and enterprising State in the whole of Asia. The lecturer then proceeded to treat of the feudalism which formed so curious a part of the internal economy of Old Japan. He showed that it was almost identical with the military feudalism prevalent in mediæval Europe. The daimio, or baron, was then described. His territory and castle, with the dwellings of his vassals, the samurai, were shown completely to resemble the strongholds of the middle ages, as depicted in the pages of Froissart and Scott. The outline of the most popular Japanese tale of chivalry, the History of the 47 Ronin, was given to show what loyalty and devotion were displayed by the retainers to their lord in critical times, death being always preferred to dishonour.

The swords of the various periods were described in detail, and some interesting facts given of the etiquette practised with regard to that national weapon. A quotation was given from the "Romance of Prince Gengi," written by a learned Japanese lady in the 10th century, to show what advanced ideas were prevalent at that remote period with regard to art. Even the modern catchwords of "correct taste and high æsthetic principles" are found in this remarkable novel. A few of the leading facts in the history of Japanese art were then noted, particularly as regards the life of the Hogarth of the country, the renowned Hokusai. By the kindness of Mr. W. H. Patterson, his famous work, "The 100 views of the mountain Fusiyama," were exhibited, to show his skill. After a full explanation of the general principles on which their art is founded, and a description of the way a Japanese artist works, a quotation was given from Mr. W. Anderson, illustrating the distinction between the ordinary artisan and the inventor artist, who, gifted with talents of a very high order, designed and carried to completion the splendid works in bronze, porcelain, and lacquer which have reached Europe. Some amusing instances of the marvellous skill said to have been attained by the old masters were cited, such as that of the artist who drew a dragon, and, as he completed the eye of the monster, it rose and flew away. The famous horse painted on a temple screen was also mentioned, which was nightly accustomed to leave the picture and roam the rice fields, but was at last recognized, and its ravages stopped by blotting out the eyes of the masterpiece. The different substances employed in their art industries were indicated, and the concluding portion of the lecture was devoted to describing the more important, such as lacquer, ceramics, metalwork, and enamels. A concise history of the methods employed in lacquer was given, and examples of this beautiful art shown, more particularly on sword mountings. A fine example in the possession of the reader was exhibited, with eight distinct varieties of lacquer used on it, beside many other processes of inlaying and other arts peculiar to Japan. The remarks made on the various kinds of pottery and porcelain were illustrated by specimens of each manufacture. The stone wares of Bizen, Raku, and Soma were discussed, and the porcelain of Kaga and Kioto; whilst the famous Satsuma and its imitations were fully explained. The subject of metal work occupied some time, as, by the kindness of Mr. Henry Matier, J.P., a very choice collection of the finest old bronze and inlaid work was exhibited and described. Much satisfaction was expressed among the audience that the late disastrous fire at Dunlambert had not materially injured any of these masterpieces. The subject of bronze casting was entered into, and a brief account given of the Japanese process of founding, which is similar to that known in Europe as "cire perdu." The different subjects commonly chosen for delineation by their craftsmen were mentioned at length. The religions and mythology of the country were briefly touched on, the seven favourite divinities and the five monstrous animals frequently found on their art productions being remarked on, and examples of some of them pointed out as fashioned in bronze, pottery and enamels. The subject of enamels was taken up in the last place. The superiority of Japanese work was indicated by the comparison of some examples of the middle period, in the form of plaques and vases, with old Chinese work. The lecturer then concluded by giving a short description of some of the beautiful works in bronze and other metals kindly lent for exhibition on the occasion by Mr. Henry Matier, J.P. A large flower vase from a Japanese temple, cast in bronze, and properly inlaid with silver, having panels on each face in raised metals, one representing a god seated beside the national vehicle, the jinrishka, was much admired. Another was particularly noticeable for the skill with which a dragon, encircled by clouds, was depicted. A large plaque, with a monstrous cuttle-fish seizing an unfortunate wretch, who has endeavoured to pilfer a vase lying on the sea beach, was much remarked for the masterly skill displayed in its manipulation and the precious metals used. Specimens of the best work, in wrought iron, inlaid with gold, and chased in high relief, were also shown. The incense burners, of elaborate bronze work, are unique of their kind.

6th January, 1885.

PROFESSOR EVERETT in the Chair.

JAMES MUSGRAVE, ESQ., gave an account of

A RECENT VISIT TO AMERICA,

Including the Yellowstone Park and the Colorado, illustrated by Photographs.

MR. MUSGRAVE said, on the 7th August last he left Liverpool with one of his brothers, for New York, in the Germanic, one of the finest of that White Star line of steamers of which the people of Belfast had reason to feel proud. His object in proceeding to America was two-fold; first, to attend the meeting of the British Association at Montreal, which would give him an opportunity of gaining some knowledge of the Dominion of Canada; and, second, to visit, amongst other places, the scenery which the writings of Washington Irving and Fenimore Cooper had invested with the true spirit of romance, and to observe for himself, even superficially, the people and the institutions of that wonderful country.

Mr. Musgrave then described a visit to the Yellowstone Park, which a few years ago was set apart by Act of Congress as a national park for the American people. Mr. Rigg, president of the London Association of Engineers, had joined in the trip. A circular tour was arranged with the Northern Pacific, the Union Pacific, the Chicago and Alton, and the Baltimore and Ohio Railways, a tour which, with an extension into the Denver and Rio line, he could recommend to any one desirous of seeing that country. He wished to thank Mr. Mackenzie, of the Baltimore and Ohio in Philadelphia, and Mr. Macdougal, of the Northern Pacific in Montreal, for their attention and forethought, which enabled the party to accomplish the journey without a single hitch. After giving some account of the journey through the older parts of the United States, he said that at Rock Island they crossed the Mississippi, which, even at that distance from New Orleans, is a broad navigable river. There they saw the Government arsenal and armoury, which, as well as many private factories, are worked by water-power, derived from a great dam at Molines. St. Paul, the capital of Minnesota, is one of the most thriving towns in America, containing 100,000 inhabitants. Minneapolis, another town of almost equal importance, is only eight miles distant, and, though some jealousy exists, they are no doubt fated to become one town. St. Anthony's Fall is the overflow from what was said to be the greatest waterflow in America. It drives a large number of flour mills, one of which they examined carefully. It was said to turn out more flour than any other place in the world, and that they could well believe. What surprised them most was that the country appeared richer than that to the east of Chicago. There were rich corn crops on either side of the railway, interspersed with small towns devoted to various manufactures. He was shown a factory where one thousand ploughs were turned out every day.

From St. Paul they entered upon the vast tract of prairie land now so actively developing by the Northern Pacific Railway, through their commissioner, Mr. Lamborn, of St. Paul, who gave him the maps now on the table. Travelling day and night through the territories of Minnesota, Dakota, and Montana, they stopped at Amnabar, the nearest station to Yellowstone Park, which lies principally in the territory of Wyoming. The prairie was not so flat as he expected ; every here and there are hillocks, with occasional groups of small trees. The Missouri River is navigable for steamers up to the town of Bismarck, and there is a fine suspension bridge across the Missouri, connecting Bismarck with Mandan. At Dickenson they parted with a fellow-traveller, who was president of several large cattle ranches, and the groups of head ranchemen and cow boys who were waiting to receive him gave them a very favourable idea of the class of men engaged in developing that country. He produced a newspaper called the *Bad Lands Cow Boy*, which gave some idea of the state of society in that region. A special Pullman car was provided for members of the British Association at St. Paul. Sir Richard Temple and some of his friends from the Winnipeg excursion joined them at Targo, and the novelty and excitement of conveying so large a company in four-horse "stages" from the railway terminus over the rough roads and through the wild scenery leading to the Mammoth Springs Hotel was a fitting preparation for the extraordinary country they were about to see. They had been told that that hotel cost £40,000. Everything was on a large scale, and the electric light was used. It was crowded with the most picturesque assembly of men he had ever seen. Members of the British Association bargaining for carriages to convey them for a week through the park; stage coach owners and drivers, ranchemen, cowboys, trappers; most of them in distinctive and picturesque dress, formed a scene he enjoyed greatly. At dinner they noticed a party of six dining together. His brother fell into conversation afterwards with one of them, who, when he knew that they were Britishers, stepped out in front of them and exclaimed, "You are English; I love the English; I am an Englishman myself;" and then he described how he had been taken prisoner while serving in the army of Maximilian in Mexico, and obtained no relief from the American Consul, but when he applied to the British Consul he was immediately released, and added, "Is it any wonder I am proud of being an Englishman?" In the morning they visited the Mammoth Springs, which the lecturer then described, and exhibited photographs of them. In the course of their visit to the boiling springs, they met a noted photographer, Mr. Watkins, of California, who was so particular as to his atmospheric effects that he kept his camera ready in front of "Old Faithful" (the name of one of the springs) for two days, waiting for a clear sky, as clouds would have marred the picture. Having stopped at "Marshall's," where they met travellers of various nationalities, they made an early start for a long day's drive through the forest to the Grand Canon of the Yellowstone. The forest consisted mainly of young trees. In some parts there were miles of space covered with the black stems of trees, the result of forest fires, while the surface underneath was covered with young trees a foot or two high. Their coachman was invaluable in these long drives, of a class one rarely meets with at home. He was familiar with English literature, and full of curiosity as to England and the mode of life there. He had a capital tenor voice, and they asked him to sing the American National Anthem. He struck up the air of "God Save the Queen" to words which were new to them, and which, he thought, were little known in this country. He would give them the first verse :—

> "My country, 'tis of thee,
> Sweet land of liberty,
> Of thee I sing.
> Land where my fathers died—
> Land of the pilgrims' pride—
> From every mountain side
> Let freedom ring."

They all joined in a hearty chorus, recognising in such an apostrophe to liberty wedded to our own national air, another tie of sympathy between the American people and the mother country, which has been the parent of liberty in its best and broadest sense. Although very tired when they reached the tents near the Grand Canon, they started off to the Falls. The Yellowstone was a considerable river, and the height of the lower fall is 350 ft., more than double that of Niagara. The Grand Canon, of which many people spoke with the greatest rapture, surpassed anything he had seen of rugged scenery. A canon is a water course of immense depth. In Colorado and Wyoming there is so little rain that the river banks are not, as in this country, worn to an easy slope, but are so precipitous that they cannot be climbed. In Yellowstone Canon they could not get even half way down to the river, but, standing on a projecting point, they saw the river below, with steep cliffs rising to a height of some 1,200 feet on either side. The rocks were worn into pinnacles of the most fantastic forms, the prevailing tone a rich yellow, but stained in parts with colours so brilliant that they saw Mr. Thomas (an accomplished artist whose pictures he hoped to see at the Academy), who joined their party, use carmine and other vivid colours to produce his effects.

They next journeyed to Helena, Salt Lake City, the Rocky Mountains, the Colorado Springs, and back to New York by way of Kansas City, St. Louis, and Baltimore. Such were some of the physical characters of the portion of the American continent through which they travelled. He would conclude with a few words regarding the people. Owing to the unfortunate tendency of able writers to make amusing books of travel, the American people had been too often presented to them in a grotesque attitude. He expected to see them boastful, talking through their noses, and speaking a language which was a travestie of the English tongue. He found them free from "brag;" the men particularly expressed themselves on all subjects with moderation, and had much repose of manner, while their provincialisms were not more numerous than in England. He was glad to observe everywhere a tone of sympathy for the "Old Country," and a desire to have the good opinion of the "Britisher." The American people are thoroughly imbued with the spirit of the best English literature. Their principal class-books are English. Sir Henry Roscoe found his "Chemistry," and their companion, Mr. Rigg, found his history of the steam engine, in daily use in the Boston colleges. In the gallery at Washington devoted to mementos of those who worked for the independence of the United States, the portrait of Lord Chatham is placed by the side of Lafayette, and the speeches of the former, and of many other great English speakers, give the keynote of the best American oratory. A St. Louis gentleman told him that Thackeray's portrait of Colonel Newcome was his ideal of what a man should be. He was not long in America till he almost forgot he had crossed the Atlantic, and he came back from Canada and the United States impressed with the hope that we may never do anything to forfeit our position as the friends and natural leaders of the English-speaking race throughout the world.

The lecture was illustrated by large photographs of scenery, by geological specimens, and by diagrams, which were explained by the lecturer.

3rd February, 1885.

ROBERT YOUNG, Esq., C.E., in the Chair.

THOMAS WORKMAN, Esq., read a Paper on

EASTERN REMINISCENCES, WITH LANTERN AND PHOTOGRAPHIC ILLUSTRATIONS.

3rd March, 1885.

R. LLOYD PATTERSON, Esq., J.P., in the Chair.

J. H. GREENHILL, ESQ., read a Paper on

ELECTRIC LIGHT AND TRANSMISSION OF POWER BY ELECTRICITY.

And Repeated (by request of the Council) on 5th March, when DR. EVERETT, F.R.S., *presided.*

FRICTIONAL Electricity is always of high tension, but of small quantity. Thermo-Electricity has, up to the present, been of comparatively low tension, but of large quantity, whereas Voltaic and Magnetic Electricity may combine within certain limits both tension and quantity.

Metals in their relation as conductors of electricity may be compared to pipes for the conveyance of water, but with this notable difference, that whereas pipes of a given diameter or bore, whether made of lead, iron, copper, or fire-clay, will convey an equal quantity of water at a given pressure, metallic conductors of electricity vary enormously in this respect. For instance, a pure copper wire will conduct about seven times as much electricity of a given tension or pressure as an iron wire of the same size ; hence if iron cables were used instead of copper, they would require to be of much larger size where much current would be passed along, as in the case of central district lighting. No economy in the first cost would therefore arise, and it is this difficulty which operates so strongly in preventing stations for the supply of electricity being established.

Any fatal accidents which have occurred have invariably arisen with high tension currents, but it is noteworthy that currents of a certain tension may be practically harmless if continuous or unbroken, whereas the same "pressure" may produce most serious results if intermittent or alternating; in other words, if there are periods of cessation in the flow of the current, or if it is made to pass in one direction and then in the opposite. The Board of Trade stipulated, in the Act of Parliament passed for permitting companies to supply electricity from central stations for domestic use, that the tension for *direct* currents inside the house should not exceed 300 volts (the volt is a term applied to the unit of tension), whereas, with alternating currents, the limit should not exceed 100 volts. One advantage gained in the use of high pressure is that the sectional area of the copper wires for conducting the electricity may be much less than what would be necessary for low tension, thus reducing the first cost of the installation; and, up to certain limits, there is greater economy in the working; but on the other hand there are certain objections to very high tension (besides the danger), as the light produced when arc lights are employed is of an unpleasant blue or violet colour.

Frictional Electricity, because of its high tension, has not been used to any great extent, except for experimental purposes, or for the explosion of mines; but latterly a new field has been opened for its employmeut by a little apparatus for lighting gas.

It is noteworthy that although the so-called "storage" of electricity has created a great deal of interest of late, yet as a matter of fact the "bottling up" has been known for centuries in respect to Leyden jars, whereas the "storage" of the present day is not a material accumulation of the current, but merely changing the chemical condition of lead plates and the acid in which they are immersed, by the action of a current of electricity when passed through them, and it is the tendency for the lead plates and acid to return to their original condition, which again gives rise to new electrical currents when a connection is made to permit the currents to flow. The action which takes place in the lead plates and acid in the act of charging and discharging, is as follows, according to Dr. Frankland (see the report published in "The Electrician" of 31st March, 1883): "Occluded gases play no part, practically. The active material on lead plates is lead sulphate. The initial action in charging the battery is the electrolysis of sulphuric acid into hydrogen, sulphuric anhydride, and oxygen. The hydrogen decomposes the lead sulphate on the negative plate into spongy lead and sulphuric acid, whilst the oxygen decomposes the lead sulphate on the positive plate into lead peroxide and sulphuric anhydride. All sulphuric anhydride is at once converted into sulphuric acid. In discharging, the initial action is again the electrolysis of sulphuric acid, which restores the coating of the two plates to the original condition of lead sulphate. As the charging of a cell is attended with the liberation of sulphuric acid, and its discharge with the abstraction of this acid from the liquid contents of the cell, it is only necessary to ascertain the specific gravity and consequent strength of the acid, to determine the amount of charge in a cell at any given moment, provided that the specific gravity of the acid in the *charged* and *uncharged* conditions of the cell be previously known. In the case of a cell with which Frankland experimented, each increase of 0·005 in the specific gravity of the dilute acid, meant a 'storage' of available energy equal to 20 amperes for one hour."

"Thermo-electricity," by reason of its low tension, has only been used for electro plating, as in this process high tension is not admissible. "Voltaic electricity" has been employed to a limited extent for electric lighting; but one serious drawback to its general adoption for this purpose is the great expense entailed, as electricity produced by the consumption of zinc and acid in a battery costs, in round numbers, about ten times more than the same amount of electricity obtained by the use of a dynamo machine.

Soft iron, after being magnetised, loses nearly all its magnetism as soon as the exciting agent is removed; but it retains a very minute trace, although perhaps not sufficient to indicate its presence to a marked degree, and it is this residual trace which plays so important a part in dynamo machines.

All magnets have innumerable "lines of force," as they are technically called, in their vicinity; and unmistakable evidence of their existence is obtained when iron filings are brought within their influence. The filings cluster more densely near the ends of the magnet than at the centre, and they appear to arrange themselves in arcs of curves from one extremity to the other. In Fig. No. 3 on the screen, a novel arrangement of apparatus is shown, consisting of a magnet held between two sheets of glass. There is a third sheet of glass fastened at a little distance from the others, thus allowing a space in which iron filings can be scattered; thus the process in which they arrange themselves in the direction of the lines of force can be observed.

Soft iron or steel may not only be magnetised by proximity to another magnet, but it may also be acted upon to a far greater extent by wrapping insulated wire upon it, and sending a current along the wire. If the current is again passed along the wire in the opposite direction, the end which was formerly a North Pole is now a South. Faraday made the discovery that if a coil of wire with its ends connected together was moved in a certain manner near to a magnet, a powerful current was generated in the wire. Of course if the ends of the wire were not joined, no current was developed, as in all cases where a current passes along a wire, the circuit must be completed, either by direct connection of the ends, or by the interposition of some conducting medium, such as the earth or liquids, more especially if the latter are acidulated. Even in the case of "arc" electric lighting, although it may at first sight appear as if the circuit was broken between the carbons, as indicated by Fig. 4 on the screen, yet the continuity of the conducting medium is maintained by the intensely heated air at the point of separation, and by the particles of carbon which jump across the space. As the polarity of the magnet can be changed by reversing the direction in which the exciting current flows, so can the direction of the current in the coil be altered by changing the position of the poles of the magnet. In Fig. 5, the coil is supposed to move from left to right, or from the North pole of the magnet to the South. The current flows in the ring downward in the side nearest to us. When the ring approaches the centre of the magnet, the current gradually gets weaker, by reason of the fewer number of "lines of force" being embraced within it. The current begins to circulate in the ring in the opposite direction, after the centre of the magnet has been passed. The intensity at which the current flows in the ring is due to two things, namely the speed at which the movement is made along the magnet, and the "strength" of the magnet itself. A similar result occurs if the ring is made to move in the arc of a circle between the poles of a horse-shoe magnet, as shown in Fig. 6. In the next diagram (Fig. 7), the horizontal lines between the poles of a horse-shoe magnet are supposed to represent the "lines of force"; it will be observed that when the ring is perpendicular to these lines, it encircles the largest number; but when angled, the number decreases, thus producing a fall in the potential of the current.

It is possible to obtain all the effects of a magnet, although no iron or steel may be present. If, for instance, a wire is coiled into a ring or helix, and a current is caused to traverse it, the air space in the centre becomes filled with magnetic lines of force. Some electrical machines are constructed in this manner, so that lightness of the moving parts and ventilation may be obtained, besides avoiding what are termed Foucault or wasteful currents, which sometimes arise if iron is employed without due precaution having been taken in the construction. In the earlier machines, these wasteful currents in the iron itself proved highly objectionable, causing much power to be absorbed uselessly; but in good machines of the present day, iron is employed with great advantage, and without any wasteful currents being generated to signify.

Machines may be divided into two classes—*direct current* and *alternating*—and these may be subdivided into magneto and dynamo generators. In *direct current* machines, the electricity always flows along the conductor in one direction, but with *alternating* dynamos, the current flows in one direction, and then in the reverse, but the changes in direction amount to an immense number per minute, up to ten or twenty thousand.

In magneto machines, the magnets are permanent steel ones, but in dynamos the magnets are of iron, with coils of wire wrapped upon them, and the magnetism is produced by currents of electricity passing along the wire : such currents may either be produced by the machine itself, or by a separate "exciting" machine or battery. Again, in direct current dynamo machines in which the magnets are excited by their own currents, the magnets may be coiled with comparatively thick wire, and made to receive all the current generated, which, after passing along the coils surrounding the magnets, proceeds to the lamps or external circuit, thence back to the machine. These are termed "series" machines. Instead of the magnets having a comparatively short length of thick wire, thus producing but few turns, they may have an immense length of fine wire coiled upon them, and returning direct to the revolving armature (which is the name applied to the rotating coils of wire in which the currents are generated), with a separate set of conductors leading to the lamps; thus only a very small proportion of the current generated in the armature passes round the magnets, in consequence of the fineness of the wire and its extreme length. These are termed "shunt wound" machines. It is noteworthy that the small amount of current which passes round the magnets in a "shunt" machine is quite as effective as the large or total amount of current which flows round the magnets of a "series" machine, in consequence of the greater number of turns in the case of a "shunt" arrangement, as one ampere (the unit applied to *quantity*) passing along one hundred turns of wire on a magnet is as effective, practically, as one hundred amperes passing *once* round the iron. Frequently machines have their magnets coiled both with a fine "shunt" wire and a thick "series" one, and the current passes along both, but in inverse ratios to the relative resistances. They are thence termed "compound," and are generally employed for incandescent lighting, as they are more nearly self-regulating, provided a regular speed is maintained, whereas with "shunt" machines it may happen that if a great number of lamps are switched off, too much current passes through the remainder, thus injuring or utterly destroying them. The action of a dynamo machine is as follows:—When the armature is caused to rotate, the residual magnetism in the iron induces a feeble current in the revolving coils ; this current passes along the wire encircling the magnets, and strengthens the magnetism, which in turn induces a stronger current. Thus an action and reaction takes place, but with such amazing rapidity that practically the machine is enabled to generate its maximum strength of current instantaneously.

I have referred to both the "arc" and "incandescent" forms of electric light. The former is that produced by the separation of two carbons after the current has been established ; it meets with great resistance at the point of separation, and thereby heats up the ends of the carbon to an enormous temperature, thus producing a light of intense brilliancy. Both carbons consume away, but not at the same rate. The one at which the current enters from the machine, and called the "positive" carbon, is consumed twice as fast as its neighbour or "negative" carbon. The "positive" has a concave or hollow-shaped end, whereas the negative is pointed. A portion of the positive is carried to the negative by the action of the current. This is only the case when direct currents are used, but with alternating currents both carbons consume alike.

With "incandescent" lighting, the lamp consists of a small glass globe, from which all the oxygen has been exhausted. Inside the globe there is a fine filament of a carbonised material, made by different inventors from various products, but in the final condition reduced to carbon. The current traverses this filament, which being of considerable resistance, becomes heated to whiteness, and thus gives off a beautifully clear and soft light With reference to the power required to drive an electric machine employed for generating currents of electricity for "arc" or for "incandescent" lighting, the same power will produce about ten times the aggregate light with an "arc" compared to "incandescent," hence it is more economical where large spaces have to be illuminated ; but for confined spaces, especially where there is not much head room, the arc light is far too brilliant. Under these conditions, the loss of power can be submitted to in the employment of the "incandescent" light. As a rule, one actual horse-power will give from 1,500 to 1,800 candle power by arc lighting, or from 160 to 180 candles by incandescent lamps. Another system of lamp, somewhat between the arc and the incandescent, is what has been termed "semi-incandescent." It consists of a thin rod of carbon which is caused to press against a heavy block of the same or other material, and the light is emitted where the two unite; but this method has not been much employed.

The method in which an installation of *arc* lighting is carried out is quite different from that which has to be adopted for *incandescent.* In the former, the lamps are arranged in "series," that is, the current is driven through the first lamp, then through the second, and so on, finally returning to the machine. The *quantity* of electricity required is always the same whether one or forty lamps are used, but the *potential* or *pressure* of the current has to be increased for every lamp. With incandescent lighting, a portion of the current is sent through each lamp independently of its neighbour. The cables are arranged in parallels, very similar to the sides of a step-ladder, and the incandescent lamps are attached between them, thus being analogous to the steps of the ladder. It is obvious by this arrangement that the *pressure* or *potential* of the current should remain constant, but the *quantity* should be in proportion to the number of lamps, ten lamps requiring ten times as much current as one lamp.

Now, as regards the danger of fire in connection with electric lighting, there is no artificial mode of illumination so *safe* if properly installed, and none so *dangerous* if erected in ignorance of what is necessary. The danger arises from what I may term the insidious nature of the current. If there is a leak in a gas pipe, it can generally be detected without the reprehensible method of trying for it with a light, but there may be a condition of affairs with an improperly erected installation of the electric light which will give no warning before damage is done. For instance, cables may be dangerously near to iron without being properly protected; in course of time they may come into metallic contact with the iron, and serious results may happen. Now it is possible so to arrange matters that even if all the cables or wires in the building were adjacent to metallic materials, no serious harm could happen; and the method is to insert in various parts of the building *safety fusible connections*, so that if any accidental "short-circuiting" should occur, the safety fuse would instantly melt, and thus stop all further progress of the current. Another ingenious method is by using patent safety cut outs, which consist of a magnet and counter weight or spring. The latter overpowers the magnet's influence under ordinary circumstances, but if the current, from any cause, increases beyond its normal strength, the power of the magnet is increased, and overcomes the weight or spring, and thus stops the current altogether. Again, the cables and wires may all be well protected from any external metallic fittings, and yet there may be danger of the wires getting very hot by reason of them being far too small in sectional area for the current they have to carry. The fusible connections are equally effective in this event.

As to the advantages of using the electric light for mills, factories, business premises, and private houses, there are numerous cases where electricity is infinitely superior and very much cheaper than gas; and on the other hand, there are many places where gas is cheaper, and good enough as an illuminant. Wherever power is available, either by water or steam, then the electric light is by far the best, especially if the hours of lighting are sufficient to permit only a small per-centage of interest on first cost to fall upon each hour's lighting. Flour mills, which generally work all night, are well adapted for the electric light, whereas large factories, whose ceilings are so low that arc lights are not suitable, and where light is required for only a few hours daily, even in the winter months, do not offer such a good opportunity to make the incandescent electric light pay. Again, in shops, the cost of gas may possibly be somewhat less than the electric light, especially if power has to be specially provided, but the gain annually in the preservation of the fragile goods by the use of the electric light compared to the destruction caused by gas, (not to speak of the unhealthiness by the latter to the employés), is so enormous, that many firms who have adopted electricity, in London and elsewhere, have increased the original installations four-fold. With respect to the employment of incandescent lamps in houses, I have had personal experience of the benefit arising by the use of electricity over other artificial modes of lighting, as I have had the electric light in my house for several months, with most satisfactory results. A careful perusal of the following table will no doubt prove instructive. It was read by Mr. Crompton at the Health Exhibition in London; the results were the work of Dr. Meymott Tidy and others :—

Burned to give light of 12 candles, equal to 120 grains per hour.	Cubic feet of Oxygen consumed.	Cubic feet of air consumed.	Cubic feet of Carbonic Acid produced	Cubic feet of air vitated.	Heat produced in lbs. of water raised 10° Farht.
Cannel Gas ...	3·30	16·50	2·01	217·50	195·00
Common Gas ...	5·45	17·25	3·21	348·25	278 60
Sperm Oil ...	4·75	23·75	3·33	356·75	233·50
Benzole ...	4·46	22·30	3·54	376·30	232·60
Paraffin ...	6·81	34·05	4·50	484·05	361·90
Camphine ...	6·65	33·25	4·77	510·25	325 10
Sperm Candles ...	7·57	37·85	5·77	614·85	351·70
Wax Candles ...	8·41	42·05	5·90	632·25	383·10
Stearic Candles ...	8·82	44·10	6·25	669·10	374·70
Tallow Candles ...	12·00	60·00	8·73	933·00	505·40
Incandescent Electric Light	none	none	none	none	·13·80

It will be seen by the above that bad as gas may be, it is not nearly so injurious as oil and candles, but the electric light is far superior to them all.

With reference to the use of electricity as a transmitter of power, the machinery employed is a double set of dynamos, practically the same as used in electric lighting. By driving one machine, the current is generated, and by allowing this current to pass through another machine, its armature revolves, and either propels a car, or turns other machinery. When electricity is employed for the propulsion of tramcars, the current may be conveyed along an insulated rail or cable, and collected by the running vehicle by means of a brush of copper wires made to press on the conducting rail. As a rule, only from 50 to 60 per cent of the original power can be utilized when transmitted by electricity, but even this small percentage may be most valuable in certain cases, especially if the original power is obtained from a waterfall which would otherwise go to waste, such, for instance, as the electric tramway at Portrush.

Another method for making use of electricity for motive power is by using accumulators or storage batteries. The objection to these at present is their weight and size, but I believe there is a great future for the employment of storage batteries, and it would not surprise me to find the tramcars of Belfast and other towns propelled by electricity before many years pass by. Storage batteries are of immense service where temporary stoppages of the machinery occur, or for the regulation of the light when the power is of a fluctuating nature; also, where a few lights are required to be kept in operation all night.

The lecture was illustrated by numerous photographs thrown on a screen by dissolving lanterns, operated by Mr. R. W. Welch. Not only were there diagrams for shewing the special parts of the machines, but the various types of the leading dynamos of different construction were illustrated. The experiments, named by Mr. Greenhill in the early part of the paper, were most successfully carried out.

At the conclusion, on the second evening, Prof. Everett, F.R.S., in proposing a vote of thanks, said, that he felt great pleasure in presiding that night, and he was very much pleased that the lecture had been repeated, as it gave him and others who were not present on the first evening, an opportunity of hearing it on the second occasion. He had to congratulate Mr. Greenhill for the lucid explanations of what some might think rather complex matters, and for the successful way in which the experiments had been carried out. He was sure that it must have been a matter of surprise to many to witness the very steep gradient which the small electric car had been able to ascend, and he also wished to direct the attention of the audience to the extremely small dimensions of the dynamo which Mr. Greenhill had constructed for his experiments, but which proved so remarkably powerful.

24th March, 1885.

Joseph J. Murphy, Esq., in the Chair.

J. Brown, Esq., read a Paper on

FORMATION OF A STALACTITE BY VAPOUR.

The reader described a curious phenomenon which he had observed during the electrolysis of the double chloride of aluminium and sodium fused in a small porcelain crucible provided with a porous partition. The anode was of carbon, and the cathode platinum-foil.

A considerable quantity of vapour was given off, especially from about the anode, forming a white smoke and depositing a white substance, doubtless mainly hydrated aluminium chloride, on the carbon rod, and about the mouth of the crucible, ultimately closing up the latter all but a small hole, through which the vapour poured rapidly. From this hole there grew out a beautifully delicate little tube about $1\frac{1}{2}$ inch long, and tapering from about $\frac{1}{6}$ inch at the base to $\frac{1}{10}$ inch in the middle of its length, after which it increased in diameter, and also flattened out owing to the vapour-jet coming close over the bend of the platinum-foil cathode, which seemed to cause, by some kind of eddy current, a flattening of the stream of vapour.

Soon afterwards the supply of vapour slackened, and there was a corresponding diminution in the size of the tube in the last quarter-inch of its length till the end became almost closed. The formation of this tube seems quite analogous to that of the ordinary tubular lime-carbonate stalactite deposited from dropping water by contact with the atmosphere ; only we have here a tubular deposit of hydrated aluminium chloride by the combination, at the edge of the growing tube, of the water-vapour in the air with the anhydrous chloride contained in the vapour-stream.

24th March, 1885.

Joseph J. Murphy, Esq., in the Chair

William Workman, Esq., read a Paper on

VENTILATION AND HEATING OF CHURCHES AND DRYING ROOMS.

Heating and ventilation are mostly in inverse ratio to one another. If ventilation be good, heat is little, and draughts great, coughs, both loud and deep, vie with the speaker for the attention he should have, and never fail to get more than an intelligent audience should give to inarticulate sound. If heat be good, carbon acid rapidly accumulates, and heads nod more familiarly than reverently towards him who desires their lively attention. The problem to be solved may be thus stated :—How to obtain air without coughs, and heat without headaches ;—or, ventilation without draughts, and warmth without running it to waste through ventilators.

I suppose a church or assembly-room to be air-tight as buildings go, that there be no ventilating openings except where indicated, and that the seams of the ceiling, if sheeted with wood, be fairly close and tight. At one end the heating apparatus is placed. There is no reason why it should not be inside the building instead of attached, should circumstances make that arrangement desirable. To the heating chamber a flue leads to supply fresh air. Opening below the level of the apparatus from it ascends another close to the level of the ceiling, where it discharges freely the hot air into the building. The outlets for the cold air are through the floor, numerous and moderate in size, opening into a flue below the floor, and carried to an upright flue, ending at or above the top of the building like a chimney. The expected result from this arrangement, tracing the air from its inlet, is—the air being admitted below the level of the heating apparatus—none of the heated air is likely to escape from a blow-down ;—also, having a flue full of heated air of considerable height, force is added to the current in proportion to the height. When discharging into the church according to the law of lighter fluids, it will float on the colder air, forming a sheet of warm air close under the ceiling. This will constantly be supplied and displaced downwards by the continuous flow of hot air from the flue, until ultimately all the original cold air is displaced by the warm air. While this is going on above, the coldest air is continuously being driven down through the openings in the floor, carried through the horizontal flue to the upright one, where, still having some ascending power from the remains of its heat derived from the apparatus and that added to it by the assembly, it will assist in keeping up the circulation. The draught towards an outlet for air is of a very different nature to that from an inlet, being more diffused and tending to flow in radii towards the centre, namely, the outlet. Those from an inlet may pass for a considerable distance in an unbroken stream, and, if passing in with much velocity, may stir up a wide area of draught by its friction. This may be observed on a stormy night by opening a window half-an-inch wide when the wind is blowing against it: this will stir the whole air of a moderate sized room so that a draught may be felt in almost any part of it. The two flues, when no heat is being used, would still act to some extent as ventilators. In the case of a room full of people, if there were only a very slight current at first, it would soon increase by the heated air from the assembly passing up the outlet flue, the pure cool air being, as it were, pulled in up the inlet flue. The air in the building should be as much as possible under the same conditions as in that a diving-bell, where the only escape is at the bottom. The same plan, it would seem to me, would be the most economical method of applying heat in drying rooms for yarn, &c., as none but the coolest air could escape, and the amount of hot air admitted could be regulated, so that no air would leave the apartment until completely saturated with vapour. By the ordinary method in use, for heating both drying rooms and churches, the hottest air immediately makes its way to the highest part of the building, and escapes by the nearest outlet before it has done much of its intended work. A method which has been successfully tried in our iron war ships, but not yet in our churches—that is, to coat the interior with a non-conducting paint—would be worth the experiment; it would likely prove a means of saving fuel and adding considerably to comfort. Every one knows how much more comfortable a new house seems, and no doubt is, after it has been papered and painted, and how one will almost be inclined to shiver on going into a new house with its bare plastered walls. It is not a mere imagination that drawing the curtain close adds to the comfort of a sitting-room on a cold winter night. The curtains are really like blankets, only more distant from the body than would be comfortable in bed. Let anyone try sleeping in a room with the blind up in the cold weather instead of drawn down. The difference in temperature will be quite perceptible without the help of a thermometer, a difference hardly to be expected from a thin piece of cotton hanging in front of the window, or the loosely-fitting slips of a Venetian blind. We have all noticed the dew forming on the carafe of cold water on a dining-table. Often it will trickle down in streams. Did anyone ever notice the table-cloth or napkin in that state, or even damp, from the same cause? In former days tapestry must have added materially to the comfort of rooms, acting as a non-conductor between the cold walls of the building and the bodies of its inmates.

April 14th, 1885.

W. H. Patterson, Esq., in the Chair.

The Rev. Robert Workman, B.D., read a Paper on

LAND TENURE AND CULTURE IN ANCIENT IRELAND.

The Rev. Mr. Workman in the first half of his paper endeavoured to show that all the peoples of Christendom originally held the land in common, and that the institution now known as "the village community" prevailed amongst them. This, he said, was originally the condition of Ireland. In Ireland every "community" became a clan, and the chief soon gained a position of great power. In the primitive period, the members of the clan were comparatively independent of the chief, who was merely their headman or leader ; but by the sixteenth century the chief had become chief lord and absolute owner of the land, which he rack-rented. Having referred to the circumstances which brought about this change, Mr. Workman made a lengthened and interesting reference to some curious customs pertaining to agriculture that existed among the ancient Irish. It was perfectly evident, he said, that only a small part of Ireland was cultivated during the 16th century. If they were to credit the high authority of Sir W. Petty, the population at that period could not have been very much above a million. Such a population did not require a large area of tilled land, and no works of supererogation were performed by them. From an early period, moreover, Ireland was a country of forests. In

1542, "the English troops, penetrating to the centre of Ulster, found it a jungle. Tyrone County is described as not containing one single castle, nor yet one town walled, but full of wood, great bogs, and waters, here called loughs." The English, whose appetites were proverbially good, could hardly understand how the Irish got a living in so desolate a land. In 1560, Lord Fitzwilliam, Governor of Dublin, in great fear about rebellion, wrote—"The country is for the most part a wilderness, but the desolation is no security; the Irish would keep the field when the English would starve. No men of war ever lived the like, or others of God's making, touching feeding and living." In ancient times the good cheer of Tara consisted in devouring great quantities of meat, for neither bread nor drink were mentioned. Nor did bread appear to have been the staff of life to the Irish people of the 16th century. Export of hides was the mark of a pastoral flesh-eating people; and about the middle of the 16th century "the Irish sent great quantities of raw and tanned hides and sheepskins and some furs to Antwerp, also some coarse linen and woollen cloths." Fish were exchanged with France and Spain for wares by chieftains on the coast. They must suppose that after the Plantation, Ulster rapidly prospered in agriculture, and became largely a grain-producing country; but the records of the exportation from Belfast in 1663 showed by their preponderance of flesh, tallow, and skins that the greater part of the land was untilled. Having further referred to the character of the exports at later periods, with a view of indicating the condition of the land as regards cultivation and the pursuits of the people, Mr. Workman, in conclusion, said the subject affords fresh illustration of the persistent tenacity of the characteristics that distinguish the different races of mankind. We are assured that the negro race is as old as the Egyptian monuments, and we know that the Jews have continued to be the world's greatest merchants for more than 2,000 years. So here in Ireland we may regard the eagerness with which our peasantry cling to the soil as a survival of the spirit of the ancient village community, the absolute owner of its own land. Moreover, the pastoral instinct has prevailed over the agricultural amidst all the changes of Irish history. At the present day, Ireland is specially a grazing country, and the Irishman has a proverbial liking for cattle, and pigs, and horses, and must be regarded as one of the least successful agriculturists of the Old World, whilst we are told that it is the Scotchman or the Englishman, rather than the Irishman, who becomes the great cultivator of the boundless grain-growing prairies of the New World.

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