Proceedings and Reports

OF THE BELFAST
NATURAL HISTORY
and
PHILOSOPHICAL
SOCIETY

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1821

SESSION
1924-25.

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Proceedings and Reports

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BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY

———FOR THE———

SESSION 1924-25.

EDITED BY
ARTHUR DEANE, F.R.S.E., M.R.I.A.
HON. SECRETARY.

Belfast:
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1926.

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[ESTABLISHED 1821.]

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The membership of the Society consists of Shareholders, Annual Subscribers and Honorary Members.

Shareholders holding more than two shares are not liable for an annual subscription, but shareholders of two shares pay an annual subscription of five shillings, and holders of one pay ten shillings.

In 1914 a new class of membership was created including persons of either sex, to be elected under the bye-laws of the Society, and admitted by the Council on payment of ten shillings per annum. Such members have all the privileges of the Society, and take part in any business of the Society not affecting the ownership of its property. In 1917 an Archaeological Section was founded. Persons wishing to join the Section must be members of the Society and pay an additional minimum subscription of five shillings per annum. An Application Form for Membership to the Society and to the Section will be found on page vii.

A general meeting of Shareholders and Members is held annually to receive the Report of the Council and the Statement of Accounts for the preceding year ending 31st October, to elect members of Council, to replace those retiring by rotation or for other reasons, and to transact any other business incidental to an Annual Meeting.

The Council elect from among their own number a President and other officers of the Society.

Each member has the right of personal attendance at the ordinary lectures of the Society, and the privilege of introducing two friends for admission to such.

Any further information required may be obtained from the Hon. Secretary at:—The Museum, College Square North, Belfast.

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Belfast Natural History and Philosophical Society.

Founded 5th June, 1821.

Application Form for Membership.

To be filled up by the Candidate.

Name, etc. ....

[Please write name in full.]

Description ....

Residence ....

....

.........................., being desirous of becoming a Member of the Society, I, the undersigned member, recommend........ as a suitable candidate for election.

Dated this..........day of.............................., 19.....

Signature of Member ....

[Candidate must be known to the Member signing this form.]
[*All applications are subject to the approval of the Council.*]

Received .... Elected by Council ....

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Signature of Candidate } ....

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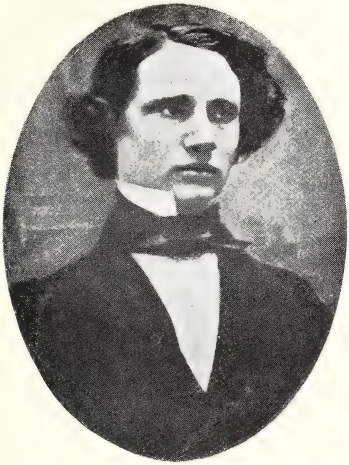


Lord Kelvin at the age of 22.
From the Jubilee Commemoration Volume.

Lord Kelvin at the age of 82.
From Prof. S. P. Thompson's "Life."

[See also Plates following Page 9.]

PROCEEDINGS OF THE BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY. SESSION 1924-25.

---o---

4th November, 1924.

In Museum, College Square N.,

PRESIDENTIAL ADDRESS, LORD KELVIN.

By Professor W. B. Morton, M.A., M.R.I.A.

Any account of William Thomson, Lord Kelvin, must begin with his father, James Thomson. There is a special reason for this, over and above the interest which attaches to the heredity of a great man. When genius has appeared in the world it has often had a double task to perform; to free itself from a cramped and unfavourable environment and then to do its special work. In the case of the Thomsons these tasks were divided. It was the father who broke away from the farm in County Down where his ancestors had lived for four generations. By his ability and force of character he made a place for himself in the world of learning, and a home filled with eager interest in the things of the mind. In such surroundings the genius of the son found everything favourable to its rapid development and full expression. So, in a way, the two lives seem to combine into a continuous whole, the life of strenuous preparation followed by the life of splendid achievement.

The way to knowedge was opened for James Thomson, as it has been for many another farmer's son, by a scholarly country minister. The Thomson home was near the Spa at Ballynahinch, and at Ballykine, not far away, a school was opened by the Rev. Samuel Edgar, the minister of the Secession body of Presbyterians in that district. He was a man of note in his day and was afterwards chosen to be

Professor of Theology at the College in Belfast. He was succeeded in his chair by his son John Edgar, the well-known philanthropist, and in Ballynahinch, at church and school, by another son, Robert Edgar. James Thomson became an assistant teacher in the school, and entered the University of Glasgow, spending the winter there in four sessions while supporting himself by teaching at home during the successive vacations. He wrote a series of text-books, in particular an arithmetic which was used by many generations of Irish schoolboys. When the Belfast Academical Institution was opened in 1814, he was the first teacher of mathematics, and was shortly afterwards promoted to the Professorship in the Belfast College. He built two houses in College Square East, one of which, No. 17, he occupied. In 1832 he was called to the chair of Mathematics in Glasgow. His second son William was then eight years of age.

Two years later, at the ripe ages of ten and twelve, William Thomson and his elder brother James matriculated in Glasgow University. So great was their precocious ability and so thorough the preliminary education received from their father that they were able to profit by the College classes and to win prizes in competition with older students. It is to be remembered that Scottish lads in those days went to College at earlier ages than is now the custom. For the Thomson boys the College took the place which the school does for the ordinary boy; and when William, who proved himself to be the more brilliant of the two, went up to Cambridge at the age of 17 his knowledge and maturity of thought placed him in a different class from the ordinary undergraduate even of the best type. Notwithstanding this, he entered into the life of the place with the zest of the normal undergraduate. "Thomson of Peterhouse" was one of the founders of the "University Musical Society" and played the cornet; he went in for rowing, and won the "Colquhoun Sculls." Meanwhile he was contributing original papers to the "Cambridge Mathematical Journal," signing them "P.Q.R.," as if to avoid by this anonymity any assumption of superiority over his fellows. At the Tripos of 1845 he was second Wrangler, being beaten by a man who had been practising the rapid writing-out of examination answers while his great rival was adding to knowledge by his researches.

Meanwhile at Glasgow Professor James Thomson was planning the future career of his brilliant son. The Professor of Natural Philosophy, Dr. Meikleham, was very old and infirm, and had been obliged, even before William went to Cambridge, to delegate his work to substitutes. A vacancy in the chair was bound to come soon, and the father was determined that the son should be in all points qualified to fill it when the time came. Accordingly in the year following his graduation William was sent to Paris to make the personal acquaintance of the French mathematicians and physicists, among whom his work was already known, and to widen his experience in the experimental side of Natural Philosophy. Everything fell out as it was hoped. In 1846 the chair fell vacant. The application sent in to the electors by the young man of 22 was accompanied by testimonials from all the greatest scientific men of Britain and France and by a list of 26 original papers already published. His election was unanimous, and so began the greatest scientific professorship of all time. It lasted till 1899, when at the age of 75 Lord Kelvin resigned his chair and enrolled himself as a "research student" of Glasgow University. It was a quaint fancy on the part of the veteran man of science, but "research student" continued to be a correct description up to the very end of his life. For eight years he continued to think and to write, both on those fundamental questions which had always occupied his mind, and on the new subject of radio-activity, which was to bring such profound modification in our views on the structure of matter.

It was a life of singular unity, consistency and completeness. Except for the adventure of the Atlantic cable, it was outwardly uneventful. But the mental life was lived at the unresting speed of genius, a life full of excitement, of eager search and discovery, of intense and wide interest, of constant give and take with other minds, of splendid service to humanity.

In attempting to give some account of this long life of thought, action and influence I shall speak of his work, first in abstract Physical Science, then in the application of Physics to practical ends, and lastly of his personal influence on his contemporaries. His especial greatness lay in the close union of the discoverer, the inventor and the teacher.

His advances in theoretical Physics were based on an intimate knowledge of the work of the great school of French Mathematical Physicists. While still a boy he had made himself acquainted with the writings of Lagrange, Laplace and Poisson, and just before leaving Glasgow he had eagerly read the work of Fourier on the theory of Heat-conduction. Nowadays the student at a University derives his knowledge from text-books which systematise the results obtained in the different branches and make it possible for the average man to gain a knowledge of a fairly wide range. In those days before text-books the average man learned nothing at all of advanced subjects, but the exceptional man, who was able to read the original authorities, derived a much greater insight and inspiration from his contact, at first hand, with the thought of a master-mind. This was the case of William Thomson. There were three books of which he always talked with a grateful enthusiasm, viz., the work of Fourier just mentioned, "Théorie Analytique de la Chaleur," Carnot's "Reflexions sur la Puissance Motrice du Feu," and Green's "Essay on the Application of Mathematical Analysis to Electricity and Magnetism." The second and third were books which he himself discovered; being in advance of their time they had utterly failed to obtain recognition, and had been forgotten. All three exercised a profound influence on the work of Thomson. Fourier's work formed the starting point of researches on the conduction of heat in the crust of the Earth, which led to an estimate of the length of time required for the globe to cool down to its present condition. This produced a famous controversy with the geologists whose views on the age of the Earth required a much more liberal allowance of time. The dispute has lost interest now, since the discovery of a new source of heat in the radioactive minerals. Of much greater importance was the work inspired by Carnot; work which made Thomson rank along with the Germans Helmholtz and Clausius, as one of the founders of the Science of Thermodynamics. At the time when he entered on his professorship the caloric theory still held the field, according to which heat was an imponderable and indestructible fluid. The experiments of Joule, carried out about that time, supported the modern view that heat was a form of energy, a view which had been put forward earlier, on theoretical grounds, by Mayer. Thomson was greatly impressed by the work of Joule, with whom he formed a close personal friendship. For some time, however, he hesitated to accept the new theory as to the nature of heat, because the argument of Carnot regarding the efficiency of heat-engines was based on the caloric theory, and led to results of undoubted validity. Ultimately he was able to reconcile the conflicting points of view and establish definitely the laws which govern the transformation of heat into mechanical work.

In Electricity his earliest work was occupied with the way in which electric charges distribute themselves over conductors. In this connexion he devised, while yet an undergraduate, a quite original method of great beauty and power. Afterwards he wrote and experimented in many departments of Electrical Science including the nature of Magnetism and the propagation of electric signals along cables. He was the first to deduce the existence of the electrical surgings in which the waves of "wireless" have their origin. He was mainly instrumental in settling the system of electrical units, and he founded the science of exact electrical measurement by his many designs of instruments. His laboratory was the first in which research work on electrical and other properties of matter were carried out by a band of advanced students.

Lord Kelvin's most absorbing interest on theoretical matters was the nature of the aether. This subject was never far from his thoughts, and he returned to it again and again throughout the whole of his life. The object of his search, one which occupied the minds also of all his great contemporaries, was a mechanical aether which would "work." To explain, we go back to the origin of the wave-theory of light founded by Huygens in the 17th century and by Young at the beginning of the 19th. This theory had its foundation in the fact that many of the phenomena of light were analogous to those which could be produced by wave-motion through a medium. The theory was developed mathematically by Fresnel, and the agreement with observation was so satisfactory that belief in the real existence of the hypothetical medium became absolute. But the aether was found to be strangely elusive when attempts were made to penetrate into its inner nature, to imagine how its parts moved in transmitting the light-waves, to find out its relation to ordinary matter and to the phenomena of electricity and magnetism. All the "models" which were devised failed in some respect, that is to say, the behaviour deduced from the supposed mechanical properties of the medium did not agree with the observed behaviour of light, Lord Kelvin towards the end of his life confessed to a sense of failure in this life-long effort, but he did not labour in vain. Not only did results of great value in Mathematical Physics accrue from his investigations, but also, by his thorough exploration of the possiblities in this region, he left physical speculation in our day free to try other paths.

In the bronze statute by Mr. Bruce Joy which stands in our Botanic Gardens Park, Lord Kelvin holds in his hand a piece of paper on which is a diagram of four linked gyrostats. This recalls his great interest in Dynamics, the science of motion and force, and specially in the theory of spinning motion. His work on this subject is embodied in the classical treatise on "Natural Philosophy" written in collaboration with his Edinburgh colleague, Prof. P. G. Tait. This was intended as a first volume of a large work which should extend over all departments of Physics. The larger scheme was abandoned, partly on account of the other pre-occupations of the authors and partly because the ground was covered by separate works like Lord Rayleigh's "Sound" and Maxwell's "Electricity and Magnetism." As it stands the book is unique in its profound and exhaustive treatment of the subjects which form the foundation of all Physical science. The designation "Thomson and Tait" is usually replaced by the contraction "T and T′" which is due to the writers themselves. In their correspondence they began their letters with "O T" and "O T′" instead of the conventional openings.

It was Lord Kelvin's work in connexion with the laying of the Atlantic cable which brought him into the greatest public prominence and led to his knighthood in 1866.

There could have been no success but for his profound knowledge of theory, his patient investigations and his inventions, but his triumph was one of character as much as of intellect. He had to contend with ignorance, incompetence and perversity, under conditions which would have been intolerable to a lesser man or a man less single-minded. The story of the cable has often been told. At the beginning Professor Thomson occupied a curious and rather anomalous position. He accompanied the expeditions, not to advise as a physicist, but to represent the interests of the Scottish shareholders. He put his knowledge and skill freely at the disposal of the engineers engaged in the work of laying the cable and when at last this was accomplished in the face of enormous difficulties he was obliged to stand by and see the cable destroyed through the procedure of the official electrician of the company. The problem to be solved was the production of readable signals by means of electric currents sent through the large resistance and capacity of the great length of conductor. The electrician, Whitehouse, was the patentee of certain receiving apparatus of rather clumsy construction which could be actuated only by comparatively large currents. His idea was to send into the cable currents of very high voltage, which had the effect of breaking down the insulation and rendering the cable useless. Thomson saw clearly that the only solution of the problem lay in devising receiving apparatus which would respond to the weakest currents. For this end he devised his mirror-galvanometer, and later his siphon-recorder. In the former the reception of minute currents was shown by the movement of a spot of light along a scale in a darkened room, the light being reflected from a small and delicately suspended mirror. On the back of this mirror a fragment of magnetised watch-spring was moved by the current in a surrounding coil. In the siphon-recorder a light coil through which the current passed was suspended between the poles of a strong magnet. From a fine tube attached to the coil a jet of electrified ink was squirted on a travelling strip of paper giving a wavy line from which the Morse signals could be read.

In 1865 the attempt was renewed with Thomson as chief consultant, the "Great Eastern" being used as cable-ship. In that year there was a break in mid-ocean, but the following year not only was a new cable successfully laid from shore to shore, but the broken cable was recovered and completed. As a demonstration of the delicacy of the receiving apparatus messages were sent and read at Valencia going out along the one cable and back along the other, the two being joined in series for the occasion, by means of a battery made of a lady's silver thimble containing acid and a small piece of zinc.

Of even greater practical benefit were Lord Kelvin's services to the art of the navigator. He was made personally familiar with the problems to be solved through his experience as a yachtsman, all his leisure time in summer being spent on board his famous schooner the "Lalla Rookh." His compass, his sounding-apparatus, his tide-recorder and tide-predicter came from his interest in all matters concerning the sea.

Lord Kelvin had to engage in litigation in connexion with his compass-patents. His opponent was a well-known Belfast man of a past generation, Mr. F. M. Moore. It is told that during the hearing of the case one of the judges, perplexed by the extremely technical character of the evidence, enquired of counsel if it could not be possible to explain the point at issue without bringing in the earth's magnetic force!

In connexion with the taking of soundings at sea a great improvement was effected by the introduction of steel piano-wire to take the place of rope. Along with this there were ingenious devices for paying-out or hauling-in the lead and a depth-indicator on which the pressure of the water was made to compress a spring and so leave a record of the greatest depth reached. The tide-recorder was a device for obtaining an automatic graphical record of the varying height of the sea at a given place. Having obtained this for a sufficient period of time the record was mathematically analysed and the sequence of future tides predicted.

When we come now to consider Lord Kelvin's work as a teacher we are met by a limitation which was a consequence of his type of genius. The ordinary students who formed the great bulk of his classes at Glasgow were able to learn almost nothing from his lectures, though they cannot fail to have been impressed by his personality. In the scientific army he was chief of staff with nothing to say to the common soldier. In his lectures he was unmethodical and erratic, constantly deviating from the matter in hand by some side-issue which he would follow up enthusiastically, generalising, surmising and extending, while his audience gave up all hope of understanding. His scientific papers give the same impression of a mind moving with extraordinary rapidity among new ideas, too eager to make fresh discoveries to give much thought to the clear presentation of the results already won. He was at his best in the company of other investigators in Physical Science. The occasion on which he expressed himself most fully on the perennial problem of the aether was when he gave, in 1884,

College Square East, Belfast, showing Birthplace of Lord Kelvin. Site now occupied by "Kelvin Picture House."

The two houses on left of street lamp were built by Professor James Thomson. The first house was Lord Kelvin's birthplace. His elder brother, James Thomson, was also born there.

(Reprinted from the Society's Centenary Volume, 1821-1921).

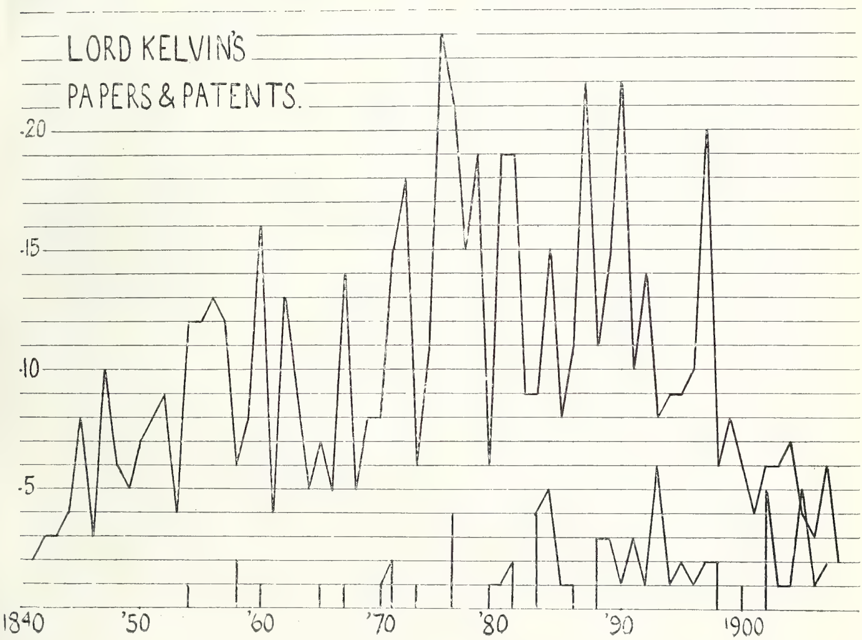
Photo: A. R. Hogg.

Sir Wm. Thomson, Baron Kelvin of Largs, O.M., G.C.V.O., P.C.

Born Belfast, 1824, Died at Largs, 1907.

Buried in Westminster Abbey.

[From a bronze statue by A. Bruce Joy, 1913, in Botanic Gardens Park, Belfast.]


LORD KELVIN'S
PAPERS & PATENTS.
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1840
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'80
'90
1900

INVASION OF THE ARDS.

WONDERFUL GARDENS OF MOUNTSTEWART.

BELFAST FIELD CLUB VISIT.

BALLYWALTER'S LAUGHING JACKASS.

Once again the Belfast Naturalists' Field Club have held the record excursion for a N.F.C. in the British Islands, this time a whole day affair last Saturday. Their former outstanding affair was an afternoon visit only to Hillsborough Castle, demesne, and fort, and on that occasion 198 turned up, the hon. secretary, Mr. N. H. Foster, F.L.S., M.R.I.A., and Mrs. Foster entertaining the party to tea.

Leaving the Old Museum on Saturday morning shortly after ten o'clock, three motor-charabancs of the Ards Transport Co. took 100 of the party, about 80 extra travelling in their own cars, of which there were 18 present. On arrival at Mountstewart they were met by Mr. Bolas, the head gardener, who pointed out the various interesting trees and shrubs along the avenue, including a very fine and tall Mediterranean heath and a great Pinus insignis.

Entering the pergola round the sunk garden, both it and the extension—the Red Hand of Ulster garden—delighted the party. Among the many plants here on the terrace or at the east end of the Italian garden, near the Noah's Ark and Dodo pillars, were big Eucalyptus trees, Eucalyptus globulus, the blue gum of Australia growing here to a height of 85 feet, the two largest clipped bay trees in the British Isles, two very fine Florence-court yews, and a big New Zaland tree fern which Mr. Bolas told the party was quite hardy at Mountstewart.

With these were many rare or interesting rock and other plants, including the rare Californian shrub Dendromecon rigidum, with its big yellow flowers. The pergola is planted with twenty species or varieties of Australian and New Zealand acacias, the Club palm, Cordyline australis; the Chusan palm, Chamaerops humilis; ginger plant, Hedychium Greenii; Japanese banana, Musa japonica; Jerusalem sage, Phlomis fruticosa; Chilian nut, Guevina avellana; cork tree, Quercus subes; bottle brush tree, Metrosideros; loquat, Eriobotrya; Viburnum rhytidophyllum from China; Eucryphia cordifolia and Crinodendron Hookeri from Chili, with Desfontainea spinosa and some fine lilies, Lilium auratum, L. Henryi, L. Pardalinum, etc.

Roun[illegible] are many fine plants, Gunner[illegible] [illegible]ese primulas, irises, &c., but time [illegible]d not permit of a visit on this occasion.

ECHO OF POTEEN-MAKING DAYS.

After a visit to Lady Mary's tea-house, with its dovecote and two old "knocking stones," formerly used for crushing barley for poteen making, and still used on many small farms for bruising young whins for horse-feeding, a fine example was seen of a rat-proof and cat-proof bird-house on a tall column, and some more of the quaint reproductions of extinct animals of which many had been seen at the east terrace, including the pterodactyl, &c., and the now extinct Irish greyhound pig on wall at west end.

Some of the oldest members remembered seeing it in the sixties and seventies of last century still existing in Donegal, Mayo, &c.

After a visit to a cork tree the next stop was at Ballywalter Park, to visit Lady Dunleath's bird aviaries, rock garden, and bird pond, where many interesting birds were seen in large open-air aviaries, or in the wired-in area round the bird pond. Among the birds in No. 1 aviary were Australian flock doves and blue-eye doves (both have bred this season), palm doves, snow bunting, red Hand and Zebra finches, cutthroats, bulfinch, goldfinch. In No. 2 Australian and other finches, spire birds, blackheaded and whiteheaded news, cordon bleu, masked doves, redpoles, Pekin robins, ribbon finches, &c. Outside there are trumpeters, Austraian piping crows, karracorrys, tinemon, Californian quail, Brazil jays, many species of duck in pond, black swans, and a white rhea. In the rockery was seen New Zealand ferns, wild small white foxglove from the Alps, soldanellas, vincetoxium officinalis, and many other plants from the Alps and Pyrenees.

While the party were lunching here under the shade of many big trees a stately white rhea and a number of water birds made their appearance, walking about among them, to the special delight of the young folk, many members of the junior section of the club being present.

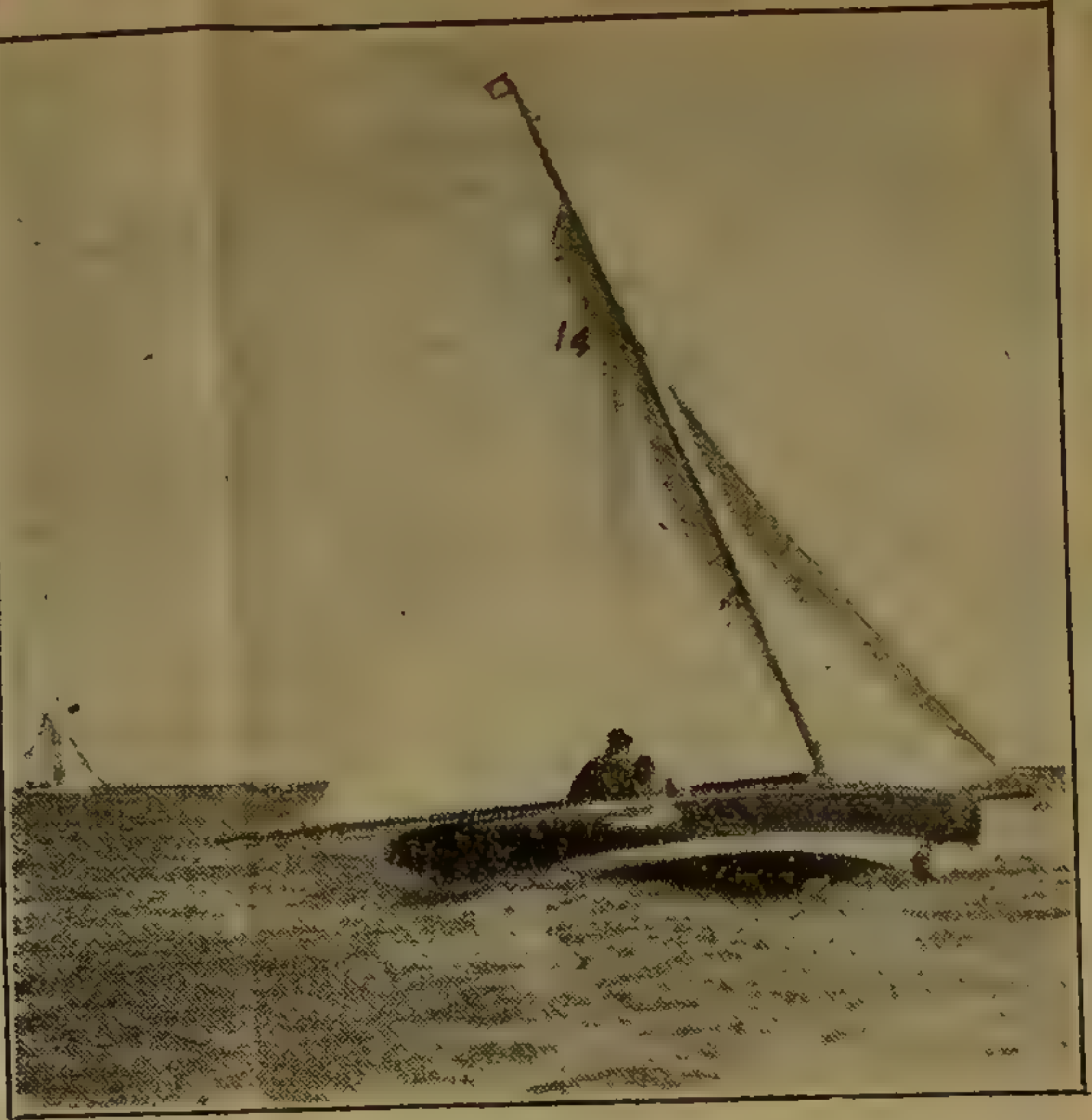
LAUGHING JACKASS HEARD.

The caretaker of the birds was fortunately able, before all the party had left the avaries, to let quite a number, mostly of the junior section, hear the laughing jackass at its best, the weirdest sound from a bird they had ever heard in their lives.

At Portavogie, Mr. Steven, Chief Inspector of Fisheries, showed the party much of interest at the fishing harbour; here the artists, amateur photographers, and anglers of the party found much to interest them. At the week-end many of the boats were in harbour. Mr. Steven pointed out nets damaged by dog fish, and mentioned that a number of young salmon were now being taken in the herring nets: fairly grown specimens, evidently just out of some breeding river.

Before tea at the West End Cafe, a number of ladies had a nice bathe on the strand, some of the junior members having already had a dive into Strangford Lough, at Mountstewart. The state of the tide, all the boats being high and dry, prevented any marine dredging being carried out, but a number of the juniors visited the rock pools on an outlying reef.

Before departing from Portavogie, the usual business meeting was held on a delightful part of the roadside beside a field of corn in stooks. The president (Mr. Wm. M. Crawford, M.A., F.E.S.), in the chair, votes of thanks were passed to Lady Londonderry and Lady Dunleath, and also Mr. Stevens, who with Mr. R. J. Welch, M.Sc., conducted the party. Some announcements were made about the annual conversazione, and a new junior member was elected. The party enjoyed a beautiful run home in brilliant sunshine.



CO. ANTRIM YACHT CLUB REGATTA.—THIS FIXTURE, WHICH WAS POSTPONED ON THE 31st ULT. OWING TO A FLAT CALM, WAS HELD AT WHITEHEAD ON SATURDAY IN A HIGH WIND WITH A LIVELY SEA, THE VAST MAJORITY OF THE COMPETITORS BEING REEFED. PHOTOGRAPH SHOWS MESSRS. GUNNING AND M'KINNEY'S COOMARA, WHICH WON THE "FAIRY" RACE BY JUST FOUR SECONDS FROM MESSRS. BECK AND JAMISON'S PSYCHE.

LUNAR RAINBOW AT ORLOCK HILL.

Sir—On Saturday night last a very fine lunar rainbow was seen about half past eleven from Orlock Hill. It was a perfect bow, and several colours were visible, pink and blue clearly so. It remained visible for about half an hour to the north-west of the Hill, the moon being behind or south-east of our house. A faint indication of a second bow was also visible. The rainbow was seen by members of several families, and it was so striking, that one party stopped their motor car and got out to see it more distinctly.—Yours, etc.

ALICE GLENDINNING,

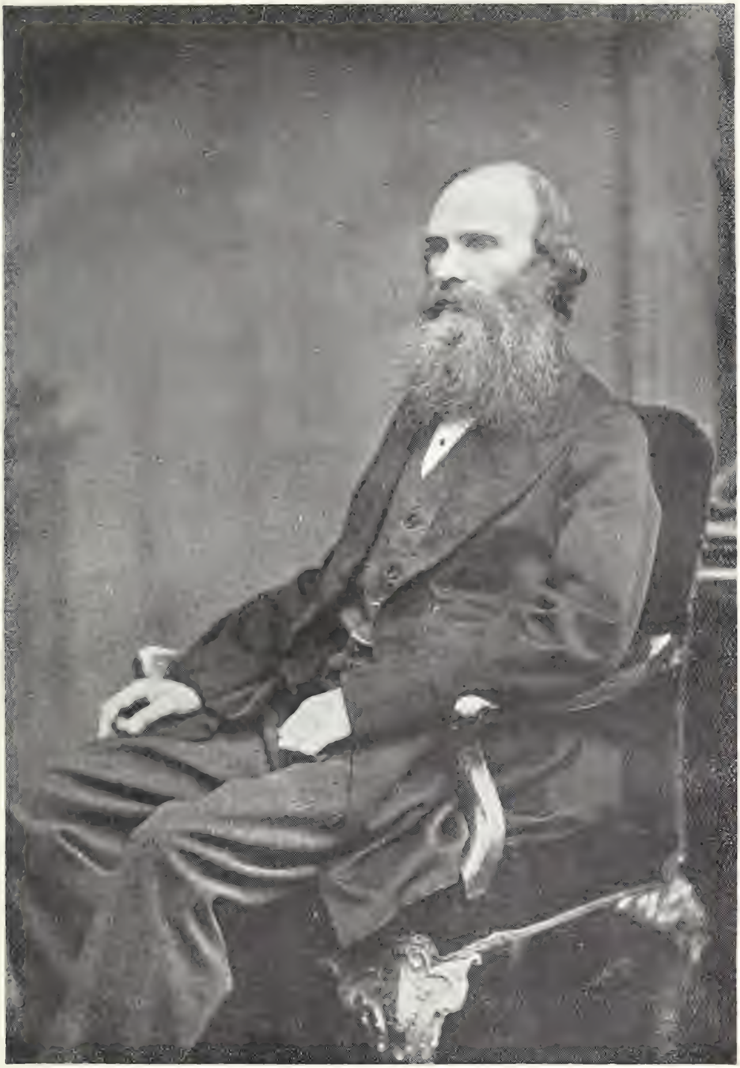
Orlock, Co. Down.

[We have had letters from several other correspondents to the same effect.—Ed. B.T.]

B.N.F.C.

MR. JAMES MAHOOD'S LILIAS, WHICH HAS SCORED SOME NOTABLE VICTORIES THIS SEASON, WON THE "WAVERLEY" RACE BY OVER TWO MINUTES FROM MR. J. H. M'VEA'S WAVERLEY, MR. J. HAY'S KENILWORTH BEING THIRD, AND MR. AUSTIN BOYD'S MONTROSE FOURTH.

NAUTCH (LIEUT.-COLONEL R. G. D. GROVES RAINES, D.S.O.), WHICH WAS SECOND IN THE THRILLING FINISH OF THE "DANCING" CLASS, BEING BEATEN BY THE NARROW MARGIN OF THREE SECONDS BY GAVOTTE (MR. J. A. ROGERS).



Prof. James Thomson, D.Sc., LL.D., F.R.S.,
Born 1822. Died 1892. Brother of Lord Kelvin.
From a photograph taken in 1878.
(Reprinted from the Society's Centenary Volume, 1821-1921).

a series of twenty lectures at the John Hopkins University in Baltimore. Here he had an audience of accomplished physicists from American Universities with one or two from England; his "twenty-one co-efficients" as they were called, in reference to the twenty-one quantities so designated in the theory of elasticity. During the course there was a free interchange of suggestions and fruitful co-operation between the lecturer and the audience with the result that much fresh light was thrown on a difficult subject. A verbatim report was taken by one of the audience who was an expert shorthand writer as well as an able mathematician. This was much expanded by Lord Kelvin, and published as a volume ten years later.

Lord Kelvin was as much beloved for his character as he was revered for his genius. He was for a large part of his life the acknowledged leader of Physical Science in Britain, but he never showed a trace of arrogance or assumption of superiority to other workers. Lord Rosebery on one occasion spoke of his "laborious humility." He was always ready to listen to others and to learn from them. To young men he was ready with encouragement and a charming courtesy, without a hint of condescension. In the midst of his busy life he would willingly go anywhere to lecture or take part in a conference. He enjoyed intercourse with his fellows, at meetings of the learned Societies or elsewhere. It is impossible to estimate the value of the influence he exerted and the inspiration of which he was the source. Although he left this country at a very early age he always called himself an Ulsterman. We may surely call him the greatest Ulsterman.

The lecture was illustrated by portraits of Lord Kelvin at different periods of his life, and also of his father and his brother James Thomson, Professor of Engineering at Belfast and afterwards at Glasgow. Views were shown of some pieces of apparatus, of the old and new Colleges at Glasgow and scenes connected with the Thomson family at Ballynahinch. The lecturer expressed his indebtedness to Mr. R. B. Bailie, of Ballynahinch, an authority on local history, who had given him much information and also to Mr. R. J. Welch, M.Sc., who had taken the photographs at Ballynahinch.

9th December, 1924.

In Museum, College Square North.

Professor W. B. Morton, M.A., M.R.I.A., President, in the Chair.

A. H. Muir, F.C.A.

"CHRISTOPHER PLANTIN,"

Printer of Antwerp, 1520—1589.

In the heart of the City of Antwerp is found the Musée Plantin-Moretus. It is a printing works which was in the control of one family from its foundation in 1555 until the year 1870, a period of more than 300 years. It contains the records of the firm since its earliest days, with the old printing plant intact, and is an example of the house and works of a famous printer of the sixteenth century. It was purchased from the representative of the family in the year 1870 by the municipality of Antwerp and is maintained as a Museum.

Christopher Plantin, the founder of the firm, was born in France in 1520. His early days were spent in poverty, and he was left by his father in Paris at the early age of 14, and thereafter supported himself, and picked up an education. He went to Caen in Normandy, and with a letter of introduction from his Latin master in Paris, obtained employment in the works of Robert Macé, Printer and Bookbinder, with whom he spent five years. He fell in love with a girl in the household of his employer, called Jeanne Riviere, and married her in 1546. She was probably illiterate and had no wealth, but she proved of sterling character, and made him a true helpmeet. The young couple moved to Paris, where Plantin set up a small business in book-binding and leather work In 1549 they moved to Antwerp with their eldest daughter. At that time Antwerp was probably the most prosperous and wealthy city of the Continent, with a population of 125,000, and trading with every part of the world. There he continued his business of bookbinder with some success. He became favourably known to one very important man, namely the Seigneur Gabriel de Cayas, secretary to King Phillip of Spain, who remained his friend throughout the years.

Plantin met with an adventure, which nearly cost him his life, and incapacitated him from pursuing his calling as a bookbinder and leather worker. He was conveying to de Cayas, a leather worked casket, wherein de Cayas wished to place a jewel he was conveying to the Queen of Spain. As Plantin hurried along in the dusk he was set upon by some half drunken and masked roysterers, who mistook him for a musician, who had incurred their resentment, and he was run through the body with a sword, and left for dead. He was, however, nursed back to health, and being unable to continue his former occupation, set up a printing establishment. This was in the year 1555. He worked hard, and as he had managed to pick up a good education he prospered, and devoted himself to publishing books of learning. The times were troublous, however, and the printer had many difficulties to face. The laws against the publication of books of a heretical character were severe. In 1561 Platin had to go to Paris on business, and was absent from Antwerp. One morning his family was alarmed to hear hammering at the door. It was the Margrave with an escort, and it appeared that he had a copy of a book entitled "A Brief Instruction for Prayer," which was stated to contain doctrines contrary to the teaching of the Catholic Church. It bore no name of any printer, but the type was identified as being that in use in the Plantin Press. It turned out that the book had been printed by certain of the workpeople, unknown to Plantin, at their own expense. They were at once arrested and taken to prison. But worse was to follow, for later an order was received that Madame, the daughters, and the servant were to present themselves for examination before the dreaded Inquisition. They were all good Catholics, but by the intervention of some of the Cathedral dignatories, the matter was settled. Nevertheless, the news got abroad, and the creditors of the firm became alarmed, as the mere suspicion of heresy was sufficient to affect credit, and the whole of the printing plant and household effects were sold up at auction prices, and the family found themselves in dire straits. They set up a little business in underclothing to keep themselves alive until the return of Plantin. When he came back he found his business had disappeared in his absence, but fortunately he had brought money back as a result of the settlement of certain affairs in Paris, and was able to buy back a little of his plant. Nevertheless, he was hard pushed for money, and often in difficulties. At last some of the Antwerp merchants, who had a high opinion of Plantin, found the necessary capital, and entered into partnership with him. From that time the business went ahead, and soon Plantin was able to buy them out, and recover the ownership of his business.

Two of his employees were destined to play a large part in the future of the undertaking. These were Francis Rapheleng and John Moretus.

John Moretus was the first apprentice of Plantin, and when Plantin was sold out in 1562, he went to Venice for a time, but returned in 1565, and ever after was Plantin's right hand man on the business side of the undertaking. In 1570 he married Plantin's second daughter Martine, and when Plantin died in 1589, he inherited the famous printing house, which was subsequently carried on by his descendants.

Francis Rapheleng was a poor student, who had studied in Ghent, Paris and Cambridge. He had a good knowledge of the Semitic languages, and was Plantin's stay on the literary side. He was not a good business man, like Moretus, but his great knowledge made him invaluable when Plantin published his great work, the Polyglotte Bible. He married Platin's eldest daughter, Marguerite, in 1565. He inherited from Plantin the printing house which Plantin established in Leyden.

Plantin was a man of high ideals, and set himself to use the art of printing for the spread of knowledge, and made it his endeavour that all his publications should be printed in the best style. He illustrated his books with plates, for the production of which he had recourse to the best artists of his day. His great work was the Polyglotte Bible, which set out in parallel columns the text of the Bible in Greek, Hebrew, Chaldean and Latin. The work took four years to accomplish, and was supported by the King of Spain. The best scholarship of the day was applied to make the book the best book of reference of its time. Rapheleng proved most useful and untiring in his efforts for its perfection, while the King of Spain sent his chaplain, Doctor Arias Montanus, a man of great learning, to assist in its production. The cost of production, however, was very heavy, and involved Plantin in serious liabilities.

Plantin's activity as a printer made itself felt far beyond the boundaries of the Netherlands. He had uninterrupted business relations not only with Dutch, Flemish and Brabant booksellers and printers, but with Englishmen, Scotchmen, Germans, Italians, Swiss, Poles, Portugese and Spaniards. He had branch establishments at Paris, Leyden, and Salamanca in Spain, and was on the point of opening one in London. He disposed of his Hebrew Bible in the North Western region of Africa, between the Mediterranean and the Sahara. He sent books to America, and was one of the most regular and influential visitors at the Fairs at Frankfort.

In 1570 King Phillip of Spain appointed him Prototypographe, an honour which brought him no wealth but much worry. He was given the privilege of printing the liturgical books for Spain, a privilege which involved him in grave monetary difficulties, as the King was not at all prompt in settling accounts. This privilege, however, while a cause of much embarrassment to Plantin, proved a little gold mine to his heirs.

Meanwhile Antwerp had declined in population and wealth owing to the disturbances of the times. In 1576 came the terrible " Spanish Fury " and the sack of Antwerp, in which Plantin suffered both in wealth and in health. Antwerp took years to recover from the harm inflicted on her.

When Plantin died in 1589 he was buried in the Cathedral of Antwerp, and when his widow died in 1616 at the advanced age of 95 she was laid by his side. His tomb can be visited to this day in one of the chapels off the ambulatory, while in an adjacent chapel lie John Moretus, the erstwhile apprentice, and his wife Martine Plantin.

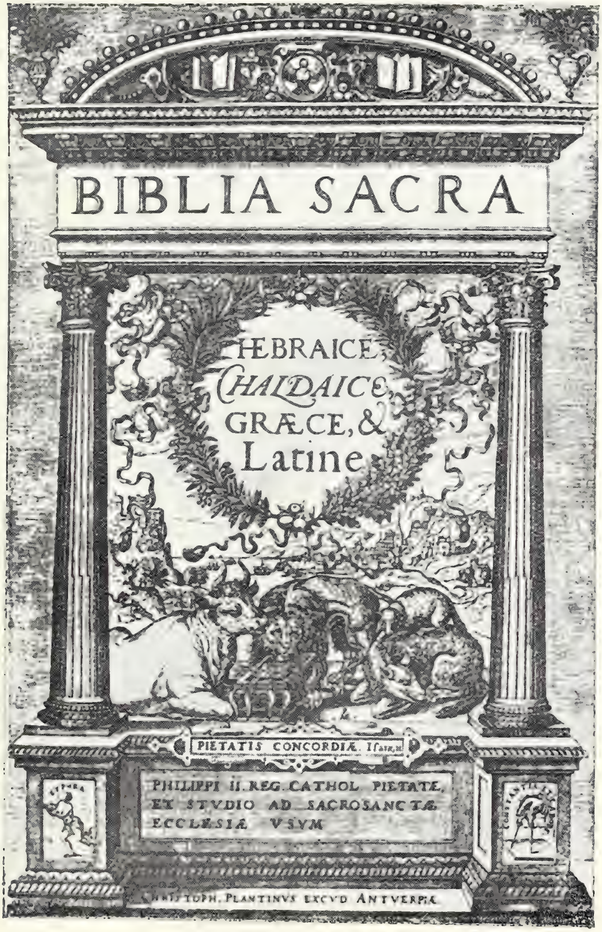
Plantin had many cares and worries in his life, even when he was famous. Some arose from the disturbances of his time, others from his business, especially with reference to meeting his liabilities, and others from certain members of his family, and something of his philosophy of life may be gathered from a sonnet written by him entitled " Le Bonheur de ce monde."

Avoir une maison commode, propre et belle,
Un jardin tapissé, d'espaliers odorans,
Des fruits, d'excellent vin, peu de train, peu d'enfans
Posseder seul sans bruit une femme fidéle.

N'avoir dettes, amour, ni procés, ni querelle,
Ni de partage à faire avecque ses parens,
Se contenter de peu, n'espérer rien des Grands,
Régler tous ses desseins sur un juste modéle.

Vivre avecque franchise et sans ambition,
S'adonner sans scrupule à la dévotion,
Domter ses passions, les rendre obéissantes.

Conserver l'esprit libre, et le jugement fort,
Dire son Chapelet en cultivant ses entes,
C'est attendre chez soi bien doucement la mort.



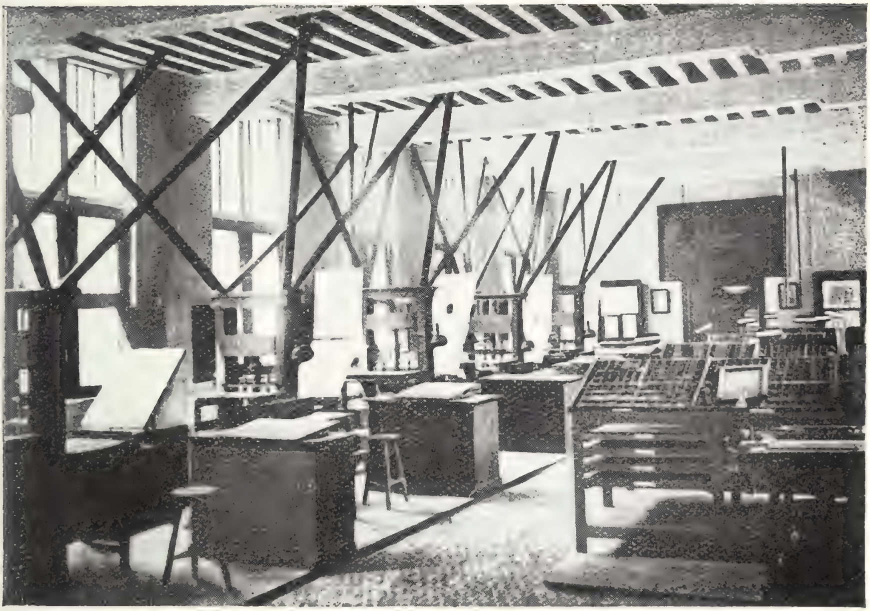
FRONTISPIECE OF THE PLANTIN POLYGLOT BIBLE.

Illustration reduced from "Christophe Plantin," by M. Max Rooses

The Plantin Family.

From the Triptych above the tomb in Antwerp Cathedral.

Illustration reduced from "Christophe Plantin," by M. Max Rosses



THE OLD PRINTING ROOM.

Illustration reduced from "Christophe Plantin," by M. Max Rosses

27th January, 3rd and 10th February, 1925.

In Physics Lecture Theatre, Queen's University.

Prof. W. B. Morton, President, in the Chair.

"SPECTROSCOPY AND ITS APPLICATIONS."
By R. C. Johnson, B.A., Ph.,D.

[Summary of three popular lectures, illustrated by lantern slides and demonstrations.]

Introduction.

The physical conception of wave-motion, and the mathematical development of this idea have perhaps played a greater part than any other in correlating some of the most widely diverse phenomena of Nature. The aether of space, which has been postulated as the medium in which all electromagnetic waves are propagated, may or may not have a real existence according as one rejects or accepts the modern relativistic position; but of the nature and mathematical description of the wave-motion itself there can be no doubt.

While all electromagnetic waves have one feature in common (the velocity of propagation "in vacuo"), they may, of course, differ vastly in wave-length or frequency of vibration, and this determines the nature and properties of the waves. At the one extreme we have electromagnetic waves varying say from 10^6 cms. to 10^2 cms. in length, which are the waves used in radio-transmission. These merge into heat waves which may have wave-lengths from about 10^{-2} cms. to 10^{-4} cms.; shorter than these we have the visible radiations lying between 7.10^{-5} cms. and 4.10^{-5} cms., which affect the eye and give rise to the sensations of colour: and again, shorter still, we have ultra-violet radiation incapable of affecting the eye but capable of detection by the photographic plate (and in other ways). Ultra-violet radiation merges into soft X-radiation at about 10^{-6} cms. wave-length, while "hard" or penetrating X-rays may be as short as 10^{-8} or 10^{-9} cms. The highly penetrating radiation of cosmic origin of which we have heard recently has a wave length presumably of the order of 10^{-13} cms. In spectroscopy we are concerned only with the analysis and measurement of the waves which constitute light: visible light within the range mentioned above, say 7.10^{-5} cms. to 4.10^{-5} cms., ultra-violet light on the short-wave side and infra-red light adjacent to the long-wave side. It will be necessary later to refer to wave-lengths again, and perhaps a word is desirable as to the units in which these are measured. We call 10^{-3} cms. an Angstrom Unit, and on this scale the visible spectrum extends from about 7000 A.U. to 4000 A.U. Fig I.* indicates roughly the wave-lengths corresponding to the colour sequence red, orange, yellow, green, blue, and violet of the visible spectrum. For measurements of the long waves in the infra-red and the shorter waves of the ultra-violet various methods are available, and these will be described later.

Spectroscopic Instruments.

The basis of spectroscopy is the analysis of light, and therefore any procedure by which a composite beam of light is dispersed into its components is available for the purpose.

The historical method—and one of very great value still—is the use of a prism of glass or some other transparent substance. To prevent overlapping of the images in the spectrum produced, a fine slit is employed. This is at the focus of a lens (the collimating lens) so that when the slit is illuminated by the source of light in question, a parallel beam is incident on the prism, is dispersed by it, and produces a spectrum which is focussed by another lens (the camera lens. Such a spectrum consists in reality of a number of images of the slit of the instrument, each one being in monochromatic light. If the instrument is intended for visual observations only, the spectroscope will be provided with a cross-wire and eye-piece, but if for photographic records the instrument has a photographic plate instead of an eye-piece. This description of the essential features of a prism spectograph is illustrated in Fig. II.

In the case of work in the visible spectrum, the prism is usually made of dense flint glass of refractive index, say about 1.7. Such a system will, however, transmit very little ultra-violet light shorter than 3900 A.U. and for work in this region a quartz prism and quartz lenses are generally

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*Plate and Figures follow Page 28.

used. In this way it is possible to photograph spectra down to 2100 A.U. The absorption of the film of gelatine on the photographic plate becomes very pronounced for wave-lengths shorter than this, and if it is desired to proceed further it is necessary to use Schumann plates in which the sensitive silver salt is deposited directly on the glass. Using these special plates one may photograph spectra down to 1800 A.U., but below this—in the extreme ultra-violet—the oxygen of the air absorbs rapidly. It is then necessary to use vacuum spectrographs (or alternatively, spectrographs filled wth Helium), and the instruments in this case have necessarily to be of special design. With such instruments wave-lengths as short as 300 A.U. can be measured.

At the other extreme we are faced with the insensitivity of the photographic plate to red and infra-red light. An ordinary panchromatic plate will record wave-lengths up to about 7000 A.U., and by staining with suitable dyes (such as di-cyanine) it is possible to photograph up to 9500 A.U. Beyond this, however, the photographic plate is useless, and almost all infra-red work has therefore to be done with a thermopile and sensitive galvanometer. The thermopile receives an infra-red line on a small blackened strip, which is consequently heated slightly; the heat is transformed into electricity, and the small resulting current is measured by the galvanometer.

Glass is not of much use as material for a prism in infra-red work, and quartz absorbs strongly above 40,000 A.U. Rock-salt and sylvine are therefore chiefly used for the purpose—the latter is transparent up to 180,000 A.U. Both substances suffer, however, from the disadvantage of being hygroscopic, so that they are attacked by moisture in the atmosphere. A remedy for this, which makes them reasonably permanent, is to paint the surfaces with a suitable varnish.

There are, of course, a great many detailed considerations in connection with prism spectroscopy at which it is impossible here to do more than merely hint. The accuracy with which wave-lengths can be measured depends not merely upon the size of the instrument, but on the quality or definition of the spectral lines—and the latter is intimately bound up with the properties of the optical system of the instrument. It is necessary in some cases to use photographic plates of extra thin glass, so that these can be bent into a curved holder in order to yield the best possible definition.

Perhaps a word may be inserted with regard to the time required in spectrum photography. In the case of intense sources of light (such as arcs) a fraction of a second may suffice, but in the majority of cases the time of exposure may be minutes, or even hours. The photography of comparatively faint spectra under high dispersion is therefore a matter of some difficulty, and in order to reduce the time of exposure to a reasonable amount the experimentalist may have to investigate with some thoroughness the conditions of production which will yield the spectrum in question with the greatest intrinsic brightness.

In addition to prism instruments there is another class altogether, which are capable of giving high dispersion and resolving power: they are called gratings. Gratings may be either of the transmission or reflection type, though the latter are used in general in all important work. A reflection grating consists of a large number of parallel rulings on a plane or concave metallic mirror, usually either 14,000 or 20,000 lines to the inch. Such gratings are made by a special engine under conditions of great rigour, the rulings being done by a diamond point. Concave gratings possess focussing power per se, but plane gratings are used in combination with a suitable lens. A grating constructed in this way has the property of "reflecting" a beam of light as a spectrum—it may be several feet in length. To be more precise, a grating—unlike a prism—produces several spectra, and in this respect has the relative disadvantage that as only one spectrum can be utilised at a time, a considerable percentage of the incident light is unavailable for photography. The mode of action of a grating is too complex to describe fully here, but it is based upon the property of light waves known as interference. Just as two trains of waves of any kind (e.g., waves on water) are capable of producing a stationary pattern of ripples such that at some points there will be reinforcement and at others annulment, so in the case of the light waves reflected from the rulings of the grating there will be certain directions of reinforcement, and in these directions spectra will result.

Types of Spectra.

Emission spectra, which constitute the analysis of any source of light, fall into three classes:—continuous spectra, line spectra, and band spectra. All incandescent solids, with the exception of one or two rare earths, exhibit a continuous spectrum only. An incandescent mantle, or a glowing electric light filament shows only this type of spectrum, and the distribution of energy in the spectrum depends almost entirely upon the temperature of the source. Most other sources of light yield spectra of bright lines, e.g., metallic arcs, high potential electric sparks, and the electric discharge of an induction coil through a gas are of this kind. Such spectra are called line spectra, in contrast to another type known as band spectra. These are usually produced under similar conditions, but are strikingly different in their appearance. As the name indicates, they usually have the appearance of bands or flutings, sharp on one side, but degraded away on the other. Under very high dispersion the band heads can be split up into fine lines, and the individual wave-lengths of these lines measured.

Line and band spectra differ, however, not merely in their appearance, but in a more fundamental way. They obey different mathematical laws of correlation, and they have different origins. *Line spectra arise from atoms; band spectra arise from molecules.* To this generalisation there is no exception known.

The plate indicates a few of these types of spectra. Numbers 1, 2, and 3 contain band spectra; Numbers 4 and 5 are exclusively line spectra; Number 3 contains a certain amount of continuous spectrum in addition to bands.

There is another very general class of spectra, viz., absorption spectra, which may also be of the line, band, or continuous type. Absorption spectra are the converse of emission spectra; that is to say, a beam of light from a source which would yield a continuous spectrum may—when passed through the substance in question—have certain wave-lengths absorbed. In this case the spectrum of the transmitted light will show dark lines or bands.

Production of Spectra.

All light is the result of atomic or sub-atomic processes. The modern views of atomic structure all indicate that the origins of line spectra are to be found in the transitions of electrons within the atom from one orbit to another. During these jumps energy is emitted, and appears as monochromatic radiation in the spectral lines. If the atoms of an element are subject to comparatively feeble excitation, then only one—the outermost electron—is disturbed from its normal orbit; and in this case the " arc " spectrum, as it is called, is partially or completely developed. If the means of excitation are more intense, the first electron may be completely removed and a second one disturbed. Such spectra, arising from the singly ionised atom, are described as " spark " spectra. It may be that the atom can be doubly ionised by vigorous excitation, and in this case a further line spectrum is obtained. Thus it happens that the same element may have several line spectra associated with it, which can be stimulated in turn by increasng the intensity of the exciting conditions. Band spectra, which arise from molecules, are, as a rule, found with the less energetic processes of excitation when the molecule is capable of existing as such.

It is well known that many metallic salts, when introduced into a bunsen flame, give characteristic colour to the flame. The spectrum of such a flame sometimes contains bands due to the salt molecule; but usually the light is that of the arc spectrum of the metal, either completely or partially developed. Flame spectra represent, then, the least energetic type of excitation. The ionisation in this case has purely a thermal origin; i.e., the violence of atomic collisions at the temperature of the flame is sufficient to produce disturbance of the electrons inside the atoms. The bunsen flame itself has at least three interesting spectra. The luminous blue cone contains the " Swan " bands, due probably to some hydrocarbon molecule, and also the so-called CH bands, of which the precise emitter is also unknown. From the non-luminous sheath there is strong ultra-violet radiation arising from the OH bands. Only a limited number of substances give flame effects, viz., volatile salts of sodium, potassium, strontium, barium, calcium, thallium, and a few others. It is, of course, necessary for the production of flame spectra that the salt be volatilised. This may be accomplished by introducing the salt on a platinum wire directly into the flame, but a better method is illustrated in Fig. III., where a spray of salt solution is introduced into the flame. Coal gas passes through the jet A, and burns at the top of the tube B. The flame can be made more or less luminous by rotating the jet A so as to have it more or less inclined to the vertical. The flask below contains dilute hydrochloric acid and magnesium turnings together with a trace of a soluble salt containing the metal of which the flame spectrum is required. The generation of Hydrogen gives rise to a fine spray which is carried up the tube B by the draught of air, and colours the flame. Suppose a trace of Strontium Chloride is the salt in question —the flame will yield bands due to Strontium Oxide and Strontium Chloride, together with lines due to Strontium. By feeding the flame with Chlorine, however, the spectrum can be reduced to a few band of Strontium Chloride. If it is necessary to avoid acids, we can use a spark or arc discharge between poles of the substance below the tube B and thus generate a fine dust which is carried by the draught of air into the flame.

The presence of minute traces of Sulphur in the ordinary coal-gas flame can be detected by means of the blue zone which appears close up to the surface of a cold plate or tube which may be placed in the flame. This blue light is due to the band spectrum of Sulphur.

Another general method of producing spectra is by burning an arc between poles of the substance, or alternatively, between Carbon poles which are impregnated with the material. Currents of 2 to 15 ampères may be used according to the volatility of the substance. The spectrum of the Carbon arc (excepting impurities) shows only one line of 2478 A.U. in the ultra-violet. The greater part of the light originates in the positive crater, and is continuous spectrum. The violet Cyanogen bands are also present in the Carbon arc spectrum by reason of the presence of Nitrogen in the atmosphere.

The arc burned between Iron poles is of considerable use in spectroscopy as a " standard " spectrum. It is very prolific in lines,—to the number of several thousands—and a considerable proportion of these have been accurately measured and adopted as standard wave-lengths.

The arc between Mercury poles, enclosed in a suitably shaped tube, yields a brilliant green light consisting of the arc lines of Mercury. This light is used as a source of illumination in drawing offices, as it provides a pronounced black and white contrast.

An arc—being essentially an electrical phenomenon—can be burned under a liquid, but in this case the spectrum lines are usually broadened considerably, and accompanied by the lines of Hydrogen if the arc is burned under water.

Spark spectra proper are produced by use of an induction coil, which yields a small current at a high potential—say, 10,000 to 20,000 volts—together with a condenser in parallel and a spark gap in series (vide fig. IV.). The condensed spark between poles of the substance inquestion yields a spectrum consisting of both pole lines and air lines. No. 5 spectrum of the plate is a photograph of the light from a condensed spark between Aluminium poles in an atmosphere of Oxygen. The Oxygen lines can be distinguished from the pole lines, in that they run uniformly across the spectrum, exhibiting no concentration in the neighbourhood of the poles.

The nature of the electric spark has been the subject of a good deal of investigation. During each "crack," in which the condenser discharges across the spark gap, there really take place many thousands of oscillations of the electric current. By various experimental devices—such as the use of rapidly moving films—it has been found possible to measure the velocity and energy of the oscillations in the spark, and even to examine the spectrum of the light resulting from successive oscillations. A single discharge of the condenser yields a highly damped series of oscillations as a rule—a great part of the energy being in the "pilot spark," or first member. This pilot spark of great energy gives only air lines, but it volatilises the metal at the same time. Subsequent oscillations generate the metallic line spectra, but it is clear that a considerable part of the energy of the spark is wasted in the production of air lines. The introduction of an inductance into the circuit lengthens out the period of the oscillations, and at the same time throws more energy into the subsequent oscillations. By using large inductances the air lines can be removed, while the metallic lines remain. The velocities of the metallic vapours in the spark vary between 400 and 1,300 metres per second, higher velocities corresponding to the lower atomic weghts.

The preceding methods of exciting spectra are not easily adaptable to the case of gases. In this case the best method is to pass a high potential discharge from an induction coil through a glass tube fitted with two electrodes, and containing the gas at a few millimetres pressure. The conditions of excitation are then under very convenient control, e.g., the tube can be easily immersed in liquid air or raised to a high temperature in observing the modifications of spectra. An ordinary induction coil discharge through a tube is comparable as regards energy conditions to arc spectra; while if a condenser is put across the terminals (as in fig. IV.) and the tube put in series with the spark gap, the light from the tube yields " spark " lines of the enclosed gas.

It is impossible here to go into detail about the manufacture and filling of discharge tubes: this is all a regular part of the work of the spectroscopist. Likewise one can only hint at the tremendous extent of the field of modern spectroscopic research. It must be remembered that every element has its own line spectra—which are capable of excitation under suitable conditions—and when it is recalled how many molecules (oxides, nitrides, hydrides, halides, etc.) may possibly be expected to yield band spectra, the search for these and the accurate measurement of their wavelengths throughout the region from infra-red to ultra-violet is itself a gigantic task. Many of these exhibit structural peculiarities. Some are modified by magnetic fields (the Zeeman effect), some by strong electric fields (the Stark effect), and some are profoundly modified when other radiating gases or vapours are present at the same time. The whole question of the intensities of spectral lines and bands opens up another large field of work, particularly as various physical conditions are capable of modifying the distribution of energy in spectra.

The Applications of Spectroscopy.

The data of spectroscopy are of very considerable value in several distinct branches of Natural Science. For the chemist and metallurgist there is here a new analytical weapon of far greater sensitivity than any chemical reaction could provide. A spectroscope could detect the presence of one millionth part of the least quantity of sodium which the chemist might detect by chemical means. So in a metallic alloy the presence of minute quantities of impurity are exhibited by corresponding lines in the spectrum. To the physicist the analysis and interpretation of spectra provide a clue to atomic and molecular structures. It is not too much to say that when the nature and genesis of spectra are fully understood we shall have solved the most fundamental problems of physics. On the mathematical side Bohr, Sommerfeld, Heurlinger, Kratzer, and others have in recent years developed theories of the genesis of spectra from the atom and the molecule. On the experimental side the last quarter of a century has yielded a tremendous amount of information with regard to actual spectra. Before the latter results can be interpreted, however, the frequencies corresponding to the various lines in the spectrum have to be related together in formulae of certain types, and then a theoretical interpretation of the various coefficients is possible.

If, however, the study of spectra has yielded information of fundamental importance to the physicist, it has quite revolutionised astronomy: so much so that the last 25 years have witnessed the birth of a new science, "Astrophysics." By an analysis of the light coming from distant stars and nebulae, from the sun and the planets, it has made possible not only a celestial chemistry but a celestial physics, in providing us with knowledge of the behaviour of matter at temperatures and pressures differing vastly from any that occur on the earth. But by a study in the laboratory of the variations in spectra under various physical conditions we have an index to the extreme conditions prevail in celestial bodies. In connection with the solar spectrum, for example, there are some 16,000 lines, two thousand of which belong to Iron. Altogether some 66 terrestrial elements have been detected in the solar spectrum. The conditions are apparently such as to make possible the existence of compounds like Cyanogen, Magnesium hydride, Calcium hydride, and some hydrocarbons, for all these give bands in the solar spectrum. The spectroscopic study of sun-spots has revealed the true nature of these as vortices in which matter is in rapid circulation, and it has been found that there are strong magnetic fields connected with them (as shown by the magnetic effect on the spectral lines). We also know through the spectroscope that the sun rotates not as a rigid body, but more rapidly at the equator than at the poles.

Planetary spectra again provide an interesting sequence, and these confirm the views as to planetary temperatures which had been formed on quite other grounds.

The spectra of comets have been subject to much investigation. The only elements existing without doubt in comets are Hydrogen, Oxygen, Nitrogen, and Carbon. The spectra of comet tails differ somewhat from those of comet heads. In the latter the Cyanogen bands are strong and the Swan bands appear (probably due to CH), but in the tails of many comets a new set of bands is found. These are due to an ionised CO molecule, and their origin was first identified by Fowler. Spectrum 2 of the plate shows this system of bands as photographed by the author from a tube containing Helium under special conditions.

The Doppler Effect.

One well-known physical phenomenon perhaps calls for special mention here. If a source of radiation (i.e., of waves) is moving towards or away from the observer, or if the observer is moving, or if both are moving, then the apparent wave-length as recorded by the observer is altered. We are familiar with the fact that the whistle of a railway engine approaching a station appears to rise in pitch to an observer on the platform, and to fall again as the engine recedes. Here the engine whistle is a source of *sound* waves moving relative to the observer. The same phenomenon is found in the case of *light* waves.

If a star is moving towards or away from the earth *in the line of sight*, then by no possible mechanical contrivance could a terrestrial observer recognise the fact. The spectroscope, however, reveals this motion, for since the star is in motion relative to the observer the effective wave-lengths of the lines emitted will be altered, and by measuring the displacement of the spectral lines of the star it is possible to calculate from a simple formula the actual velocity of the star in the line of sight.

By use of the spectroscope and application of this principle it has been possible to recognise binary stars which are so far distant that the most powerful telescope is unable to resolve them. In such binary systems the two stars are usually rotating about their common centre of gravity, so that in general one will be approaching the earth while the other is receding; while a quarter period later there will be no motion of either in the direction of the earth. The spectral lines from a such a star will indicate this by periodically doubling and undoubling in half the period of the stars' rotation. From such information it is sometimes possible to compute approximately the masses of the stars. A special case of the above phenomenon arises if one star has cooled more rapidly and become a "dark" star, while the other continues to give off light. In the case of a very distant star this could only be recognised by the telescope if the plane of rotation was in the line of sight, in which case the dark star would periodically eclipse the other. The spectroscope, however, indicates that the star is in motion by an oscillation of the spectral lines about a mean position.

Stellar Spectra and Cosmic Evolution.

Modern cosmogony explains the formation of stars as the disintegration products of spiral nebulae. Briefly stated the evolutionary chain is as follows:—Nebulous matter originally existed highly attenuated, cold, and widely diffused through space. The universal force of gravitation in course of time induced contraction, during the course of which two things must necessarily occur:—

(1) The law of conservation of angular momentum would involve an increasng angular velocity of rotation as condensation of the nebula continued.

(2) The gravitational energy lost by contraction would re-appear as heat, and the temperature of the nebulous matter would rise.

With increasing velocity of rotation the nebula would assume a spheroidal, and ultimately a lens-shaped configuration; but beyond a certain critical point mathematics shows that no further compensation would be possible, and matter would be flung off from the periphery. In the presence of a gravitational field, however small, the ejection of matter would be localised to two diametrically opposite points of the periphery, and so would be emitted in long spiral arms from the rotating nebula. Such longitudinal filaments, being unstable, break down into small condensations which yield stars. All stages in this evolutionary chain can be observed by the astronomer. Many hundreds of spiral nebulae have been recognised in space, all at vast distances from even the farthest stars of our own universe. Some of them are exceedingly massive, e.g., the great nebula in Andromeda is capable of yielding a hundred million stars of about the average mass of our sun. The final disintegration of a spiral nebula produces a star cluster (such as that in Hercules), and on this interpretation our own galactic universe would be a star cluster—indeed, the largest star cluster known.

We, however, are interested particularly in the stars themselves and their evolution subsequent to formation. Altogether about a quarter of a million stars have had their spectra examined, and these have been classified according to their general types into a number of groups denoted by the letters O, B, A, F, G, K, M, N, R. These groups have been again subdivided, but this general division is adequate for our present discussion. The O type are the hottest stars, are often found associated with irregular nebulae, and usually have a spectrum consisting of bright lines due to Helium and Hydrogen. The B type are predominantly "Helium Stars," but the first metallic lines appear (viz., Calcium lines). The A type have very strong Hydrogen lines, the Helium has gone, while metallic lines due to ionised Calcium, Magnesium, etc., increase in intensity. In the F type the Hydrogen lines decrease, and the metallic lines increase. Class G consists of the solar type of star (i.e., our sun is typical). They contain many metallic lines, Hydrogen lines, etc., and show the first evidence of chemical compounds. Absorption of the blue end of the spectrum makes these stars appear yellow. The K type have feebler Hydrogen lines and many band spectra. M and N types exhibit broad absorption bands, usually strong in the ultra-violet, and also bands of Titanium Dioxide. These types are "red" stars. A rough estimate of the temperatures corresponding to the different classes would be:—O— 35,000° C; B— 26,000 to 14,000° C; A— 12,000 to 9,000° C; F— 7,500° C; G— 6,000 to 5,000° C; M— 3,000° C. It is impossible here to enter into an adequate discussion of the bearing of spectroscopic evidence on the course of evolution of a star. It can only be said in passing that the evolutionary process is by no means as simple as might be imagined at first sight. Contrary to what was thought at one time a star does not pass through the stages O, B, A, F, G, K, M, N, R in the order named, but beginning as a star of comparatively late type—say F, G, or

K—and of very low density, its subsequent contraction results in a rise of temperature. This means a *regression* of type through K, G, F, A, etc. Finally a time comes when the loss of heat by radiation will preponderate, the temperature will decrease, and a *progression* along the evolutionary chain will result. The star ultimately attains a comparatively small bulk and large density (.5 to .05). This theory of stellar evolution—known as " the giant and dwarf theory " we owe to Lane, Ritter, and Russell; and it appears to be well substantiated by astronomical data.

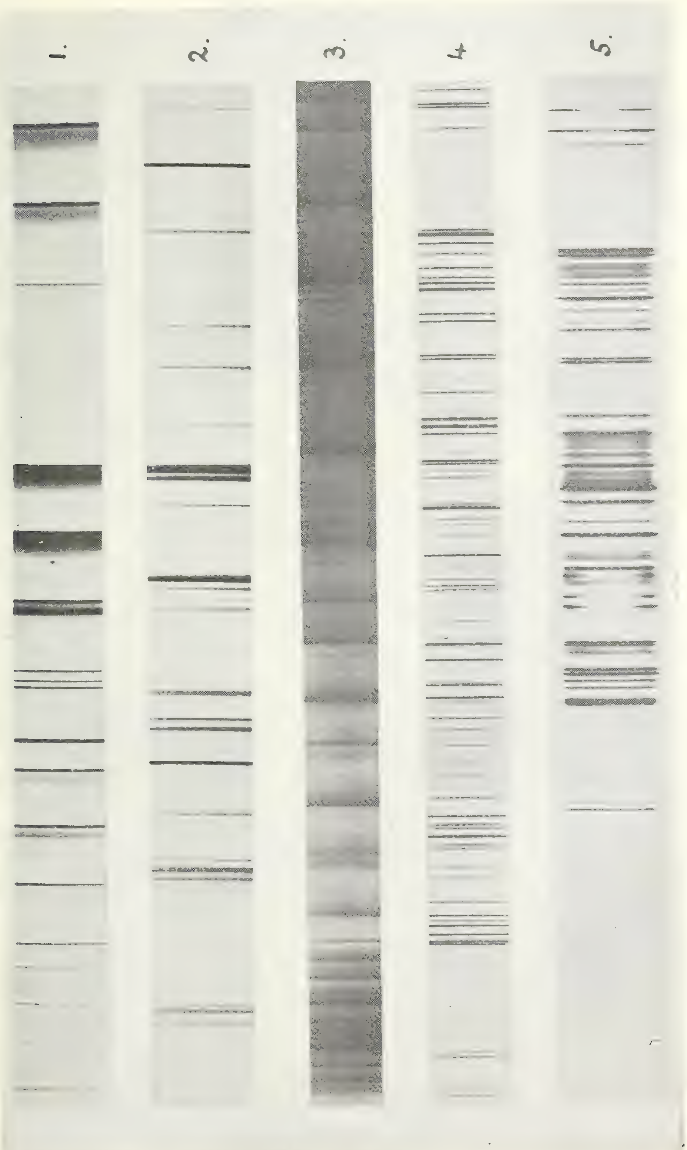
Perhaps enough has been said to show that spectroscopy is playing, and will play, a fundamental part in our knowledge not only of the fine structure of matter, but of the nature of the material Universe itself.

Physics Dept.,
Queen's University,
Belfast.

January, 1926.

Description of Plate.

1. The Negative band spectrum of Carbon. This is in the ultra-volet between 3,000 and 4,000 A.U. approximately. The spectrum originates from an ionised CO molecule.
2. The Comet-Tail bands, which also arise from an ionised CO molecule, and extend from the orange at 6,250 A.U. down to 3,200 A.U.
3. A band spectrum of Sulphur Dioxide.
4. Condensed discharge through a stream of Sulphur Dioxide in a vacuum tube. Shows the line spectra of Sulphur.
5. Condensed spark between Aluminium poles in about 80 millimetres pressure of Oxygen. Note that the Aluminium lines are strongest at the poles.


1.
2.
3.
4.
5.

20th January, 1925.

In Assembly Minor Hall.

Professor W. B. Morton, President, in the Chair.

Mr. Percy Allen.

"OUR DRAMA FROM MRS. SIDDONS TO HENRY IRVING (1800-1885)"

[*No Abstract*].

24th February, 1925.

In Assembly Minor Hall.

Prof. Morton in the Chair.

Mr. John J. Ward, F.E.S.

"LIFE: ITS MYSTERIES AND ODDITIES."

Illustrated by Lantern Slides.

[*No Abstract.*]

ANNUAL MEETING.

104th SESSION, 1924-25.

The Annual Meeting of the Shareholders and Members was held on the 21st October, 1925, in the Museum, College Square North. Professor W. B. Morton, M.A., M.R.I.A., President of the Society, occupied the chair and amongst those present were Professor Gregg Wilson, M.A., D.Sc., Colonel Berry, M.R.I.A.; Dr. D. A. Chart, Mr. A. G. Pomeroy, M.A.; Mr. F. Adens Heron, D.L.; Mr. J. M. Finnegan, B.A., B.Sc.; Mr. H. C. Lawlor, M.A., M.R.I.A.; Mr. E. J. Elliott, Mr. T. Edens Osborne, F.R.S.A.I.; Mr. David E. Lowry, Mr. Wm. Nicholl and Arthur Deane, Hon. Secretary.

Apologies for absence were received from Sir Charles Brett, LL.D.; Sir Frederick Moneypenny, C.V.O.; the Rt. Hon. Samuel Cunningham, Mr. R. M. Young, M.A.; Dr. S. W. Allworthy, Mr. Robert A. Mitchell, LL.B.; Major Blakiston-Houston, and Mr. W. B. Burrowes, Hon. Treasurer.

The Hon. Secretary read the notice convening the meeting, and also the Annual Report of the Council, which was as follows:—

Your Council has the pleasing duty of placing before the Shareholders and Members the report of the work of the Society for the closing year.

OBITUARIES.

Your Council regrets the decease during the year of four members, Mr. A. W. Stewart on the 8th December, 1924; Mr. J. B. O'Neill on the 16th March, 1925; Mr. James R. Bristow on the 4th April, 1925, and Dr. Gawin Orr on the 18th May, 1925.

NEW MEMBERS.

Twenty-one candidates have been elected to membership, making a total of 322 Shareholders and Members. Three Shares (No. 426) registered in the name of the late John Anderson, F.G.S., for many years Hon. Treasurer of the Society (1871-1882) have been transferred to Mr. Harcourt Howard Jones.

LECTURES.

The Session was opened on the 4th November, 1924, with an illustrated address by the President, Professor W. B. Morton, M.A., M.R.I.A., on Lord Kelvin. Altogether seven lectures were delivered, two in the Museum, two in the Assembly Minor Hall and three at the Queen's University. The Council desires to make special reference to a course of three lectures by Dr. R. C. Johnson, Lecturer on Physics at Queen's University, on "Spectroscopy and its Applications," which were well attended by members and the public, and were much appreciated.

COUNCIL'S THANKS.

Your Council is again indebted to the Vice-Chancellor of Queen's University (Dr. Livingstone, M.A., M.R.I.A.) for the use of rooms; the Physics Lecture Theatre being used on the 27th January and 3rd and 10th February. The Council desires to record the Society's thanks to the University authorities for their continued co-operation in the Society's work and to the lecturers for the assistance rendered by them. They wish also to thank the Press for the interest they have taken in the Society's proceedings during the session.

PUBLICATIONS.

During the period covered by this report two publications have been issued by the Society:—"The Monastery of St. Mochaoi of Nendrum," by Mr. H. C. Lawlor, M.A., M.R.I.A., Hon. Secretary of the Archæological Section, and "A Guide to the Ruins of Nendrum Monastery," by Major Blakiston-Houston, J.P. Both publications have met with great success.

ARCHÆOLOGICAL SECTION.

The Archæological Section continues its progressive work. A separate report of the Archæological Committee will be submitted to the members of the section at its Annual Meeting. Your Council has approved under date, 6th February, 1925, revised by-laws governing the Section. These have been printed, and copies may be obtained from the Hon. Secretary of the Section.

EXCHANGE.

Your Council continues to receive, in exchange for the Society's Proceedings, publications from some sixty Societies and Institutions in all parts of the world. Many of these publications are of much value and importance.

DEPUTATION TO QUEEN'S UNIVERSITY.

A proposal was made at the last Annual Meeting and referred to the Council for consideration, that a deputation from the Society should wait upon the Senate of Queen's University with a view to establishing a Chair of Archæology and Classical Art. The deputation has been sympathetically received by the Senate of the University, and your Council hopes that the University at the earliest opportunity will follow the example of many of the more modern Universities in England and Scotland by establishing either a chair or a lectureship in Archæology.

BUILDING.

Your Council was compelled, owing to the condition of the outer walls of the Museum staircase, to have them repointed, many slates replaced, and new gutters fixed to staircase roof; Messrs. Young and Mackenzie kindly undertook to see that the work was satisfactorily completed. The fabric of the building, including the house attached, is now in satisfactory condition, and the thanks of the Council have been tendered to Messrs. Young and Mackenzie for their services.

COUNCIL MEMBERS.

In accordance with the constitution of the Society five Members of the Council retire from office, viz., Sir Charles

Brett, Dr. S. W. Allworthy, Messrs. T. Edens Osborne, Wm. Faren, and A. Deane. All these members are eligible for re-election.

FINANCIAL STATEMENT.

The Financial Statement, which has been passed by the Auditor of the Local Government Department of the Ministry of Home Affairs, appears on page 41.

In submitting his statement for the year ending 31st October, 1925, the Hon. Treasurer (Mr. W. B. Burrowes) reported that the credit balance at the beginning of the year was £55 9s 9d. This had been changed to a deficit of £119 12s 9d, partly accounted for by some exceptional expenditure which had to be met such as repairs to the building, £70 0s 0d, and a balance on the Centenary Volume of £120 0s 0d. These items, however, will not arise again, as the Hon. Treasurer does not anticipate any large amount to be met during the coming season.

ADOPTION OF REPORT.

In moving the adoption of the Report the President said all the members of the Society were greatly indebted to Mr. Deane for the work he had done for the Society since he became Hon. Secretary. His efficiency, interest, and zeal had certainly made his (the president's) work very easy. The Report was of a very satisfactory nature, and showed that the Society had initiative, and was carrying on its work in an efficient manner. Whilst encouraging their own members to give papers, they at the same time felt it a duty to bring in distinguished lecturers from outside in order to spread scientific knowledge among the people. In carrying out that policy they had not had to refuse any paper from any of their own members; they had not sacrificed one side to the other, and they had had excellent papers from their members as well as lectures by prominent men from outside their own ranks. Thus interest in the work of the Society had been kept alive. It was, he continued, a good thing to have a course of lectures carried on at the University, as it made them feel the close connection which existed and ought always to exist between the Society and the University. They looked forward in the next session to having similar meetings at Queen's. In conclusion the President referred to the important work done by Mr. H. C. Lawlor and his colleagues in connection with the work of the Archæological Section at Nendrum, and said he had heard the highest opinions expressed regarding Mr. Lawlor's book and the work which it embodied.

Colonel R. G. Berry, M.R.I.A., seconded, and the report was unanimously adopted.

ELECTION TO COUNCIL.

On the motion of Mr. David E. Lowry, seconded by Mr. A. G. Pomeroy, M.A., the following five members of Council retiring in rotation were re-elected for three years:—Sir Charles Brett, Dr. S. W. Allworthy, Messrs. T. Edens Osborne, William Faren and Arthur Deane.

THANKS TO PRESIDENT.

Proposed by Mr. H. C. Lawlor, M.A.,

Seconded by Mr. E. J. Elliott, and unanimously

Resolved—" That we place on record, at this Annual Meeting, our deep appreciation of the services rendered by Professor W. B. Morton, M.A., M.R.I.A., during his second year of office as President of the Society."

At the conclusion of the Annual Meeting the new Council met to elect officers for the ensuing year, when Professor Morton was unanimously elected President.

The Officers and Council of Management for 1925-26 will be found on page 46.

ARCHÆOLOGICAL SECTION.

9th SESSION, 1924-25.

The 9th Annual General Meeting of the Archæological Section was held in the Museum, College Square North, on Wednesday, 2nd December, 1925. In the absence of the Chairman, Sir Charles Brett, LL.D., the chair was occupied by Mr. Godfrey W. Ferguson, J.P.

The Hon. Secretary of the Section (Mr. H. C. Lawlor, M.A., M.R.I.A.) presented the Committee's Report for the year ending 31st October, 1925, as follows:—

The Committee regret that by death or resignations the Section had lost twelve members during the year, while eight new members had joined, the total membership now standing at 118.

The Committee held four meetings during the year, which were well attended; at its first meeting Mr. Andrew Robinson, M.V.O., M.B.E., was co-opted a member.

As forecasted in last year's Report, the Committee undertook the investigation and repair of the cashel and souterrain at Dromena, under the supervision of Colonel Berry. Considerable difficulty was experienced in procuring labour, as men can only be obtained when they can spare time from their farms. Hence the work at Dromena has made slow progress; Colonel Berry will defer his report upon the investigation until it is completed, which he hopes will be next spring or summer.

A former resident in the district of Newtownards reported to the Hon. Secretary that on Chapel Island in Strangford Lough, he had once seen a number of cairns of stones which he believed were prehistoric burial mounds. Chapel Island is very difficult of access, but Lord Londonderry, on hearing of the matter, placed his motor launch at the Hon. Secretary's disposal, which enabled him to inspect the cairns. There were five in number, and had all the appearance of burial cairns. Major C. Blakiston Houston offered, if we engaged James Lowry and his men, who had worked at Nendrum, to convey them across to the Island in the morning and back in the evening, on whatever day suited Lord Londonderry's convenience to lend the boat from Mountstewart.

The date arranged was the 3rd September. The men on arrival proceeded to examine the cairns by removing the stones at the centre, down to the undisturbed till. It was found that at the bottom there remained the foundations of the walls of dry-stone buildings, some six feet square, open on the south side; modern nails were found on the floor. The cairns were certainly not of prehistoric age, and from enquiries made by General Montgomery, the owner of the Island, it appears that the island at one period, perhaps a hundred years ago, had been a great centre of the kelp burning industry; the heaps of stones were evidently the ruins of the kelp burner's shelters which were built open to the south to protect them from the bitter north wind that sweeps over this exposed part of the Island.

The afternoon was spent in examining the ruin of the tiny chapel on the eastern summit of the island. A mere fragment of the foundation of the early chapel remains; this was carefully exposed by removing the debris of a modern mortared erection used apparently as a cattle shelter at one time, and a kelp burner's house at another, as in the debris was found a kelp sickle. On the debris being cleared it was found that the early chapel had been of clay cemented stones, dating probably contemporaneous with the school at Nendrum, say 9th or 10th century. The chapel measures (inside) E. to W. 28ft. 10in., N. to S. 14ft. 4in. Walls 33in. thick. The door was on the north side, 7ft. 2in. from the west gable. On each side of the doorstep, which is very much worn, is a fragment of a jamb, very roughly cut to receive a door. In the N.W. corner were the foundations of a little room, some 8ft. x 6ft. inside, evidently a priest's kitchen. The doorway between the jambs is 2ft. 6in. wide, but only about 6in. of the jambs remain on either side.

Almost on the surface of the floor were what appeared to be the much decayed bones of a heifer or similar animal, as if it had been thrown in there without a grave, and the ruined remains of the modern building thrown over it to bury it. On digging, the only antiquarian remains found were a few fragments of pottery of the old or souterrain type, and one fragment of a wheel turned vessel. The fragments were too small to reconstruct the vessels, but the former may be as early as the 7th century, the latter as late as the 10th or 11th.

To the E. of the chapel, in the hollow, perhaps 30 feet below the level of the hilltop, are a number of irregularly placed stones in what appears once to have been a walled enclosure. This is evidently the church yard attached to the old chapel.

Of the history of this ancient ecclesiastical site, apparently nothing is preserved. Dr. Reeves visited it in 1844. At that date probably what now have the appearance of burial cairns had some shape indicating their actual use, kelp burner's shelters, as he does not refer to them. Had they been as they now appear, he could not have failed to enquire into the possibility of their being prehistoric cairns.

The Committee wish to record their special thanks to Major Blakiston Houston for his keen interest in this investigation, and for the use of his motor launch in bringing Mr. Lowry and his men across the lough and back again, and generally superintending the work. Especial thanks are also due to Lord and Lady Londonderry for the use of their launch and boat. Lady Londonderry came and took the keenest interest in the matter, and the Marquis intended to be present; he had a sudden call on Parliamentary duty, and at the last moment could not come. The Committee also wish to thank General Montgomery of Greyabbey, the proprietor of the island, for so willingly according consent to the investigation. He came with his brother Mr. George Montgomery and both took a lively interest in the proceedings. It is quite possible, and even very probable, that Chapel Island, with its 10th century, or earlier, chapel, was an outlying daughter of Nendrum. Local tradition supports this idea.

Thus the actual investigation work of the Archæological Section, compared with previous years, has not a great deal to show. But its influence has been felt. In last year's Report reference was made to a deputation from all the interested Societies which waited upon the Government to urge upon it the necessity of an Act of Parliament for the Preservation and Protection of Ancient Monuments. The members of the deputation, while representing the Royal Irish Academy, The Royal Society of Antiquaries of Ireland, The Belfast Naturalists' Field Club and this Society, were all members of the Archæological Section of this Society.

As a result of the representations made to the Government, a Bill dealing with the subject was promised in the King's Speech at the opening of the present Parliament. This Bill is being influentially supported, and may have been entered as an Act of Parliament before this Report is presented to the Section. It is satisfactory to have to record that if so entered, it will have been entirely to the credit of the Archæological Section of this Society.

The Hon. Sec. being in Augher, Co. Tyrone, in September, made enquiries regarding that very important monument of antiquity, the chambered tumulus of Knockmany, containing several engraved stones of importance quite equal to those at New Grange. He was informed that as nobody seemed to know anything about it as being important, the stones had been shifted, and that it might suffer injury at the hands of the men working on the Government Forestry Department. On his return, the Hon. Secretary reported to Dr. Chart the danger to which he had heard that the monument was exposed; Dr. Chart asked for a detailed report, which he could lay before the Ministry of Agriculture, to whose Department the site belongs. The Hon. Secretary visited the monument early in October and found the stones much injured by hooligans cutting their initials or names over the precious spirals, cup marks, and other designs, which, in addition, were rendered almost invisible through the growth of lichen. Several of the stones were either prone or in danger of becoming so. Dr Chart forwarded this report to the Forestry Department, and we are assured that the Monument will be carefully surrounded by a barbed wire enclosure, to which no one will be admitted without a permit, and that the recently displaced stones will be re-set up and the lichen cleaned off. If this were done, possibly more clear transcriptions of the inscriptions might be made or others found.

With regard to Nendrum, Mr. Johnston reported that during the past summer a very large number of people had visited the ruins, and the "Guide to the Ruins," by Major Houston had had a ready sale. Of 600 copies, only 50 now remain, in the hands of various booksellers, etc. These would certainly be sold early in the coming year, and a second edition would be necessary. Out of the funds in the collecting box at Nendrum, sign posts directing visitors where to go, were purchased, and Mr. Lowry and his men had been paid for two days' work, cutting down the weeds and brambles. These items of receipt and expenditure appear in the Hon. Treasurer's account.

With regard to the Nendrum Book; this was issued on the 17th March, 1925. 600 copies were printed, of which 400 were bound. Of these some 30 copies were issued to the Press for review; ten copies were, under customary use, taken by the Author, and 320 copies actually sold; some forty copies remain in the hands of the printers and booksellers. The average price realised by sales was about 7/11 per copy. The accounts, in which the book venture is included in the "Nendrum Fund," show that after all charges for circulars, printing, advertisements, etc., have been paid, there is a credit balance of some £7. Sales of the Book continue at, of course, a reducing rate, but when the remaining bound copies are disposed of, there should be a surplus of at least £20/25 to the credit of The Nendrum Fund. To this must be added the sale of the still unbound copies, 200 in number, which may have to be sold as a Publisher's Remainder, at perhaps a net sum, after cost of binding, of say 2/6 each, which represents a liquid asset of about a further £20.

The Press Reviews of the book have been eminently laudatory. Of these special mention must be made of those in *The Times*, *The Review of Reviews*, *The Irish Rosary*, *The Antiquaries Journal*, London, *The Spectator*, *The Journal of the Cork Historical and Archæological Society*. *The Scottish Historical Review*, *The Journal of the Royal Society of Antiquaries* (Ireland), *The Irish Statesman*, *The Glasgow Herald*, *the Scotsman*. *the Journal of the Co. Louth Archæological Society*, *The Dublin Magazine*, *The Belast News-Letter*, *Northern Whig*, *Irish News*, *The Belfast Telegraph*, *The Irish Times*, *The Daily Independent*, *The Irish Book-Lover*, and in the *Welsh Y Tyst*. *Further* reviews, chiefly in Continental papers, are promised. A statement of the sale of this volume will be found on page 42.

In the unavoidable absence of the Hon. Treasurer, the Financial Statement was also read by the Hon. Secretary. It showed a balance to credit of the Section of £111 12s 9d, including £6 8s 9d to the credit of the Nendrum Fund after all expenses in connection with the Nendrum Book had been paid.

After some amendments, on the suggestion of the Very Rev. the Dean of Down, the report was adopted and ordered to be sent forward to the Parent Society for printing in the Society's Proceedings.

ELECTION OF OFFICERS AND COMMITTEE.

Sir Charles Brett was unanimously re-elected Chairman, and Mr. H. C. Lawlor, Hon. Secretary of the Section. The Committee, of which the Section elect under Rule III. nine members, was re-elected, it being understood that at its first meeting, it should co-opt Mr. Andrew Robinson and Mr. David E. Lowry. The Committee thus, including the co-opted members, will consist of:—Sir Charles Brett, LL.D., Chairman; Mr. W. B. Burrowes, Hon. Treasurer; Mr. H. C. Lawlor, M.A., M.R.I.A., Hon. Secretary; Messrs. F. A. Heron, D.L.; R. S. Lepper, M.A., F.R.Hist.S.; T. Edens Osborne, F.R.S.A.I.; J. Theodore Greeves, R. J. Welch, M.Sc., M.R.I.A.; G. W. Ferguson, J.P.; Colonel R. G. Berry, J.P., M.R.I.A.; Professor W. B. Morton, M.A. (President), Andrew Robinson, M.V.O., M.B.E.; David E. Lowry, Arthur Deane, M.R.I.A., Hon. Secretary of the Society.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885.

The Account of Belfast Natural History and Philosophical Society for the year ended 31st October, 1925.

Dr. — **Cr.**

CHARGE.

To Balance as per last Account		£55 9 9
,, Subscriptions		126 8 0
,, Dividends		29 6 5
,, Rents		75 0 0
,, Realised by Sales, Centenary Volumes ...		5 2 0
,, Miscellaneous Receipts, viz. :—		
Lectures	£4 8 0	
Archæology	36 13 8	
Nendrum Book	140 19 3	
		182 0 11
Balance against Account on 31st October, 1925 ...		119 12 9
List of Securities.		
York Street Spinning Co. 4½ per cent.		
Debentures	£400 0 0	
5 per cent. War Loan 1929/47 ..	305 5 3	
Total ...		£592 19 10

DISCHARGE.

By Maintenance of Premises, etc.		70 0 0
,, Rent, Rates and Taxes		43 17 9
,, Salaries		25 0 0
,, Printing and Stationery Accounts ...		182 11 0
,, Postages		5 19 3
,, Advertising		17 2 11
Other Payments, viz. :—		
Lectures	£28 16 0	
Lantern Slides	4 0 0	
Bank Charges	1 1 0	
Audit Fee	1 1 0	
Nendrum Book	166 8 9	
Archæology	47 2 2	
		248 8 11
Total ...		£592 19 10

We certify that the above is a true account.

E. J. ELLIOTT, Governor.

W. B. BURROWES, Accounting Officer.

8th day of February, 1926.

I certify that the foregoing is correct.

R. CLARKE, Auditor.

9th day of April, 1926.

IN ACCOUNT WITH THE BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY.

ARCHÆOLOGICAL SECTION.

For the Year ended 31st October, 1925.

Dr. | **Cr.**

NENDRUM BOOK.

Dr.	£ s. d.	Cr.	£ s. d.
To Balance from Nendrum Fund ...	£31 18 3	By Advertising ...	£3 15 0
,, Sales, etc. ...	140 19 3	,, Printing, etc. ...	159 13 9
		,, R. Welch, Account ...	3 0 0
		,, Balance ...	6 8 9
	£172 17 6		£172 17 6
To Balance ...	6 8 9		

Dr.	£ s. d.	Cr.	£ s. d.
1924-25—		By Expenses (Travelling, etc.) ...	16 0 10
To Amount at Credit ...	£100 0 0	,, B. Walsh (Dromena) ...	10 5 0
,, Subscriptions ...	36 13 8	,, James Lowry (Nendrum) ...	4 18 4
,, Subsidy ...	15 12 6	,, Col. J. Berry's Expenses ...	13 10 0
		,, John Quigley ...	0 9 0
		,, Northern Whig, Ltd. ...	1 19 0
		,, Balance ...	105 4 0
	£152 6 2		£152 6 2
To Balance ...	105 4 0		

EXCHANGES.

ABO—Publications of the Abo University Library.

BASEL—Verhandlungen der Naturforschenden Gesellschaft in Basel 1922-24.

BERGEN—(Norway)—Publications of the Bergen Museum.

BERKELEY—Publications of the University of Californa.

BOLOGNA—Publications of the Royal Academy of Science. 1923-24.

BREMEN—Publications of the Bremen Museum.

BRIGHTON—Abstracts of Papers of Brighton and Hove Natural History and Philosophical Society. 1924.

BRUSSELS—Bulletins of the Royal Society (Botanical) of Belgium.

BUFFALO—Bulletins of the Buffalo Society of Natural Sciences.

CALCUTTA—Publications of the Geological Survey of India.

CAMBRIDGE—Proceedings of the Cambridge Philosophical Society.

CHICAGO—Annual Report of the Field Museum of Natural History.

CHRISTIANIA—Publications of the Royal University Library.

CINCINNATI—Publications of the Lloyd Library.

COLUMBUS—Bulletin of the Ohio State University. Ohio Journal of Science.

DUBLIN—Proceedings of the Royal Dublin Society.

EDINBURGH—Transactions and Proceedings of the Botanical Society of Edinburgh, 1923-24.

GLASGOW—Transactions of the Geological Society of Glasgow, 1924-25.

,, Proceedings of the Royal Philosophical Society of Glasgow, 1922-24.

La Plata—Publications of the National Museum of Natural History.

Lausanne—Memoirs and Bulletins de la Societe Vaudoise des Sciences Naturelles.

Lima (Peru)—Boletin del Cuerpo de le Ingenieros de Minas del Peru.

London—Quarterly Journal of the Royal Microscopical Society.

,, Memoirs of the Royal Astronomical Society.

Manchester—Journal of the Manchester Geological Society. 1921-22.

Orono—Bulletins of the Maine Agricultural Experiment Station.

Ottawa—Publications of the Geological Survey of Canada, Department of Mines.

Paris—Publications of the Geological Society of France.

Philadelphia—Proceedings of the American Philosophical Society.

Pusa—Scientific Reports of the Agricultural Research Institute. 1923-24.

Rennes—Bulletin de la Geologique.

Rio de Janeiro—Publications of the National Museum of Brazil.

San Francisco—Proceedings of the Californian Academy of Sciences.

St. Louis—Public Library Monthly Bulletin.

Stratford—The Essex Naturalist.

Tacubaya—Annual Report of the National Astronomical Observatory of Tacubaya.

Torquay—Transactions and Proceedings of the Torquay Natural History Society. 1923-24.

Warsaw—Zoological Publications of the Museum of Poland.

WASHINGTON—Yearbook of the United States Department of Agriculture, 1923.

,, Annual Report of the Smithsonian Institution.

,, Annual Report and Bulletins of the United States National Museum.

,, Publications of the Bureau of American Ethnology.

,, Bulletins of the Smithsonian Institution.

,, Proceedings of the United States National Museum.

,, Smithsonian Institution, Miscellaneous Collections.

,, Publications of the United States Geological Survey.

BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY.

Officers and Council of Management for 1925-26.

President;
PROFESSOR W. B. MORTON, M.A., M.R.I.A.

Vice-Presidents;
SIR CHARLES BRETT, LL.D.
S. W. ALLWORTHY, M.A., M.D., F.C.S.
PROF. GREGG WILSON, O.B.E., M.A., D.SC., PH.D., M.R.I.A.
ROBERT M. YOUNG, J.P., M.A., M.R.I.A.
J. M. FINNEGAN, B.A., B.SC.
WILLIAM SWANSTON, F.G.S.

Hon. Treasurer;
W. B. BURROWES, F.R.S.A.I.

Hon. Librarian:
ROBERT M. YOUNG, J.P., M.A., M.R.I.A.

Hon. Secretary;
ARTHUR DEANE, M.R.I.A.

Council:

W. B. BURROWES, F.R.S.A.I. E. J. ELLIOTT. H. C. LAWLOR, M.A., M.R.I.A. WILLIAM SWANSTON, F.G.S. PROFESSOR GREGG WILSON, D.SC., M.R.I.A.	Retire 1926.
JOHN M. FINNEGAN, B.A., B.SC. PROFESSOR W. B. MORTON, M.A., M.R.I.A. F. ADENS HERON, D.L., J.P., F.R.S.A.I. ROBERT M. YOUNG, M.A., M.R.I.A. RT. HON. S. CUNNINGHAM.	Retire 1927.
SIR CHARLES BRETT, LL.D. T. EDENS OSBORNE, F.R.S.A.I. S. W. ALLWORTHY, M.A., M.D., F.C.S. WILLIAM FAREN, F.R.S.A.I. ARTHUR DEANE, M.R.I.A., F.R.S.E.	Retire 1928.

SHAREHOLDERS AND MEMBERS.

Corrected to November, 1925.

[**Denotes Holders of three or more Shares.*]

[a ,, *Members of Archaeological Section.*]

Adams, John, Auburn, Cranmore Park Belfast
*Alexander, Francis, B.E. do.
Alderdice, Richard Sinclaire, F.C.I.B., 7 Wellington, Place, do.
*a*Allingham, Robert, J.P., North Street, do.
Allworthy, S. W., M.D., Manor House, Antrim Road, do.
*Anderson, John, J.P., F.G.S., (Representative of), Holywood, Co Down
*a*Anderson, Frank, M.B.E., Willoughby Terrace, Portadown
*a*Andrews, Michael C., F.R.G.S.. F.R.S.G.S., Orsett, Derryvolgie Avenue, Belfast
Andrew, John, L.D.S., R.S.C.ENG., 23 University Sq. do.
*a*Andrews, Miss Elizabeth, 10 Park Crescent, Tonbridge, Kent
*a*Archer, Rev. Canon, B.D., Seagoe Rectory, Portadown
Armstrong, Hamilton, Corlea, Ashley Park, Belfast
*a*Atkinson, Arthur S., Dromana, Knockdene Park, do.

*a*Baird, Major William, J.P., Royal Avenue, do.
Beaumont, Ivor, A.R.C.A., F.R.S.A., School of Art, do.
*a*Bennett, S. A., B.A., B.SC., Campbell College, do.
*a*Bennett, J. L., B.A., Helen's Bay
*a*Berry, Colonel, M.R.I.A., Ardaluin Newcastle
Bigger, Francis J., M.R.I.A., F.R.S.A.I., Ardrigh, Antrim Road, Belfast
Bingham, John A., M.P.S.I., 1, Ashley Avenue, do.
*a*Birch, J. P., Ashfield House, Ravenhill Road, do.
Blair, John G., 3 Victoria Gardens, do.
*a*Blake, R. F., F.I.C., 4 Knock Road, do.
Boyd, Thornton, Blackstaff Spinning Company do.

*a*Boyd, Miss Kathleen St. Clair, Chatsworth, University Road, Belfast
Boyd, John, San Remo, Holland Park, Neill's Hill, do.
Bradbury, Prof. F., Municipal College of Technology do.
*a*Breene, Rev. R. S., Killinchy, Co. Down
*a*Brett, The Venerable Archdeacon, M.A., Montrose, Fortwilliam Park, Belfast
Bristow, John, 10 College Square North, do.
*Brown, George B., Lisnamaul, Ormeau Road, do.
Brown, J., M.A., B.SC., 32 Maryville Park, do.
*a*Burrowes, W. B., F.R.S.A.I., Ballynafeigh House, Ravenhill Road, do.
*a*Byrne, J. Edwards, J.P., F.R.S.A.I., 37 Royal Avenue, do.

Calwell, R. I., C.B.E., B.E., M.I.C.E., Carninard, Annadale Avenue, do.
*a*Cameron, G. A., Institution Road, Coleraine
*a*Campbell, A. A., F.R.S.A.I., Drumnaferrie, Rosetta Park, Belfast
*Campbell, Miss Anna (Representatives of), do.
*a*Carmody, The Very Rev. W. P., Dean of Down, Downpatrick
Carr, A. H. R., 22A Donegall Place, Belfast
Carrothers, E. N., 145 Stranmillis Road do.
*a*Carter, C. S., 7 Knockbreda Road, do.
*Charley, Phineas H., Coolbeg, Cultra, Co. Down
Clark, Sir George S., Bart, D.L., Dunlambert, Belfast
*a*Clarke, John, Antrim Arms Hotel, Glenarm
*a*Cleland, A. McI., Macedon, Green Road, Knock, Belfast
Combe, Barbour & Co., Ltd., do.
*a*Chart, D. A., LITT.D., 12 Malone Park, do.
*a*Clarke, G. W., M.B.E., 39, Adelaide Park, do.
Crawford, Rt. Hon. R. G. Sharman, Crawfordsburn
*a*Crawford, W. M., B.A., I.C.S., F.E.S., F.Z.S., Marlborough Park, Belfast

*a*Cromie, Thomas, M.D., Clough, Co. Down
Cromie, A. G., Seeburgh, Castle Avenue, Belfast
Crymble, H., 40 Wellington Place, do.
*a*Cunningham, Right Hon. S., Fern Hill, Ballygomartin Road, do.
Cutler, H. A., M.INST.C.E., City Hall, do.

*a*Dawson, W. R., 26, Windsor Park, do.
Davies, A. C., Lenaderg House, Banbridge, Co. Down
Davin, Miss A. G., Glenmore Lodge, Lambeg
*a*Davis, Colonel, 21 Malone Place, do.
Davison, A. H., F.A.I., 32 Wellington Place, do.
Deans, T. M., LL.D., Academy House, Rosetta, do.
*Deramore, Lord, D.L., Heslington Park, York
Despard, V. D., 10 Academy Street, Belfast
Devoto, V. A., Kilmorna, Glastonbury Avenue, do.
Dixon, Professor, M.A., SC.D., F.R.S., St. Ives, Bladon Drive, do.
Dobbs, A. E., M.A., Kildollagh, Coleraine
*Donegall, Marquis of (Representatives of), Belfast
*Downshire, Marquis of.
Drummond, T. H., 7, Chichester Street, do.
Dunleath, Lord, Ballywalter Park, Ballywalter, Co. Down

Earls, Professor J., B.A., Municipal College of Technology, Belfast
Ewart, Fred W., M.A., B.L., Derryvolgie, Lisburn
Ewart, Sir Robert H., Bart., Glenmachan House, Belfast
Eliott, David, J.P., B.A., Ardroe, Bloomfield, do.
Elliott, E. J., The Towers, Donegall Park Avenue, do.

*Fenton, Francis G., 5 Rue Crevaux, Paris
*a*Ferguson, G. W., C.E., J.P., Carnamenagh, Antrim Road, Belfast
Finlay, Archibald H., A.C.G.I., A.I.E.E., Willesden, Holywood

Finlay, Robert H. F., Victoria Square, Belfast
Finlay, W. J., 10 High Street, do.
Finnegan, John M., B.A., B.SC., 23 Botanic Avenue, do.
Fitzsimons, N., F.R.I.B.A., 92 Myrtlefield Park, do.
Forsythe, J., Lisadell, Cliftonville Road, do.
*a*Frazer, Kenneth J., Hillmount, Cullybackey
*a*French, E. J., M.A., St. Anne's, Donnybrook, Dublin
Fry, W. Arthur, High Street, Holywood
Fulton, G. F., Arlington, Windsor Avenue, Belfast

Geale, R. G., 40 Wellington Park, do.
*Getty, Edmund (Representative of), do.
Gibbon, Ltd.-Col. W. D., D.S.O., M.A., Campbell College, Belfast
Gibson, Andrew, F.R.S.A.I., Fairfield, Lansdowne Road, do.
Gibson, S., J.P., Summerhill, Dunmurry, Co. Antrim
Gibson, W. H., O.B.E., D.SC., F.I.C., F.INST.P., York Street Flax Spinning Co., Belfast
Gibson, W. K., 16 Chichester Street, do.
Goldsborough, J. B., Central Public Library, do.
Gore, Wm., F.R.S A.I., Municipal College of Technology do.
Gordon, J. S., D.SC., Ministry of Agriculture, do.
Gordon, Malcolm, Dunarnon, University Road do.
Gourlay, R. J., Central Public Library, do.
Green, H. Percy, Limehurst, Holland Park, do.
*a*Greeves, Arthur, Altona, Strandtown, do.
*a*Greeves, John Theo., Nendrum, Knockdene Park, do.
*a*Greeves, W. Leopold, 11 Ormeau Road, do.
Grogan, J., Junior, 2 Orient Gardens, do.
Gillmour, J. W., Knocknarea, Kensington Road, Knock

Harris, Miss S. M., 25, Hartington Street, Belfast
Hale, W. Barcroft, 6 Salisbury Gardens, do.
*Hall, Frederick H., Waterford

Hamilton, Rt. Hon. and Rev. Thomas, M.A., D.D., LL.D., 21 Chlorine Gdns., Belfast

*Hamilton, Hill, J.P. (Representatives of), do.

Hanson, W. M., St. John's Villa, Holland Park, do.

Harland, Capt. W., 4 Psalter Lane, Sheffield

*a*Hastings, S. R., J.P., Church Street, Downpatrick

Hastings, Archibald, 7 Cavehill Road, Belfast

Hawthorne, John, B.A., PH.D., F.I.C., 16 Donegall Square S., do.

Hayward, Harold R., F.R.S.A.I., Hopefield House, Antrim Road, do.

Henderson, J. W., M.A., Methodist College, do.

*a*Henry, Professor R. M., M.A., M.R.I.A., Crosshill, Windsor Avenue North, do.

*a*Henry, T. W., F.S.ARCH., Greenbank, Mount-pleasant, do.

Herdman, E. C., Carricklee House, Strabane

*Herdman, Robert Ernest, J.P., Merronhurst, Craigavad, Co. Down

*a*Heron, F. Adens, D.L., J.P., F.R.S.A.I., Maryfield, Holywood

*a*Hewton, John, M.P.S.I., Ava Pharmacy, 315 Ormeau Road, Belfast

Heyn, James A. M., Head Line Buildings, do.

Higginson, R. E., U.S.P.C.A., Carnmoney

*a*Hill, S. W., M.D., 46 Pound Street, Larne

Hind, John, 22 Cliftonville Road, Belfast

*a*Hogg, A. R., 10 Thorndale Avenue, do.

Honneyman, Wm., B.SC., (LOND.), F.I.C., 18 Halstein Drive, Ballyhackamore, do.

Hoskins, A. Percy, F.I.C., F.C.S., 14 Rosetta Park, do.

**a*Blakiston-Houston, Major C., J.P., Myode, Bloomfield, do.

*Hughes, Edwin, Craigavad (Representatives of) Co. Down

Hummel, Professor, M.SC., A.M.I.C.E., Queen's University, Belfast

Hunter, Dr. J. A., Hampton Cottage, Balmoral Avenue, Belfast
Hunter, William, J.P., Fortwilliam Villas, do.

James, Wm., L.D.S., 93 Gt. Victoria Street do.
Jamieson, Andrew (Andrew Jameson, Ltd.), Sandy Row, do.
Jenkins, J. C., 86 University Road, do.
*a*Johnston, E. C., F.R.S.A.I., Glenmount, Newtownards
*Jones, H. H., 3 Wilmont Terrace, Belfast
*a*Jury, P. M., Brooklands, Dunmurry
*a*Jennings, V. G., Wellcroft, Sandown Road, Knock

*Kinghan, John R., Windsor Avenue (Representatives of), Belfast
Kinkead, G. W., 9 Donegall Square S. do.
*a*Knox, Major S. W., LL.B., Glenburn, Dunmurry, do.
Kyle, Robert Alexander, 15 Wellington Park, do.

*a*Lamb, G. C., Leura, Finaghy, do.
*a*Lawlor, H. C., M.A., M.R.I.A., 8 Windsor Avenue do.
*a*Lawlor, Mrs. H. C., 8 Windsor Avenue, do.
*a*Lepper, R. S., M.A., F.R.HIST.S., LL.M., F.R.S.A.I., Elsinore, Crawfordsburn, Co. Down
Lewars, D. B., 17 Dundela Gardens, Bloomfield, Belfast
Lindsay, Professor J. A., M.A., M.D., F.R.C.P., Queen's Elms, do.
Livingstone, R. W., M.A., D.LITT., M.R.I.A., Elmwood House, do.
*a*Loewenthal, John McC., Lennoxvale, Malone Road, do.
*a*Londonderry, The Marquess of, Mount Stewart, Newtownards
*a*Londonderry, The Marchioness of do. do.
Loughridge, James, 173, Clitfonville Road, Belfast
Logan, Jas., M.A., F.R.G.S., Greystone, Ravenhill Pk., do.

Lowry-Corry, Hon. Cecil, Castle Coole, Enniskilen, Co. Fermanagh
*a*Lowry, David E., Oakley, Strandtown

*Macrory, A. J. (Representatives of), Belfast
*a*Magill, Mrs. A. P., 9 Wilmont Terrace, Lisburn Road, do.
*a*Magill, Hugh, 217 Cavehill Road, do.
Magill, John E., Eversley, Whitehead
*a*Mackie, James, J.P., Albert Foundry, Belfast
Malcolm, Bowman, M.I.C.E., M.I.MECH'E., Inver, Ashley Park, Antrim Road, do.
Malcomson, Herbert, Riverside, Holywood
Maxton, James, M.I.N.A., M.I.MAR.E., 6 Kirkliston Drive, Belfast
*a*Mayes, William, Kenmuir, 12 Deramore Park South, do.
Mayne, H. Horner, 24 Elmwood Avenue, do.
Mercer, S. P., Hanging Leaves, Jordanstown
*a*Mercier, Mrs. W. C., Garvock, Green Road, Knock
*a*Merrick, A. S., 32 Wellington Park, Belfast
Metcalfe, A. W., Hawthornden House, Hawthornden Road, do.
Milligan, A., 4 Cooke Street, do.
Mitchell, Robert A., LL.B., T.C.D., Marmont, Strandtown, do.
Moneypenny, Sir Frederick, C.B.E., C.V.O., City Hall, do.
*a*Montgomery, Miss E. S., 26 College Green, do.
*a*Montgomery, H. C., F.R.S.A.I., 40 Rosemary Street, do.
*a*Montgomery, H. H., 19 Malone Park, do.
*a*Morton, Professor W. B., M.A., M.R.I.A., Glencarse, Nottinghill, do.
Muir, A. H., F.C.A., 7 Donegall Square West, do.
Muskett, A. E., 12 Belgravia Avenue, do.
Mullan, William, Lindisfarne, Marlborough Park, do.
*Murphy, Isaac James (Representatives of), Armagh
Maxwell, W. C., A.R.I.B.A., 29 Donegall Street, Belfast

*Murphy, Joseph John (Representatives of), Belfast
*Musgrave, Henry, D.L. (Reps.), Drumglass, Malone, do.
*a*Macalister, Professor, R.A.S., D.LITT., M.A., 18 Mount Eden Road, Donnybrook, Dublin
McBride, A. H., Ormeau Avenue, Belfast
*McCalmont, Robert (Representatives of), London
*McCammon, Thos. P. (Representatives of), Woodvale, Holywood, Co. Down
McCance, Captain Stouppe, 4 Markham Square, London, S.W.3.
McCaughey, John, 79 Somerton Road, Belfast
MacConaill, Michael, B.SC., 17 Fleetwood Street, do.
*a*M'Coy, B. J., F.R.SA.I., 84 Smithfield, do.
McCoy, W. R. S., 27 Damascus Street, do.
*McCracken, Francis (Representatives of),
*a*McCready, H. L., M.A., 104 Myrtlefield Park, do.
McDowell, Chas, Stephen, B.SC., 33 Wellington Park, do.
McGill, J. F., Ardoyne Cottage, Ardoyne, do.
*a*McGowan, Thomas, 73 Ann Street, do.
McIlveen, J. H. M., Irene, Parkmount Road, do.
MacIlwaine, Dr. John E., 26 College Gardens, do.
*a*McKisack, H. L., M.D., Chlorine Place, do.
*a*McKisack, C. J., 9 Mount Pleasant, do.
MacLaine, Alexander, J.P., Queen's Elms (Representatives of), do.
MacLane, L., Rathcline, Annadale Ave., Belfast
*a*McMeekin, Adam, J.P., Cogry House, Doagh
MacMillen, Rev. J., M.A., D.D., 151 Ravenhill Road, Belfast
McMullan, C., Bangor Road, Holywood
McMullan, P. J., J.P., Churchfield, do.
*a*McNeill, George, 12 Deramore Park, Belfast

*a*Neill, F. F., 35 Candahar Street, do.
Newell, J. F., 25 Lombard Street, do.
MacConaill, M., B.SC., 17 Fleetwood Street, do.
MacLaine, L., Rathcline, Annadale Avenue, do.
Nicholl, William, 10 St. James' Street, do.

Noble, R. S. H., M.A., Lisnaton, Suffolk, Dunmurry
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