THE LEWISHAM & BLACKHEATH
SCIENTIFIC ASSOCIATION.

159 High Street,
Lewisham
S.E.

12 Nov. 1886

Dear Sir,

At the request of Mr T. V. Holmes, President of this Association, I forward to you by this post the Reports of the Association from 1879 to 1883 inclusive.

I am, dear Sir
Yours faithfully
H. W. Jackson
Hon. Sec.

B. B. Woodward, Esq

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1879,

AND

LIST OF MEMBERS.

GREENWICH:
HENRY S. RICHARDSON, STEAM PRINTING WORKS,
CHURCH STREET.

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LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 6th January, 1880.

President,

JOHN KNOX LAUGHTON, R.N., M.A., F.R.A.S., F.M.S.,
Mathematical & Naval Instructor, Royal Naval College, Greenwich.

Council,

H. E. ARMSTRONG, Ph.D., F.R.S., Sec. C.S.

E. W. BRABROOK, F.S.A., Director A.I.

ARTHUR ROPER, M.R.C.S.

J. W. WAGHORN, R.N., B.Sc., F.R.S.N.A.

W. WEBSTER, Jun., F.C.S.

JOHN YEO, R.N., F.R.S.N.A. (Joint Hon. Sec.)

Treasurer,

JAMES VOGAN.

Honorary Secretaries,

HENRY W. JACKSON, F.R.A.S., F.G.S., &c.
15, *Limes Terrace, Lewisham,* S.E.

JOHN YEO, R.N.,
Royal Naval College, Greenwich, S.E.

PROCEEDINGS, 1879.

FEBRUARY 4th, 1879.

A Meeting was held at the Clarendon Rooms, Lee Bridge, Lewisham, Mr. H. W. Jackson, F.R.A.S., &c., in the Chair, at which the Association was established. The circular calling the Meeting had announced that "the object of the Association is the diffusion of Scientific Knowledge among its Members :—

1st.—By the Reading and Discussion of Papers, and by Lectures, on Scientific subjects generally.

2nd.—By Reports on the progress of Science.

3rd.—By the Exhibition of Objects of Interest, new Inventions, &c.

4th.—By Excursions, Field Meetings, and Visits to Museums, Workshops, &c.

"Of late years the progress of Science has been so marked, and discoveries and inventions have been so numerous and important, that public attention has been excited in no ordinary degree, and accurate information on scientific matters is everywhere asked for: the information, however, is not readily to be had, and it is in order to supply this want that the Association is to be established."

Mr. Brabrook moved a Resolution for the establishment of the Association, referring in detail to the several methods above enumerated by which it was intended to promote the object in view. He remarked :—

"If I sought to express our object in one word, I think I should have to borrow a French one, as we very often have to do when we desire to express ourselves with neatness and precision. When I visited the Exposition des Sciences Anthropologiques at Paris last year, Professor Topinard said to me, 'Our object in this Exposition is "vulgariser l'anthropologie,"' So I should be inclined to say, our object in this Association is '*vulgariser*' Science. You will see at once that I cannot translate this into English: for our insular exclusiveness has long ago attached to everything vulgar a sense of degradation. But the word just expresses what I mean: any other word, such as 'popularise,' would not do so. You cannot render Science popular except by some sacrifice of its high truthfulness, and that is what we certainly do not contemplate. In the best sense of the word, we want to vulgarise Science; perhaps, in these days of general education, the old exclusive sense will depart, and the good sense of the word will come back to it. We want to make it the common heritage of the whole community—its triumphs the common triumphs—its progress the common interests—its principles the leading and guiding aims of all of us. For if those principles be, as I maintain they are, truth, progress, and tolerance, human nature can find no higher:—and if the scientific teacher assert them, and the scientific learner be actuated by them, the more vulgar Science can be made the better.

"This leads to the remark that one of our proposed rules, while it is calculated in the good sense of the word to vulgarise Science, is likely to have the precisely opposite consequence with regard to the bad sense of the word. We propose to make our Meetings common to both sexes, by admitting the refining and elevating influence of female society to them. It will be suggested that you should resolve 'That the Meetings should usually be open to ladies as visitors on the introduction of a Member.' This is a question on which Scientific Societies are much divided; but I do not anticipate that it will cause much division among us. If our object be that which I have described, the presence of ladies on any suitable occasion, in these days when the appetite for scientific information is so widely diffused, will undoubtedly be an aid, and not a hindrance, to us. There may be occasions—I do not think they will frequently arise—when questions of a physiological or ethnological character may come before us which would involve discussions at which ladies could not assist without offence to Mrs. Grundy; but if such questions should arise, the tact of the Members may be relied upon not to bring the ladies of their family with them on any such occasions. For the great majority of cases no difficulty need be anticipated, and we hope that it will become the common practice of the Members to come here accompanied by their wives and daughters, or their sweethearts if they are in the happy stage of life indicated by that good old English expression, at once to grace us by their presence and encourage us by their interest in our work."

Referring to the establishment of similar Associations, and to the great importance and value of the objects of the proposed Association, Mr. Brabrook ventured to predict for it a long and prosperous career. The Resolution was seconded by Mr. Lockhart, F.R.C.S., supported by Dr. Armstrong, F.R.S., and unanimously carried.

Dr. Armstrong moved the adoption of the Rules, which had been prepared by the Provisional Committee, and Mr. Lavers seconded it. This was also carried unanimously; as well as the following list of Officers and Council, proposed by Mr. Lavers and seconded by Mr. Edwin Low:—

President,—Mr. E. W. Brabrook.

Treasurer,—Mr. James Vogan.

Honorary Secretary,—Mr. H. W. Jackson.

Council,—Mr. W. J. Allsup, Dr. H. E. Armstrong,
Mr. C. D. Davies, Mr. Arthur Roper.

On the motion of Mr. Lockhart, seconded by Rev. T. Bramley, thanks were voted to the Chairman for his conduct in the Chair.

MARCH 5th.

Mr. J. W. Waghorn, of the Royal Naval College, Greenwich, gave a Lecture on the "Electric Light."

The Lecturer showed experimentally that a current of electricity is produced when two plates of different metals are placed in an acid, and joined externally by a wire, as in the ordinary galvanic battery; or when, on the principle discovered by Faraday, a coil of wire is caused to rotate between the poles of a powerful magnet. The latter method, being the more economical, is always adopted in practice where the Electric Light is permanently employed. When a current of electricity meets with resistance to its passage, heat is generated, and, if the temperature be sufficiently raised, light also is given out, but the resistance must be localized so as to concentrate the heat over a small area. The two plans adopted to obtain the necessary resistance, viz.,—the one, by separating the conducting carbon rods by a small air space (the "voltaic arc" method); and the other by interposing a short length of highly resisting substance, such as platinum or carbon of small diameter (the "incandescent" method) were described and illustrated. As examples of the voltaic arc arrangement the Duboscq and Wallace-Farmer lamps, and the Jablochkoff and Wilde candles, and as examples of the combination of arc and incandescence, the Werdermann and Reynier lamps, were shown in action by a current from 60 Grove cells.

The Electric Light is found to be most economical when a single light of very great intensity is employed, but this is not adapted for houses or narrow streets. It more nearly approaches sun light in constitution than gas does, it heats the air less, and perhaps vitiates it less, although small quantities of nitric acid and prussic acid are formed. As regards cost compared with gas, an exact estimate is very difficult on the present data, it will depend entirely upon the special circumstances under which the light is used. The allowance per hour for interest and depreciation—a very large item—will depend upon the number of hours it is employed; while the cost of attendance may be either a serious item or nothing. In the newspaper comparisons gas is often estimated at the Paris or American prices, which are twice as much as those of London, and the illuminating powers are often grossly misstated; thus the Jablochkoff light on the Embankment, really equal to about 150 standard candles, is nearly always assumed to be equal to the light of 1000 candles. Only under the most favourable conditions does it appear to be undeniably more economical than gas. But it will doubtless be found very useful in concert halls and large reading rooms by reason of its purity and coolness; in ships, mines, and light-houses, where it competes with oil; and in factories where the attendance and steam power will cost very little. For household purposes the single light of great intensity would have to be replaced by many lights of less illuminating power individually, thereby immensely lessening the economy. This is the main difficulty: another lies in the fact that in this sub-division of the light, the incandescent plan must be used. Now platinum and carbon are the only substances, except the costly and rare metal iridium, which can resist without fusion the very high temperature necessary. But platinum in time becomes brittle and breaks or fuses, and carbon burns away if heated in the air; or disintegrates if in a vacuum. Edison in America has so far only re-discovered facts which are already well known, and which have been elaborately tried for more than 30 years. The only novelty which has been produced is an arrangement for generating electricity by the motion of a large tuning-fork worked by a steam engine; but this is probably the most inefficient machine for the purpose which has ever been constructed.

Note.—January, 1880: Mr. Edison admitted in December, 1879, that up to that date, when he tried the baked cardboard, nothing had been discovered of any importance, and that all his attempts so far had been fruitless. After seven weeks' trial the tuning-fork arrangement was discarded as "utterly worthless."—J. W. W.

APRIL 1st.

Dr. Armstrong, F.R.S., Secretary to the Chemical Society, read a Paper on "Starch: its Formation and Functions in Plant Life:"—

Starch is a white substance which turns violet when iodine is applied to it. On examining with a microscope the cells of the young leaves of a plant, it is found, as a rule, that their contents are not homogeneous, but that they contain a number of green granules to which the colour of the leaf is owing, the rest of the cell-contents being colourless. When a solution of iodine is added, these granules are coloured violet, and hence it is inferred that they contain starch. When, however, growing plants are placed for a time in the dark, the starch invariably disappears from the granules, but it as invariably reappears when the plant is restored to the light.

Starch is always definite in character, and possesses the same properties from whatever plant it may be obtained. It is composed of carbon, hydrogen, and oxygen, in the proportion of $C_6 H_{10} O_5$. The carbon is derived by plants from the carbonic acid which is found in small quantity in the air. This fact was first shown by Liebig; before his time it was erroneously believed that the source of the carbon was the soil. When a seed is placed to germinate in sand, and supplied with water and air which have been deprived of carbonic acid, it ceases to grow, but growth at once recommences when carbonic acid is supplied. The carbon of the carbonic acid in the air is derived principally from the respiration of animals, and from the combustion of coal, gas, &c. That carbonic acid exists in the air expired from the lungs was shown by the Lecturer, who breathed some air from his own lungs into a bottle containing lime-water. The lime-water became turbid from the conversion of the soluble lime into an insoluble carbonate of lime or compound of lime with carbonic acid. The *oxygen* of starch is also partly derived from carbonic acid, but its *hydrogen* comes from water, the composition of which is H_2O. Thus it is found that carbonic acid and water are necessary to the growth of a plant. But, in order to separate the carbon from the oxygen, Energy is required, and that energy is found in Light.

The Lecturer then stated that when a ray of white light, such as a beam of sunlight, is passed through a wedge-shaped piece of glass, it becomes spread out like a fan, and broken up into several rays coloured like the rainbow. These coloured rays—red, orange, yellow, green, blue, indigo, and violet—appear invariably in the same order, and, when thrown upon a screen, exhibit what is known as the "spectrum." Now, of these rays, the red, orange, yellow, and part of the green are necessary to the growth of a plant; the remaining rays, being inactive, are not necessary, and plants will grow if deprived of such rays. The yellow exhibits the greatest amount of energy in decomposing carbonic acid, and the intensity of action of the various colours was shown to be $R = 25$, $O = 63$, $Y = 100$, $G = 37$, $B = 22$, $I = 13$, $V = 7$. This conclusion has been arrived at by an estimation of the number of bubbles thrown off in a given time by the leaves of a water-plant when exposed to the different coloured rays in succession. Plants, however, do not assimilate all the oxygen of the carbonic acid and water, and some of it escapes, and thus the air we breathe is purified.

Starch is formed in the leaves, and is conveyed, when produced, to other parts of the plant—to the tuber of the potato-plant, for example. But starch is insoluble in water: how then can it pass through the cell-walls of the plant and into the circulation? This effect was shown to be brought about by the agency of such substances as "malt extract," which is present in all plants, and which renders the starch soluble, though it is then no longer starch but a substance closely allied. Thus dissolved, it passes along the vessels, and in the tuber of the potato-plant, by a process yet unknown, is once more converted into starch.

MAY 6th.

Mr. John Knox Laughton, R.N., M.A., F.R.A.S., F.M.S., Mathematical and Naval Instructor, Royal Naval College, Greenwich, read a Paper on "Weather Forecasting:"—

Probably no subject is of such general interest as the Weather, but as yet much of our knowledge regarding it is no better than empirical. Of folk-lore some is really valuable, but the rest is curious nonsense. The predictions founded upon changes of the moon, the moon's crossing the equator (Mr. Saxby's idea), the old moon in the new moon's arms, &c., may have some germ of truth in them, though it is difficult to find it; but it is simply absurd to connect weather fluctuations with changes of the moon which take place on a Saturday, Sunday, or Monday. Weather may be influenced by the position of the planets, but of this we as yet know nothing. Mr. Meldrum, of Mauritius, believes that he has discovered a connexion between atmospheric changes and those disturbances on the face of the sun known as "sun-spots."

Passing to the indications afforded by clouds we come to a more scientific basis, of which the value is not likely to be underrated. Much of the modern science of meteorology depends upon the study of clouds. Thus *Cirrus* (mares' tails) shows the direction of the wind at a great height, and frequently this is different from that nearer the surface of the earth. This cloud is often a token of rain or of wind. *Cirro-cumulus* (mackerel sky) foretells fresh breeze. The nautical rhyme says: "Mackerel sky and mares' tails make ships carry low sails." *Cirro-stratus* is a sheet-like form of cloud with a line edge. *Cumulus* is a lower cloud; if it grows larger and goes against the wind, it denotes rain. *Stratus* is the lowest cloud of all, and is sometimes known as ground-fog. This is the grey which the sun breaks through, and which is usually followed by a fine day. *Nimbus* is a dark cloud full of rain. When two clouds of different heights are seen going in different directions, rain usually ensues. When clouds have gaudy hues and strong outlines, rain and strong wind may be expected. But such popular weather maxims, although really valuable, are not to be implicitly relied upon.

In the year 1861 Admiral Fitzroy first issued his daily weather reports, and attempted to give forecasts for the three following days; but it was found that the warnings were so often wrong that it was deemed advisable to discontinue them. In 1869 a more modest kind of forecast was sent out, in which the direction of the wind was not furnished; some time subsequently, however, the direction was given. Quite recently the Meteorological Office, having patiently for a whole year experimented on forecasting, considered that a sufficient degree of accuracy had been obtained to furnish a daily report of the weather; and this report now appears in the "Times." The announcements published in the "Times" date from the previous evening, and in the main they are correct. They are regularly forwarded by post or telegraph to anyone who will pay the small subscription required; and, by applying at any postal telegraph office, a forecast for any part of the United Kingdom for the following day may be procured.

The principles on which the forecasts are made are thus explained. When a current of water meets with an obstruction, an eddy or whirl is produced: and a whirl results when, similarly, a current of air meets with an obstruction. In this part of the earth the natural tendency of the air is to move from west to east. But interruptions to the straightforward motion are always happening, and the current is thrown into a whirl. A whirl may form and rotate in the direction contrary to the hands of a watch; by centrifugal motion the air is thrown outwards, and there is an area of *low* pressure within. This is called a cyclone. But sometimes the whirl rotates in the opposite direction, and it has in this case a centre of *high* pressure. This is known as an anticyclone. Each of these forms of whirl gives rise to types of weather peculiar to itself.

The Barometer is the instrument with which the elastic pressure of the atmosphere is measured. As a weather-glass it fails, the wording about it is nonsense; and, as a mere indicator of the weather, a bit of dry sea-weed, or the little toy cottage with the man and woman in it, is better. The real use of the barometer, which is very important, is to enable us to compare the pressure of the air at different places. In the two types of whirls (the low-pressure cyclone and the high-pressure anticyclone) the wind moves at right angles to the direction of the gradient (to be mentioned presently), and a line of equal barometrical pressure can be drawn round the central portion of the whirl. This is known as the line of equal barometrical pressure, or isobar. Any number of isobars can be drawn on the map, but a few only are sufficient. The isobars, taken from actual observation, are sketched three times a day for the British Isles and North-West Europe, and the lines are continued conjecturally through the adjacent seas. Sometimes the log of a passing ship corroborates the curve. In both cyclone and anticyclone, when the observer stands with his back to the wind, the barometer is lower on his left hand than on his right. This rule is known as Buys Ballot's Law.

The difference of reading may be imagined to give a kind of slope; thus, the barometer at one place at 30 inches and at another at 29 inches, indicates an incline. This is called a barometrical gradient. The wind moves from one place to another across the gradient, and the steeper it is the stronger is the wind. A difference of 0·07 (or $\frac{7}{100}$) of an inch of barometrical pressure in a space of 60 miles causes a rather strong wind; when the gradient exceeds this, a gale may be expected. But the force of the wind is not regulated solely by the gradients; there are other and obscure causes at work. Cyclones travel, in a general way, from west to east. Anticyclones travel less rapidly than cyclones do; they usually hang about, and stay for days and weeks together. They are the cause of our persistent weather: the long frost of winter and the hot spells of July and August are anticyclonic.

The Lecturer exhibited several diagrams, and one of these indicated, in an admirable manner, the conditions of weather which usually prevail in the different regions of a cyclone moving eastwards. The more easterly portion shows the edge of an advancing bank of cirro-stratus; behind this is the great cloud mass of nimbus, which extends as far as the centre of the depression. Posterior to the depression, in a north-westerly direction, there is an "overcast" condition; beyond this is hazy stratus; and beyond this again there is dry and hazy weather. Posteriorly, in a south-west direction, there are, respectively, showers, cumuli and shower-clouds, and cirrus and cirro-stratus: and in the south the clouds appear to be clearing away. With the advance of the cyclone there is heavy rain-cloud with falling barometer. At the south portion of the region indicating lowest pressure, the sky clears and the barometer rises; and the coldness and dryness of the south-west wind which is here found is due possibly to the descent from the upper strata of air which is dragged downwards into the vacuum formed by the advancing whirl.

When a cyclone comes on the coast of Ireland, its position is carefully watched, and the direction noted. Earlier information, if we could only get it, would be most valuable. St. Kilda would be a desirable position for a meteorological station, if there were a telegraph there.

With regard to the American warnings of the "New York Herald," it is commonly believed that they are derived from observations of the weather on the American continent. This, however, is an error. Storms do not travel in unbroken continuity across the Atlantic, and there is no instance on record of a storm having done so. Loomis states that storms from the American coast change in two or three days, and are seldom to be identified, because they usually merge into others. Of the warnings sent by the "New York Herald" only 17 per cent. turned out true, and 42 per cent. were utterly wrong. The "Herald" refuses to give the source of its information, but it is probably derived from ships just returned from the Atlantic.

It was considered by the Lecturer that the origin of many of our cyclones is to be found somewhere off the coast of Newfoundland, where the currents of warm and cold air come into collision.

NOTE.—The matter of this Lecture was afterwards published in *Fraser's Magazine* for August.

JUNE 21st.

A Field Meeting was held. The party, consisting of Members and their friends, drove to Keston Common, and thence proceeded to the source of the Ravensbourne. Here Mr. J. JENNER WEIR, F.L.S., described, with his accustomed precision and clearness, some of the lower forms of life which such a river source affords special opportunities for observing. The party, with Mr. ROACH SMITH, F.S.A., for their guide, then visited the British Camp, or *Oppidum*, in Holwood Park, and the "War Bank." After partaking of a cold collation in the Town Hall, Bromley, they returned to Lewisham and Blackheath much pleased with the Excursion.

Mr. ROACH SMITH said that the Association had very judiciously made Holwood part of the objects of the first excursion, because the great British Earthworks were an example of the very earliest of our national monuments. Although of the highest class, they have been unaccountably neglected, and only in their later days have they been studied in a scientific spirit. Of prehistoric origin, they were also connected with historic times, for both Cæsar and Strabo describe them; and Suetonius, in speaking of the campaign of Vespasian in the time of Claudius, states that this general captured upwards of 20 *oppida,* and subjected to the Roman power two powerful tribes or peoples. To form a proper notion of British life, and of these historical circumstances, it is necessary to see the remains of the *oppida.* Fortunately, although the earthworks at Holwood have been disfigured, yet others abound in their pristine integrity; and what is in this instance wanting, can be understood by the perfect examples at Oldbury, at Ightham, and at Lingfield Mark near Edenbridge. These three are of the first magnitude: Lingfield

Mark occupying about 30 acres, Holwood nearly 100, and Oldbury even more. Fortified by fosses and *valla*, often doubled and trebled, these fortresses seem impregnable, yet they soon yielded to the Roman legions, and the entire south of Britain was then brought into perfect subjection. Nothing shows this fact more strikingly than the entire absence of the walled permanent *castra*, such as abound in the north. Holwood and other British earthworks have continually been called Roman, and even Saxon and Danish; but very slight reflection must dispel these errors. It was seldom that the Romans cared to retain possession of the *oppida*. Instances do occur, as in the case of Hod-hill and of Maiden-castle in Dorsetshire; but the retention was apparently for the purposes of peace, and not of war.

Mr. Roach Smith, in the course of his remarks, drew attention to the absence of lapidary inscriptions in the south of Britain, as evidence of superior civilization; for they are almost uniformly restricted to the localities in which the legions and auxiliary troops were quartered. These historical evidences have luckily accumulated of late years, as may be seen by Dr. Bruce's "Lapidarium Septentrionale;" and our colleagues in the north are yearly discovering additional monuments. Very recently there has been excavated the monument of a British lady, the wife of a Palmyrene merchant, settled at the locality now known as South Shields. She is described as of the nation of the Catuavellauni.

Mr. Roach Smith, previous to proceeding to the "War Bank" at Keston, said that the names of boundaries given in early Saxon charters proved that the popular notions of the origin of these names were erroneous, and he stated that Keston did not come from *castrum* (a camp), but is the Saxon *cystaning*, "the field of stone coffins."

The circular Roman building of the "War Bank" was next visited. The Lecturer said that this had nothing to do with war, but was derived from "*weard-settle*," or watch-tower, which the Saxons imagined the building to have been. It was not a temple, or a tower, but a burial-place.

As the best help towards a study of the British *Oppida*, Mr. Roach Smith recommended Mr. Warne's "Ancient Dorset."

He also referred to other *oppida* in Kent, especially those at Cobham, Syndale, Bigbury, and Chilham; and said that he believed one of the latter two had claims to be *the* oppidum mentioned by Cæsar, to which the Britons retreated after he had defeated them on the banks of a river, 12 miles from the Roman camp.

OCTOBER 7th.

Mr. A. Haddon, of the Royal Naval College, Greenwich, read a paper on "Various forms of Telephone." The Lecturer began by briefly explaining the manner in which sound is propagated through air, and then passed on to the conduction of sound through solids. In the historical notice, mention was made of Dr. Page's discovery of the sound given out by a bar of iron at the moment of magnetisation by a current of electricity, and of the adoption of this discovery by Riess in his improved form of telephone. Elisha Gray's telephone, in which the variation of the strength of the current was brought about by a wire more or less immersed in a liquid of high resistance was also explained. A telephone, of the type invented by Professor Alexander Graham Bell, was then taken to pieces, and the functions of the different parts, viz.,—the magnet, the coil, and the diaphragm, explained. Experiments were shown, to demonstrate the various modes in which a membrane or plate can vibrate. In order to prove the generations of currents in the telephone by the motion of the plate, or of a mass of iron near the end of the magnet, the following experiment was exhibited :—Two telephones, with their diaphragms removed, were placed some distance apart, and connected by wires; and opposite the free end of each magnet a tuning-fork was placed, both tuning-forks giving the same number of vibrations. When one of the forks was sounded and brought near the end of one of the telephones, the other fork vibrated also. This fact was shown to the audience by allowing a lump of sealing-wax, suspended by a thread, to rest against the end of the distant tuning-fork, and, as soon as that fork vibrated, the sealing-wax was kicked off to some distance. The lecturer then referred to Gower's loud-speaking telephone, in which the magnets are of a horseshoe form, both poles of each magnet being provided with coils of wire. In this instrument a rather thick diaphragm is used. A reed call is attached to the diaphragm, in this way dispensing with both battery and bell. The capabilities of this telephone were shown by Messrs. Wollaston and Scott, conversation and singing being distinctly heard all over the room. Mr. Edison's carbon telephone was then explained, and attention drawn to the microphone. The electro-chemical receiver was not exhibited, but the principle on which it depends was illustrated by an experiment devised for the lecture. It consisted of a weight tipped with platinum resting on a piece of calico saturated with a solution of caustic potash, the calico being stretched over a plate of zinc. To the weight was attached a string, which passed over a pulley, and to the other end of the string was fastened a counterpoise just insufficient to drag the weight along. When the current was passed between the platinum and the zinc plate, the weight was dragged along, thus proving that the friction was considerably diminished. The singing condenser was also briefly explained and shown in action, and a few sheets of tin foil sang "God save the Queen," in a most loyal manner. The Lecturer alluded to the applications of the telephone in the case of the diving-bell, mines, and the telephonic exchange, and referred to the system introduced by the Telephone Company Limited, now used in London, and about to be introduced into Manchester, Liverpool, and Birmingham. At the conclusion of the lecture, a large number of the visitors availed themselves of the opportunity of listening to Bell's Telephone, and they were much pleased with the ease and distinctness with which they could carry on conversation.

OCTOBER 18th.

By the kind invitation of Professor Owen, C.B., F.R.S., the Members of the Association and their friends assembled at the British Museum, in order to hear an Address on some of the Fossil Animals in the Museum. The learned Professor spoke for nearly an hour and a half on certain mammalia, birds, and fishes; and was listened to with very great attention by a large audience of ladies and gentlemen. At the conclusion, a hearty vote of thanks was accorded to Professor Owen for his most interesting and instructive Lecture. The party was then conducted through the galleries of the library of the Museum, and the arrangements for the distribution of the books to readers were explained by Mr. Bullen, Keeper of the Printed Books.

NOVEMBER 4th.

Mr. F. W. Rudler, F.G.S., Registrar of the Royal School of Mines, and Curator of the Museum of Practical Geology, gave a lecture on "Prehistoric Man." He explained at the outset that the term "prehistoric" was introduced by Dr. Daniel Wilson, and may be conveniently employed to designate everything prior to the commencement of history. Hence its meaning varies in different countries, according to the date at which authentic documentary evidence commences. In this country, everything may be termed prehistoric which is earlier than the Roman invasion. Cæsar found here a people acquainted with the use of iron, and therefore possessing considerable metallurgical skill. But it is believed that the use of iron had not been long known, and that the ancient Britons had only just entered upon their "iron age." Prior to the use of iron, the weapons and implements which were made of metal were cast in bronze, indicating that phase of civilization known as the "bronze age." The bronze-using folk generally burned their dead, and preserved their ashes in sepulchral urns of rude pottery, which were buried under mounds of earth called "barrows" or "tumuli." If the burial mounds consist of stone, they are termed "cairns." In addition to the cinerary urns, these barrows often contain smaller vessels, which probably held offerings of food and drink to the spirit of the departed. There are also found small vessels known as "incense-cups," but regarded by Mr. Jewitt as "immolation urns," since they often contained the calcined bones of children. The barrows raised during the bronze age are generally of circular form, but others are of elongated shape, and are consequently called "long barrows." These are supposed to contain the relics of a more ancient race, who generally buried their dead in a contracted posture, and who were not acquainted with the use of metals, all their weapons being either of bone or of stone. Such barrows belong, in fact, to the later stone-using period, or neolithic age. Evidence similar to that obtained from the barrows, is furnished by the remains of the pile-buildings, or lacustrine habitations, which occur especially in many of the lakes of Switzerland. The same sequence may also be traced in the deposits which are found in many ossiferous caves. In some of these caves, rude stone implements are met with in conjunction with certain extinct mammalia, such as the mammoth and the woolly-haired rhinoceros, and are, therefore, older than the neolithic period. They belong, indeed, to the earlier stone age called the palæolithic age. At this period, prehistoric man was ignorant of the art of polishing his stone implements. His rudely-chipped weapons are also found in association with the extinct quaternary mammals, in many of the high-level gravels which occupy the terraces bordering many of our rivers. In the French caverns, which were carefully explored by Christy and Lartet, the relics of palæolithic man include a large number of implements in reindeer antler, which bear incised figures of the animals of the period, such as the reindeer and the mammoth. These palæolithic men were probably akin to the Eskimos. They lived under a very rigorous climate; they subsisted by hunting and fishing; they were surrounded by Arctic animals; and they used carved bone implements, not unlike those of the Eskimos of the present day. As palæolithic man retreated northward, his place was taken by neolithic man. So far as we can judge by his remains, he possessed a long skull (*dolichocephalic*), had an oval face, was of short stature (say 5ft. 5in.), and may possibly be represented, at the present day, by the Basques of the Western Pyrenees. These people appear to have been invaded by the bronze-using men, who were a taller race (about 5ft. 8in.), possessed a broad skull (*brachycephalic*), had beetling brows, projecting jaw, and altogether a ferocious aspect. The Dolichocephalic being conquered, the two races probably coalesced, and hence the origin of the oval skulls found in certain caves and barrows. These people possessed the greater part of the country at the time of Cæsar's invasion. The Lecturer glanced briefly at the evidence, which has lately been adduced, in favour of the existence of man during glacial and earlier geological times. Mr. Skertchly has found rude stone implements at Brandon, in Suffolk, under conditions which point to their pre-glacial or at least inter-glacial age. On the continent, many anthropologists believe that prehistoric man appeared in Western Europe in tertiary times. Cappellini has found in certain pliocene deposits in Italy, bones of a whale so cut that he assumes the incisions to be the handiwork of man. At Thénay, in France, the late Abbé Bourgeois discovered rudely-chipped flints bearing evidence of having been burned, in strata as old as Miocene or mid-tertiary times. Below these beds no older relics of man have ever been announced, and indeed the lecturer was by no means disposed to affirm that the evidence of man's existence in the tertiary period is yet above suspicion.

DECEMBER 2nd.

Mr. Yeo, R.N., Lecturer on Steam at the Royal Naval College, Greenwich, delivered a Lecture on "The Steam Engine." He first gave some examples of the great power to be obtained by the agency of steam, and of the ease with which this power is controlled, mentioning that H.M.S. "Inflexible," a ship weighing 10,000 tons, can be made to move through the water a distance of 17 miles in an hour, with a power which is called 8,500 horse power, but which is really not less than that of 10,000 horses. The lecturer passed on to give a brief sketch of the history of the steam engine, referring to the contrivances of Hero, the Marquis of Worcester, and Papin, and then described the fire-engine of Savery, the atmospheric engine of Newcomen, and the great improvements introduced by James Watt, which led eventually to the production of the double-acting rotative steam engine in use at the present day. Comparing the steam engine, as it left the hand of Watt, with the atmospheric engine which immediately preceded it, it must be admitted that Watt was the creator, rather than the improver, of the steam engine. The introduction of steam locomotion on land, and of steam navigation, was next traced. Railroads, worked by horses, had long been used for the haulage of heavy loads in mining districts, and George Stephenson strongly advocated the employment of steam-power for this purpose. The success of Stephenson's engine, the "Rocket," in the competition trial of steam locomotives on the Manchester and Liverpool Railroad, in 1829, settled the question of the employment of steam power, not only for hauling heavy goods, but also for the transport of passengers. The application of the steam engine to ships was commenced very early in the present century. The crossing of the Atlantic by steamers was inaugurated by the voyage of the Great Western in 1838; the time occupied was 15 days. We are now able to cross in about $7\frac{1}{2}$ days. The screw has now entirely superseded the paddle, as a propeller for ocean-going merchant steamers, as well as for men-of-war. Several types of the marine engine have been introduced for driving the screw propeller, differing considerably in the arrangements of their parts; but they are all modifications of the double-acting, condensing, rotative engine. The pressure of steam used has gradually increased, and the system of using steam "expansively" has been carried out more completely, with a corresponding advance in economy of fuel. In good marine engines, at present, the work of a strong horse for an hour is obtained for 2lbs. of coal, costing less than a farthing. The important part played by steam, in the economy of the most recent men-of-war, was then alluded to. The propulsion and steering of the ship, the loading and handling of the guns, the revolving of the turrets, the raising and charging of the torpedoes, &c., are all dependent upon steam power. Steam is also used to supply the ships with air, with fresh water, and with the electric light; steam pumps are fitted for a great variety of purposes; and the large engines which propel the ships are themselves controlled by little steam engines so easily that the reversal, from full speed ahead to full speed astern, occupies only a few seconds. The Lecturer next passed on to inquire respecting the source of the power exerted by the steam engine. After showing that a power of doing work, or "energy," exists in the universe in various forms, and from various causes, he then explained that heat is one of the forms in which energy can exhibit itself. The energy which appears in the form of heat when coal is burned, came originally from the sun. Coal is formed from trees and plants, which were produced at the expense of some of the energy of the sun, and when the coal is burned, the energy originally absorbed by the plant re-appears as heat. The process by which the heat, produced by the combustion of coal, is applied to the performance of work in the steam engine, was then described, and it was stated that in the best steam engines at present not less than 90 per cent. of the energy due to the coal escapes unutilised, only 10 per cent. being applied to do work. It was explained that it is impossible by any improvement of the steam engine to do more than recover a small portion of the 90 per cent. now wasted, the amount utilised being perhaps increased to 20 per cent., and there being many difficulties in the way of accomplishing even this. In conclusion, it was pointed out that the stock of available coal in Great Britain is being drawn upon at a rapidly increasing rate, and that, at no very distant time, the increased prices must seriously affect the manufacturing industries of the country. The possibility of making more use of the energy of streams and tides was then alluded to. Several models and diagrams were exhibited in illustration of the lecture.

JANUARY 2nd, 1880.

First Annual General Meeting.

The President said :—"It is a real pleasure to me to think that the few words it is my duty to address to you, on leaving the Chair in which you did me the honour to place me last February, must be words of congratulation on your success.

"The Association is already constituted of a large number of Members, its Meetings have been well attended, it has had the advantage of hearing Lectures from persons of high competence, and its financial position is all it should be. These results are due, you will all agree with me in saying, mainly to the circumstance that we have had the services, as Secretary of the Association, of its real founder, Mr. Jackson, who has thrown into the conduct of its business all the energy which is characteristic of him. My congratulations to you, on the prosperity of the Association, are congratulations to him also on the realisation of a happy idea which has long possessed him, and which he has had the good fortune to carry to complete success.

"When it became my duty last February, by the flattering invitation of those who had joined Mr. Jackson in promoting this Association, to address you on its aims and purposes and possible future, I believe some of my friends thought I placed all these too high, and drew too rose-coloured a picture. Even if I had, it would have been a fault in the right direction: as the pious poet of Bemerton advises us in his 'Church Porch:'—

> 'Pitch thy behaviour low—thy projects high—
> So shalt thou humble and magnanimous be:
> Sink not in spirit—who aimeth at the sky
> Shoots higher much than he that means a tree.'

It may very well be that I was led by reflections on the high qualifications of some of my colleagues, and the well-earned scientific reputation of others, into an error of this kind. I am not disposed, however, to admit even this much too readily:—for I think, in its first year, the Association has succeeded in fulfilling a very fair portion of the functions which were then hinted at as being within its province and powers."

He then reviewed in detail the proceedings of the year.

Observing that "no Reports on the progress of Science had yet been given," he proceeded:—

"The science of Anthropology, as a section of the larger science of Biology, has, of late years, been claiming more and more of public attention, and has even been acknowledged by His Holiness the Pope to be the greatest of all the philosophical sciences. It is true that Leo XIII proceeds, in his own inimitable manner, to declare that nothing has been discovered in Anthropology since St. Thomas Aquinas wrote, and that the work of that father on man refutes all the errors of the ancient philosophers and even anticipates and refutes also the errors of all the moderns. A claim of mere infallibility is a trifle to this, for the knowledge beforehand of all possible errors into which poor humanity may fall is almost a claim of omniscience. I am bound to confess, with shame, that not having ever drawn my knowledge of the science from this fountain-head of it, I cannot say whether the Pope's claim on behalf of St. Thomas of Aquinum is well or ill founded, for I do not share that author's faculty of being able to refute what I have never read.

"I content myself, therefore, with reference to more modern authorities, and I find that Professor Allman, President for the year of the British Association, has followed the example set him by his predecessors—Allen Thomson, Andrews, Tyndall, Carpenter, and Huxley, by taking the present state of Biological Science as the subject of his Address. It was only natural that so distinguished a biologist should have done so; but the circumstance that in doing so he follows, in so short a period of years, so many other illustrious students of the science, is ample evidence of the hold it has gained on the public mind. It is only thirteen years since the section of Biology was constituted, with Anthropology as one of its departments, and it has already furnished six Presidents to the entire Association. Each of the six has asserted most fearlessly his conviction as to the truth of recent discoveries, and the conclusions to which they lead him.

"The subject which Professor Allman treated was the physical basis of life, which has been shown to be the same in animals and in plants, and to which the name of 'protoplasm' has been given—a substance described as structureless, semi-fluid, contractile, or 'glairy.' One remarkable feature in his address was his unreserved adhesion to the discovery by Huxley of the existence, in the bed of the Atlantic, of vast masses of slimy matter endowed with life, and consisting of protoplasm, to which he had given the name of Bathybius. Huxley himself, with the frankness and candour that characterise him, had acknowledged that the want of success of the explorers of the 'Challenger,' in finding similar deposits, had shaken his convictions, and that the appearance of life in the matter brought home by the observers of the 'Porcupine' might be a result of chemical action. Professor Allman was evidently of opinion that this admission was more than was required by the merely negative evidence of the failure of the 'Challenger' to find any trace of bathybius—a condition of living matter the most rudimental it is possible to conceive.

"Professor Allman's lecture has been happily summed up in an epigram by Dr. John Evans:—

> '’Twixt life and consciousness the chasm
> Cannot be bridged by protoplasm;
> All flesh is grass, yet chlorophyll
> Can *All-man's* functions not fulfil.'"

The President proceeded to comment at length on the Address of Dr. Tylor, as President of the Anthropological Department, and on the Report of the Anthropometric Committee.

"The question of race is one that has always presented difficulties; and Dr. Paul Topinard (of Paris) has lately published a paper on the subject in the *Revue d'Anthropologie*, which indicates that his views have undergone some change upon it. Race, he justly says, is a word which has several different meanings, as used in Science and as used in popular language, and it is very possible that we mislead ourselves by confusing these together. He groups the views held on this question by various anthropologists into three broad classes:—the first, that of the older monogenists, that man is of one species, and that races are varieties of it; the second, that of the older polygenists, that races are so distinct that they may be grouped into different species; and a third view, which he attributes to the modern evolutionists, that races are, as he expresses it, merely an optical illusion. In respect of all these, he declines to say more than that, from the point of view of natural history, human races are parts of a whole, or groups offering a particular type.

"Dr. Topinard considers the introduction of the notion of species into Anthropology to have been mischievous; and that ethnologists, in using the term 'races' as equivalent merely to 'peoples,' had placed it on the only footing in which it can be practically useful. Those who believe in fixity of race, form a very different idea of what a race is, according to the plan upon which they pursue their inquiry; and he divides such into four classes:—the historic, linguistic, prehistoric, and primordial. The fact is, that a pure homogeneous human group exists nowhere; and to arrive at races, you must study peoples. He establishes this conclusion even from the evidence afforded by the skulls discovered in caverns, dolmens, &c., of Central France. Thus the mean cephalic index (*i.e.*, the breadth of the skull divided by its length) of 24 crania from the cavern of Beaumes Chaudes is 72·6; that of 18 from the neighbouring grotto of L'Homme Mort is 73·2; that of 24 from dolmens in the same district, believed to have been formed by a conquering people from the East, 75·8; while that of 172 modern Auvergnat skulls is as high as 84.

"These figures show a gradual modification of type from *dolichocephalic* to *brachycephalic*—from about $\frac{6}{8}$ths to about $\frac{7}{8}$ths:—but when the details are looked into a little more closely, one sees that it was not by a jump that these changes were made, but that the successive populations overlapped one another. Thus 10 of the Beaumes Chaudes skulls exceeded 73; 3 of the Homme Mort exceeded 75; 6 of the Dolmen skulls exceeded 79; while more than half of the modern skulls were below 84,—which yet is the average of the whole of them. I am, of course, boiling down into a very brief space, at great risk to its clearness and force, an argument which Dr. Topinard elaborates over 72 pages, but the general result will not be difficult to express, viz.:—that the peoples which come under our observation now-a-days are the result of a variety of influences acting during long ages of the past, and that no race is to be determined by physical character only, but in connection with its origin, its descent, its migration, its admixtures with others, its traditions, its archæology, its language, its history, and its customs.

"The same subject has been pursued by M. Girard de Rialle, in an article in the *Revue Scientifique* for the 20th December, 1879, founded on Dr. Topinard's paper; in which he points out that Topinard's system, whether he is conscious of it or not, is very nearly allied to the transformist theory, as he calls the doctrine of Evolution. If human races are nothing but optical illusions, their definition as 'human groups which offer a particular type,' would be perfectly acceptable to the transformist. If it be said, in opposition to Topinard's view, that history offers us numerous cases in which the permanence of types is an ascertained fact—for instance, that on the ancient monuments of Egypt, 6000 years ago, are represented peoples whose physiognomy can be found at this day in the living Egyptians: the answer is that, in these cases, these peoples have not been subjected to the influence of crossing. This is the secret of the transformation of ancient types, and sometimes of their re-appearance by the phenomena of *atavism*."

After referring to the Proceedings of the Science Department of the University of Tokio in Japan, and to the discoveries in Science of the year, the PRESIDENT concluded as follows:—

"I have nothing more to say but to offer you my thanks for the generous confidence with which you elected me to this office, for the kind support you have extended to me in fulfilling its duties, and, I may add, for your patience in listening to me to-night. I do not know whether it is the more interesting situation to look back on a long line of predecessors, and hope you have not been unworthy of them; or to see before you, like Banquo's descendants before Macbeth, a long line of successors, and indulge the hope that, years hence, they may think you were not unworthy of them. At any rate, I bequeath to them, whatever may have been the plentiful lack of ability with which the Chair has been filled, the record of a year in which no breath of dissension has ruffled the calm surface of our Councils, no murmur of dissatisfaction been evoked by any of our proceedings."

THE FOLLOWING REPORT WAS PRESENTED BY THE TREASURER:—

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1879.

Receipts.	£.	s.	d.	Payments.	£.	s.	d.
87 Subscriptions for 1879	45	13	6	Hire of Clarendon Rooms	9	10	0
9 „ „ 1880	4	14	6	Expenses of Lectures	5	11	0
				Printing	6	12	0
				Postage and Stationery	4	15	5½
				Sciopticon	6	6	0
				Lecture Table	2	5	0
				Black-board and Easel	1	0	0
				Red Baize	1	5	6
				Sundries		10	3
				Donations		5	6
				Excursion to Bromley	5	3	9½
				Balance in hands of Treasurer	7	3	6
	£50	8	0		£50	8	0

Audited and found correct,—A. B. HOSKINGS.
J. W. WAGHORN.

Thanks having been voted to the Treasurer and Auditors for their services, Mr. W. H. Bond and Mr. W. H. Grove were appointed Scrutineers of the Ballot; and they reported that the following Officers and Council had been elected for 1880:—

President,—J. K. Laughton.

Council,—H. E. Armstrong, E. W. Brabrook, A. Roper, J. W. Waghorn, W. Webster, Jun., and J. Yeo.

Treasurer,—J. Vogan.

Honorary Secretaries,—H. W. Jackson and J. Yeo.

Thanks were voted to the retiring President for his Address.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

LIST OF MEMBERS.—130.

Armstrong, Dr. H. E., F.R.S., Sec. C.S., 38, Limes-grove, Lewisham, S.E.
Allsup, W. J., F.R.A.S., 5, Eastcombe-villas, Blackheath, S.E.
Ames, Percy W., M.R.S.L., Park-house, Lewisham-park, S.E.
Adkin, Robert, 1, Mount Pleasant-road, Lewisham, S.E.
Abbott, William, 5, Clarendon-road, Lewisham, S E.
Brabrook, Edward W., F.S.A., Hon. Director of the Anthropological Institute; 11, Limes-villas, Lewisham, S.E.
Burton, J. M., F.R.C.S., Lee-park-lodge, Lee, S.E.
Beaufort, Leicester P., 9, Eliot-park, Lewisham, S.E.
Bell, Rev. John, 10, Gilmore-road, Lewisham, S.E.
Bylandt, F. A. de, 22, Rue du Pont Neuf, Paris.
Burroughs, J. E. B., Manor-villa, Lee, S.E.
Bond, W. H., 16, Limes-terrace, Lewisham, S.E.
Bristow, Rev. R. Rhodes, M.A., St. Stephen's-vicarage, Lewisham, S.E.
Burton, Herbert C., M.R.C.S., Lee-park-lodge, Lee, S.E.
Bramly, J. R. Jennings, The Firs, Lee, S.E.
Beaufort, Rev. D. A., M.A., 9, Eliot-park, Lewisham, S.E.
Bowen, A. L., M.R.C.S., 5, Lewisham-road, S.E.
Bramley, Rev. Thomas, M.A., Colfe's Grammar School, Lewisham-hill, S.E.
Bloxam, G. W., M.A., F.L.S., Dacre-park, Lee, S.E.; 4, St. Martin's-place, W.C.
Chittenden, Dr., Jun., Preston-house, Burntash-lane, Lee, S.E.
Chandler, W. A., 3, Lansdowne-villas, Eastdown-park, Lewisham, S.E.
Candler, Henry B., 40, Manor-park, Lee, S.E.
Clarke, Reginald, M.R.C.S.E., South-lodge, Lee-park, Lee, S.E.
Carpenter, James, F.R.A.S., Chester-villa, South-street, Greenwich, S.E.
Cooper, C. W., 44, Mount Pleasant-road, Lewisham, S.E.
Corcoran, Bryan, Mark-lane, E.C.
Creed, Thomas, M.D., Crooms-hill, Greenwich, S.E.
Carr, W. Ward, M.D., B. Sc., Lee-terrace, Lee, S.E.
Canter, W. J., Royal Naval College, Greenwich, S.E.
Colchester, Henry S., 38, Manor-park, Lee, S.E.
Clarke, Captain, 27, Limes-grove, Lewisham, S.E.
Davies, C. D., 15, Lee-park, Lee, S.E.
Draper, G., 15, Camden-road, Lewisham-hill, Lewisham, S.E.

Dewick, Alfred, 10, Granville-park, Lewisham, S.E.
Dickson, A., Sunfield-villa, Tyrwhitt-road, New Cross, S.E.
Desvignes, P. H., Hither-green, Lewisham, S.E.
Drury, Frederick Dru, Devon-cottage, Blackheath-park, S.E.
Domeier, Albert, Nightingale-lane, The Grove, Blackheath, S.E.
Deverell, F. H., 6, College-park-villas, Lewisham, S.E.
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Frean, G. N., The Orchards, Blackheath, S.E.
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Giessen, Andreas, 1, Dunbar-villas, High-road, Lee, S.E.
Grove, W. H., Norman-lodge, Blessington-road, Lee, S.E.
Gibb, J., 5, Mount Pleasant-road, Lewisham, S.E.
Garnett, Thomas, Highlands, Clarendon-road, Lewisham, S.E.
Green, S. Ferrall, 172, Lewisham-high-road, S.E.
Guy, Albert L., 2, Limes-villas, Lewisham, S.E.
Geveke, George, Brunswick-house, Camden-road, Lewisham-hill, S.E.
Goedecker, H., 50, Manor-park, Lee, S.E.
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Hingeston, C. H., Clifford-house, High-road, Lewisham, S.E.
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Hutchinson, C. H., 39, Granville-park, Lewisham, S.E.
Haddon, A., Demonstrator in Physics, Royal Naval College, Greenwich, S.E.
Hoskings, A. B., Ventnor-cottage, Bonfield-road, Lewisham, S.E.
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Hitchcock, Dr., College-park, Lewisham, S.E.
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Jackson, H. W., M.R.C.S., F.R.A.S., F.G.S., M.A.I., Membre de la Société d'Anthropologie, Paris; 15, Limes-terrace, Lewisham, S.E.
Jerrard, S. J., Porson-street, Lewisham, S.E.
Jones, Rev. J. Morlais, Lewisham-park, S.E.
Keen, Percy, 34, Manor-park, Lee, S.E.
Karlowa, Otto, Benbraden-lodge, Hither-green-lane, Lewisham, S.E.
Lotz, W. F., The Hollies, Avenue-road, Lewisham, S.E.
Lubbock, Sir John, Bart., M.P., F.R.S., High Elms, Farnborough, Kent.
Lockhart, William, F.R.C.S., 67, Granville-park, Lewisham, S.E.
Lavers, T. H., 12, Belmont-hill, Lee, S.E.
Leunig, F., 31, Belmont-hill, Lee, S.E.
Laker, Abbott G., Clunie-house, Courthill-road, Lewisham, S.E.
Low, Edwin, Aberdeen-house, Blackheath, S.E.
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Laughton, John Knox, M.A., F.R.A.S., F.R.G.S., For. Sec. M.S., Mathematical and Naval Instructor, Royal Naval College, Greenwich, S.E.

Langdon, Louis K., Assistant Secretary Anglo-American Electric Light Co.; 68, Torrington-square, W.

Lambert, Carlton J., M.A., F.R.A.S., F.P.S., Professor of Mathematics, Royal Naval College, Greenwich, S.E.

Martin, Rev. R. H., 53, Blessington-road, Lee, S.E.

Mitchell, Frederick, 2, Kidbrooke-villas, Shooters-hill-road, S.E.

Morris, Henry, 4, Belmont-hill, Lee, S.E.

Newman, Arthur, 1, Carlton-road, Brockley, S.E.

Nichols, Charles, Longnor, College-park, Lewisham, S.E.

Owst, Robert Clement, Derwent-villa, Blessington-road, Lee, S.E.

Penn, John, Greenwich, S.E.

Penn, T., Grove-house, Lewisham, S.E.

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Phillips, Edward, Athena-house, Morley-road, Lewisham, S.E.

Purvis, Prior, M.D., Lansdowne-terrace, Blackheath, S.E.

Potter, Edwin J., Courthill-villa, Courthill-road, Lewisham, S.E.

Price, John Edward, F.S.A., M.R.S.L., Hon. Director A.I., 60, Albion-road, Stoke Newington, N.

Roper, Arthur, M.R.C.S., 17, Granville-park, Lewisham, S.E.

Rome, William, Kirtle-house, High-road, Lewisham, S.E.

Rudd, Rev. Thomas, Lewisham Congregational College, Lewisham, S.E.

Reid, Dr. H. W., 245, Evelyn-street, Deptford, S.E.

Robinson, Henry, Eliot-park, Blackheath, S.E.

Ritchie, J. H., Cedar-bank, Hyde-vale, Greenwich, S.E.

Rudd, Charles, R.N., 6, St. Thomas's-terrace, Charlton, Kent.

Smith, Henry Francis, Slaithwaite-road, Lewisham, S.E.

Saunders, Martin L., 36, Lee-terrace, Lee, S.E.

Saunders, H. S., 36, Lee-terrace, Lee, S.E.

Smith, Niemann, 87, Granville-park, Lewisham, S.E.

Saundry, Dr., Royal Kent Dispensary, Greenwich, S.E.

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Smale, G., Ormond-house, Granville-park, Lewisham, S.E.

Short, Frederick Hugh, 1, Marlborough-road, Lee, S.E.

Scard, F. I., F.C.S., Laboratory, Guy's Hospital, S.E.

Stanley, J. H., Napoleon-cottage, Rushey-green.

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Vogan, A. J., 22, Granville-park, Lewisham, S.E.

Vogan, H. S., 22, Granville-park, Lewisham, S.E.

Waghorn, J. W., B.Sc., F.R.S.N.A., Lecturer on Physics, Royal Naval College, Greenwich; Devonshire-house, Hyde-vale, Greenwich, S.E.

Wire, Travers B., May's-buildings, Crooms-hill, Greenwich, S.E.

Wiltshire, Rev. Thomas, M.A., F.G.S., F.R.A.S., F.L.S., &c., 25, Granville-park, Lewisham, S.E.

Westrup, W. H., 20, Dartmouth-terrace, Lewisham-hill, S.E.

Williams, Charles J., 6, Cutbill-road, Denmark-hill, S.E.

White, R. O., J.P., The Priory, Lewisham, S.E.

Webster, W., Jun., Wyberton-villa, Lee-terrace, Lee, S.E.

West, Rev. Thomas J., M.A., College-park, Lewisham, S.E.

Wade, E., 2, Kelvin-place, Courthill-road, Lewisham, S.E.

Wade, John, 2, Kelvin-place, Courthill-road, Lewisham, S.E.

Wilson, Edward, 59, Lee-park, S.E.

Wolffgang, Ernest, Greenbank, Queen's-road, Forest-hill, S.E.

Wharton, T. G., 22, Limes-grove, Lewisham, S.E.

Williams, Alfred, The Cedars, Redditch.

Yeo, John, F.R.S.N.A., Whitworth Scholar ; Lecturer on Steam, Royal Naval College, Greenwich ; Devonshire-house, Hyde-vale, Greenwich, S.E.

Zimmermann, C., 26, St. John's-road, St. John's, S.E.

H. S. Richardson, Greenwich

SECOND ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1880,

AND

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OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 4th January, 1881.

President,

DR. HENRY E. ARMSTRONG, F.R.S., Sec. C.S.

Council,

W. H. M. CHRISTIE, M.A., Sec. R.A.S.,
Chief Assistant Astronomer, Royal Observatory, Greenwich.

J. H. COTTERILL, M.A., F.R.S.,
Professor of Applied Mechanics, Royal Naval College, Greenwich.

J. K. LAUGHTON, R.N., M.A.. F.R.A.S., F.R.G.S., For. Sec. M.S.,
Mathematical and Naval Instructor, Royal Naval College, Greenwich.

ARTHUR ROPER, M.R.C.S. Eng.

WILLIAM WEBSTER, Jun., F.C.S.

JOHN YEO, R.N., F.R.S.N.A.,
Lecturer on Steam, Royal Naval College, Greenwich, (Hon. Sec.)

Honorary Treasurer,

E. W. BRABROOK, F.S.A.,
Director Anthropological Institute.

Honorary Secretaries,

HENRY WILLIAM JACKSON, M.R.C.S. Eng., F.R.A.S., F.G.S., &c.,
15, *Limes Terrace, Lewisham,* S.E.

JOHN YEO, R.N.,
Royal Naval College, Greenwich, S.E.

PROCEEDINGS, 1880.

TUESDAY, FEBRUARY 3rd.

J. E. Price, Esq., F.S.A., one of the Directors of the Anthropological Institute, gave a lecture on "Our Sports and Pastimes: their Origin and Survival."

After a few introductory remarks, the Lecturer said:—The origin of our games and amusements may be traced to far distant lands. Among the ruins of the Palatine Hill at Rome may be found the roughly-scratched diagram with which the Roman boy, centuries ago, played the game the London boy now calls "hop-scotch." In the Museum of Etruscan Antiquities at Bologna, by the side of the skeleton of a child, is its little tray of toy cups and saucers, just such as a child of the present day uses for the tea parties of its dolls. The remark of Mr. Tyler that games of children are, in their origin, sportive imitations of the serious business of their seniors, is borne out by the popularity of archery as a sport, which has survived the necessity of it as an art of war. Among the recreations allowed by the will of Abraham Colfe, to the scholars of the grammar school he founded at Lewisham are mentioned "shooting with longbows, stool-ball, running, wrestling, leaping, and other inoffensive exercises; but money plays are not to be suffered."

The principal amusements of the Anglo-Saxons were hunting, hawking, and fishing. Within doors they played at games resembling chess and backgammon, glee-men diverted them with songs, and there were exhibitions of juggling and rope-dancing.

About the 14th century, the game of cards was added to our in-door amusements. Modern inquiry shows that this had its origin in the East. At first the cards were painted or illuminated by hand, and cost a considerable sum. Bezique, a popular game at cards, may be presumed to derive its name from an Italian source, there being an old game at cards in Italy known as "Bazzica."

Under Mary and Elizabeth intellectual amusements began to make their way. Both of these Queens were industrious needlewomen, and fond of embroidery. Ladies of this period were instructed in Greek, Latin, French, Italian, and Spanish, and their amusements included playing on the lute and virginal. It was about this period that horse-racing was recognised as a regular amusement. Chester was among the first of our towns to encourage the running of horses, and to bestow prizes upon the winner.

In the 17th century the amusements of the citizens of London consisted chiefly in bowling, cards and dice, billiards, musical entertainments, dancing, masques, balls, plays, and club meetings. The Lord Mayor kept a pack of hounds for the purpose of hunting in Middlesex, Hertfordshire, and Kent. The lower classes amused themselves with football, wrestling, cudgel-playing, nine-pins, cricket, quoits, bell-ringing, cock-fighting, bull and bear baiting, &c. The baiting of bulls, bears, and boars, is among the brutalising and barbarous sports which, with us, are now happily at an end. We have, however, record of its practice as late as the present century, and it was not till the year 1835 that an Act of Parliament was passed, forbidding the keeping of any house, pit, or other place for baiting or fighting any bull, bear, dog, or other animal.

The game of ball is of remote antiquity; it has originated many popular amusements, and has, doubtless, descended to us from Roman times. It was the forerunner of our racket and lawn tennis, of cricket and croquet, football, bowls, and billiards. Stool-ball has been mentioned by writers of the last three centuries, but with little definition of the game.

Club-ball, in which a ball was struck from a straight bat, probably gave rise to our game of cricket, an agreeable, healthy, and manly exercise. Cricket was originally played without wickets, and evidently in the manner of club-ball.

Balloon-ball was a ball inflated with air, and of large dimensions. The player had his right arm from the elbow to the wrist covered with a guard, and with this he struck the ball, which was delivered to him by another person, as a bowler does at cricket.

From balloon-ball to football is an easy transition, the principal difference being that the ball was driven by the foot instead of by the hand or arm. Football was a popular exercise in the reign of Edward III, but in 1349 it was prohibited by public edict, not so much from any harm in itself, as because it served, in common with other amusements of the time, to impede the progress of archery. It consequently fell into disuse, and, in the time of James I, that monarch did his best to prohibit the game. "From this court," he says, "I debar all rough and violent exercises, as the football, meeter for laming than making able the users thereof."

The connection in ancient times existing between dancing and the game of ball has given rise to the name now in use as regards dancing entertainments. We receive our modern invitation to a "Ball," the party, however, is one for dancing. The ball is an absentee, yet the term is handed down as a legacy from the ancients.

The game of billiards is usually attributed to the French, but there are many reasons for supposing it to be the offspring of bowls. Bowls were driven along the ground towards a mark by the aid of a "battoon," or mace, and billiards formerly was played with an arch and a mark for the king, but upon a table instead of upon the ground. At one time it was held illegal for a publican to have a billiard table in his house.

Pall Mall is a game wherein a round box-ball is struck with a mallet through a high arch of iron. He who can do this with the fewest blows, or at the number agreed upon, wins. This game was formerly held in high estimation, and was undoubtedly the forerunner of our croquet. It was a favourite with Charles II, and his court.

Kite-flying is a pastime which enjoys a widespread popularity among the amusements of the young. Its practice may be said to be almost universal. It is now thoroughly at home in Europe, but it was originally introduced from Asia.

Hop-scotch and tip-cat: Everyone is familiar with the chalk lines upon our pavements which mark out certain divisions and squares, and which define the mysteries of hop-scotch. Tip-cat is equally well-known, its practice being at times, to say the least, unpleasant, if not altogether dangerous, when enjoyed in a public thoroughfare. Both sports are well-known in India.

Skating and sliding: Both of these, being winter amusements, probably had their origin in a northern climate. Skating appears to find no record until early in the 13th century. A runner of bone was at first used, and this in later years gave place to iron.

Battledore and shuttlecock: This is a boyish sport of long standing. There are drawings extant of the 14th century, showing boys engaged in this well-known game. It was a fashionable pastime among grown persons in the reign of James I. That it had an Asiatic origin there can be no question, and it is much played in China at the present-day, though frequently the shuttlecock is struck with the sole of the foot instead of a battledore.

Scratch-cradle appears upon one of Greek vases in the Hamilton collection. A figure is seen holding in each hand the loops of the entangled threads.

Dice-playing also belongs to our sedentary pastimes, and is of extreme antiquity. It owes its origin to the Astragali of the ancients, and to the knucklebones or hucklebones of the present day. Astragali were used in divination in old Rome, the sides being numbered so as to convert them into dice. Some of these are preserved in the British Museum. The ancient Germans, as we learn from Tacitus, were much addicted to gambling with dice. The same may be said of the Saxons, the Danes, and the Normans. In the 12th century there were no fewer than 10 different games of dice in fashion. John of Salisbury speaks of dice-playing as a damnable art, and a contemporary author refers to the attractions it presented to clergymen and bishops.

Ducks and drakes was played by the ancient Romans—by the old as well as by the young.

The Lecturer observed, that in tracing the descent of any particular pastime or amusement, it is often difficult to discover how it first came among us. How impossible would it seem to be to trace the pedigree of such an expression as "Buck, buck, how many horns do I hold up?" Every one knows the line, yet how did it get here? In a passage from Petronius Arbiter, dating from the reign of Nero, a boy is described as climbing upon a man's shoulders, and crying out *"Bucca, bucca, quot sunt hic?"*

The Lecturer concluded by saying that ascertaining, through records of bygone times, the occupations of mankind, even in their leisure hours, was a pursuit worthy of being undertaken upon scientific principles, as affording many valuable hints to the anthropological observer; and for that reason he had brought the subject before the Lewisham and Blackheath Scientific Association.

TUESDAY, MARCH 2nd.

J. Werge, Esq., gave a Lecture on "Photography: its Origin, Progress, and Practice."

After mentioning at some length the various unsuccessful attempts by Wedgwood, Sir Humphrey Davy, Nièpce, and others, Mr. Werge described some of the experiments of Louis Daguerre, who, after toiling in the most persevering manner for fifteen years, at last succeeded, not only in depicting a picture on a plate of silver, but in fixing it in a tolerably permanent manner. His discovery was made public in 1839. At about the same time Mr. Fox Talbot, who had also been engaged for several years in similar investigations, announced his discovery of a method of photographing on paper, and fixing the picture so that it could bear subsequent exposure to light.

By the method of Daguerre, only one picture could be produced: while by that of Talbot, any number could be printed off expeditiously and cheaply. As a consequence, the method of Daguerre fell into disuse, although the pictures were sometimes very beautiful indeed. His process is, roughly, as follows:—A highly-polished plate of silver is subjected to the vapour of iodine, until an iodide of silver is formed on its surface. The plate, now highly sensitive to the action of the light, is next placed in the camera, and the picture is taken. The plate is then exposed to the vapour of mercury, which attacks all those parts that have been affected by the light, leaving untouched the unaffected portions. The picture is now perfect, but it will not yet bear exposure to light, for there is still some sensitive iodide of silver on the plate. This is readily removed by means of a solution of hyposulphite of soda, into which the picture is dipped. The iodide of silver is washed off, and no further change ensues by the action of light.

Of the colours of the spectrum—red, orange, yellow, green, blue, indigo, and violet; those at the red end affect the photographic plate more slowly, and those at the violet end more quickly than the central ones; and, when a picture containing many colours has to be taken, the result is always more or less unsatisfactory. Thus, a young lady with blue eyes, ruby lips, pink complexion, and auburn hair, is very difficult to photograph, for the eyes, if taken properly, are apt to be represented at the expense of other parts, while if the redder tints are correctly depicted the portrait may appear without any eyes at all.

In the Talbot method, the picture which is taken on paper, is what is called a "negative," that is to say it has reversed tints, the light parts being dark, and the dark light. The negative is first "developed," in order that the picture may be distinctly seen, and afterwards "fixed," so that no further change may ensue under the action of light. It is then applied over a sheet of sensitive paper and exposed to sunlight, and as the light cannot pass through the dark parts of the negative, the portions below remain white, while those through which the light passes become dark; and thus a "positive" picture, the reverse of the negative, results. The paper for positives is prepared by being first faced with a thin coating of gelatine, or of white of egg. It is then dipped into a solution of common salt in water, and afterwards dried. To render the paper sensitive, it is necessary to float it with the coated surface downwards, in a solution of nitrate of silver. It is then dried in a dark room, and is ready for use.

When the positive print has been obtained, the picture must be "fixed," and this is done by washing it in a solution of hyposulphite of soda, and thus removing all the silver salt which has not been acted upon. But the picture resulting from the immediate washing in the hyposulphite, is not a good one, it is too pale, and a method of "toning" has been discovered, by which additional colour of any desired intensity may be introduced. This is effected by dipping the print into a weak solution of acetate of soda and chloride of gold.

The Talbot plan of producing negatives was, after a time, improved upon. Plates of glass were covered with films of various substances, such as white of egg (albumen), honey, beer, dextrine, collodion, &c. One of the most useful of the processes for obtaining negatives, was that of a thin film of collodion on glass. Cotton-wool is insoluble in a mixture of ether and alcohol; but if the wool be dipped into a mixture of sulphuric and nitric acids, and then carefully washed and dried, its properties are altered, and it is converted into "gun-cotton," a solution of which in ether and alcohol is "collodion." The collodion, when impregnated with certain iodides and bromides, is then poured upon a plate of glass, and a thin film is formed on the glass. The plate is then dipped into a solution of nitrate of silver, and must be placed in the camera while wet. After exposure, the plate is washed with a solution of protosulphate of iron, in order to "develop" the picture and render it visible. This is the old "wet-plate" process; but it is being superseded by the "dry-plate" process, in which gelatine is employed in the place of collodion.

The Lecturer then photographed a bust of Sir Walter Scott by means of the dry plate process. The light used was a brilliant one produced by burning magnesium wire. The negative picture was developed and fixed in a small portable dark chamber; the whole process occupying about three minutes. The positive was "printed" from the negative by exposure for about ten seconds to gas-light. The silver printing process is nearly the same to-day as it was when first introduced—a little albumen is, however, added to give a better and harder surface to the paper. Even the best photographs by the silver process, fade slightly under the influence of light. Some pictures, taken on platinised instead of silvered paper, were exhibited; they had a pleasant "tone," and were believed to be much more permanent than those produced by the silver process.

Some of the ingenious methods of striking off pictures from gelatine plates by the ordinary lithographic printing press, were then explained at length. Of these, the Collotype and the Woodburytype are the most useful and satisfactory. They depend upon the principle that those parts of a gelatine film containing bichromate of potash, which have been exposed to the action of light, are insoluble in water, while those which have not been exposed are readily washed away. In the Collotype, the picture is left on a thick plate of glass, the gelatine is covered with a greasy ink by means of a roller, and the impression is taken in a press. In the Woodburytype the picture, after having had the soluble parts removed by water, is pressed with great force upon a block of type-metal, and the impression remains on the metal without injury to the gelatine sheet. The metal block is then printed from by the ordinary typographic method. A sheet of gelatine about as large as a carte de visite was exhibited, which had been subjected to a pressure of 48 tons.

TUESDAY, APRIL 6th.

Professor P. M. Duncan, M.B., F.R.S., F.G.S.. &c., gave a Lecture on "Old and New Views concerning the Earth."

The problem respecting the shape and size of the earth was attacked by the earliest philosophers. The Chaldæans calculated eclipses, and thus showed that they must have devoted much time to the observation of the heavenly bodies. They noticed that the horizon, as seen from any point of view, was circular, and they then concluded that the earth was globular. Anaximander also advocated its globular shape, and maintained that it rotated on an axis. Advances in astronomy were made by Ptolemy, Pythagoras, and Hipparchus. The Arabs attempted to measure the earth by a base line, on one of the plains of Mesopotamia, and they came to the conclusion that a degree was equal to about 56 miles. The advocates of the spherical shape of the earth were ridiculed by opponents, who insisted that men living at the antipodes would stand head downwards, and would, therefore, be subject to headache and apoplexy. Copernicus declared that the earth was one of a series of bodies revolving round the sun; and Bruno further asserted that the stars are suns. The fact that a pendulum oscillates in equal times was first observed by Galileo; and it was by means of experiments with the pendulum, that the elliptical figure of the earth was discovered by Newton. The measure of an arc of the earth's surface equal to a degree, was made in Lapland, by Clairaut, who concluded that it was $66\frac{1}{2}$ miles. The first attempt to ascertain the density of the earth was made by Maskelyne, from observations on the attraction of Schehallion, a mountain in Scotland. He inferred that the earth was $4\frac{1}{2}$ times heavier than a globe of equal size composed of water. Cavendish, by a different method, arrived at a somewhat different conclusion, and fixed the proportion at 5·48 to 1. Mining operations led to the discovery that the temperature of the earth increases with the descent; and the conclusion thence drawn that a fierce heat exists in the interior, led to the nebular hypothesis of Laplace. This hypothesis is that the whole of the solar system was at one time in a condition of fiery mist or gas, from which the sun and all the planets and satellites, through radiation of heat and condensation, have been evolved by natural processes.

Playfair, in his experiments, found that there were irregularities in the movement of the pendulum, owing to the varying density of adjacent rocks, the density being less under a hill than on the plain. There is found to be a bulge on the earth of about a mile in one direction along a line of longitude, and another of about the same amount in another direction almost opposite. The polar diameter is shorter than the equatorial, in the proportion of 292 to 293. Owing to the quantity of water heaped up on the southern hemisphere, the centre of gravity of the earth is north of the centre of figure.

Rocks, as such, probably exist to the depth of twenty miles. Many rocks are seen which have undergone an enormous amount of shrinkage; the layers of many mountains are found fantastically contorted, and even overturned. The rocks extending through Belgium are so twisted and crumpled, that, if spread out, they would cover a space equal to three times the length of the country. The condition of deeply-seated rocks is of course unknown; but it is not probable that there is fluidity anywhere, as pressure prevents melting. Sir W. Thomson's investigations lead him to the conclusion that the earth is nearly as rigid as steel.

The Lecturer stated that, according to the present state of our knowledge, the earth is a spheroid, nearly rigid; that its centre of gravity is far from the centre of figure; that it has a density equal to $5\frac{1}{2}$ times that of water; that spaces filled with plastic rock are found near the surface; that a certain amount of heat is every year radiated from it into space; and that the materials of which it is composed are found, also, in the sun and stars.

TUESDAY, MAY 4th.

W. H. White, Esq., Assistant Constructor Royal Navy, delivered a Lecture on "The Progress of Ocean Steam Navigation."

Mr. White commenced by alluding to the early attempts to propel boats by steam, and traced the history of the establishment of steam propulsion on inland waters, by Symington, Bell, and Fulton, between 1788 and 1812. Gradually, the employment of steamers became extended to the coasting trade and to short sea trips.

In 1830, steamers were first tried for carrying the mails on the Mediterranean service, and were very successful. But grave doubts were still entertained as to the possibility of using them remuneratively as substitutes for sailing-ships in the Mercantile Marine. This much-debated question was set at rest by the construction and successful performance of the "Great Western," the pioneer trans-Atlantic steamer, launched a little more than forty years ago. She was considered at that time a marvel of size and of speed. She was a wooden paddle-ship, length 210ft., weight (fully laden) 2300 tons, average speed 9 knots, coal consumed on passage about 500 tons. Comparing her with the "Britannic," of the White Star line, one sees the results effected by forty years' improvements. The latter is an iron screw-vessel, length 450ft., weight (fully laden) 9000 tons, average speed in all weathers 15 knots, coal consumption 900 tons on the passage, or less than double that in the "Great Western."

The success of the "Great Western," however, was so great as to lead to the establishment of regular lines of trans-Atlantic mail steamers; and further, within five years, the Cunard Company, the

Peninsular and Oriental Company, the Royal Mail Company, and the Pacific Steam Navigation Company, were all in operation. From that time onward, sails have sunk to a more and more subordinate position with regard to steam, and the use of steam-ships has gradually extended to the trade with China and Australia.

The Lecturer proceeded to indicate some of the principal causes whose operation has been so beneficial on steam-ship design. These were enumerated as follows :—

1. The substitution of iron for wooden hulls.
2. The substitution of screws for paddles.
3. The construction of more economical types of engines and boilers.

The use of iron makes the hull 20 to 30 per cent. lighter, and enables ships to be built of sizes and proportions quite impossible with wood. This increase of size is a great source of economy. Comparing, for instance, two steamers—one weighing 1000 tons, the other weighing 8000 tons; if the smaller vessel carried 400 tons of cargo, and burned 100 tons of coal on a voyage, the larger vessel would carry about 4000 tons cargo over the same distance at the same speed, burning about 400 tons only.

The "Great Eastern" must, however, for several reasons stated, be pronounced too large for successful employment in general service. The largest steamers now being built are not one-half as heavy as the "Great Eastern."

The most important result of improvements in marine engineering, has been a great increase of economy in fuel consumption. A first-class trans-Atlantic steamer now burns 100 tons of coal daily; with engines such as those in vogue thirty years ago she would burn 350 tons a day, and would either have to carry so large a supply of coal that she would practically be deprived of cargo-carrying capacity, or, to keep down the coal supply, her power and speed would have to be greatly diminished.

Since the opening of the Suez Canal, steamers have gained enormously upon sailing-ships in the trade with India and China. The voyage from Plymouth to Bombay has been reduced thereby from 10,000 miles to 6,000; to China from over 13,000 to less than 10,000 miles; and to Australia by about 1,000 miles in 13,000.

The increase in average speed may be shown thus:—The Cunard steamers in 1840 averaged 8 to 9 knots; ten years later they had reached 10 knots; in 1860 their fastest ship averaged 12 knots; in 1870 about 13 knots. Their new ship, the "Servia," will probably average about 16 knots. and projects have been formed for vessels capable of steaming 18 knots. On the Australian voyage the "Orient" has recently steamed over 12,000 knots, at an average speed of 14 knots per hour. A similar increase in speed has been effected in war-ships of all classes.

The extraordinary results attained with the small craft used as torpedo-boats were then alluded to. Some of these boats, only 80 to 90ft. long, steam from 20 to 22 knots an hour, and the necessary power is obtained with a very small weight of machinery, by skilful mechanical arrangements. Such facts should suggest the question:—Cannot something be done to increase the ratio of power to weight in engines of larger power than those carried in torpedo-boats?

Returning to larger ships, the Lecturer pointed out that a great increase in price of coal consumption must be paid for a small increase in speed, when the speed is already high. This consideration has necessitated the adoption of larger dimensions in the swifter vessels, in order to make them remunerative. Both of these facts were fully illustrated by reference to examples.

A comparison was then made between war-ships and merchant-ships, showing that while war-ships require more power and consequently more coal for a given weight, than merchant-ships, they are able to carry only a comparatively small supply, on account of the weight of armour, armament, &c., and are therefore able only to steam over moderate distances.

In conclusion, some remarks were made on the possibilities of the future:—

1. Further economies in fuel are possible, if steam of higher pressures can be successfully employed. On a small scale remarkable results have already been attained in this direction. Whether the results claimed can be achieved

in association with the simplicity and durability so desirable in marine engines, remains to be proved.

2. The use of steel instead of iron enables weight to be saved on the hulls of ships, and to be transferred to cargo or machinery. In a merchant steamer of about 8000 tons displacement, quite 400 tons would be saved by the use of steel, and the 3000 tons of coal and cargo she can carry might be increased by that amount.

3. Improvements in the methods of steam-ship design, enabling greater precision to be given to the proportioning of engine power to speed. In connection with these improvements, mention was made of the labours of the late Mr. Froude.

A reference to the want of exact knowledge respecting the action of screw-propellers, brought the Lecture to a conclusion.

Note.—The matter of this Lecture appears in *Colburn's United Service Magazine, June and July*, 1880.

THURSDAY, JUNE 10th.

Excursion to Chatham Dockyard.—The first Excursion for the year took place on June 10th, when, by special permission of the Lords Commissioners of the Admiralty, the Members and their friends, numbering about 70 persons, visited Chatham Dockyard. The party was received at the gate by Admiral Brandreth, the Admiral Superintendent, who was accompanied by Mr. Bernays, Superintending Engineer, and Messrs. Littlejohns and Stainer of the Engineering and Constructors' departments.

Under the guidance of the last three gentlemen, the party proceeded to view the "Polyphemus," a vessel of novel design now in course of construction, described as a torpedo-ram. She is to carry no guns, and will rely for her means of offence entirely on her facilities for discharging torpedoes, and on her power of ramming. She is built of steel, and is divided into a number of water-tight compartments; her back is covered with armour plates of compressed steel, and she will float so low in the water that only a portion of her "turtle back" will be exposed to fire.

Another vessel visited was the "Nelson," one of the latest specimens of an armoured ship, and of somewhat novel construction. She carries a heavy armament of twelve guns: four 18-ton guns, and eight 12-ton guns. The machinery and magazines are protected by belts of side armour at the water-line, but the ends of the ship are unprotected, except by armoured decks below the water-line. There are in all ninety water-tight compartments, including those between the inner and outer skins of the ship.

Arrangements had been made for affording a complete view of this fine vessel, including her powerful engines, which are of more than 6000-horse power, producing a speed of 14 knots an hour.

Mr. Bernays then conducted the party to the Extension Works, which have been executed under his directions.

The works are of considerable importance, consisting of three large basins and several docks, occupying reclaimed land situated where a branch of the Medway formerly ran. between the mainland and St. Mary's Island.

At Mr. Bernays' office the visitors had an opportunity of seeing many very interesting objects, which had been recovered from the bed of the river in making the excavations for the construction of the works.

The intention was, that the programme should include an inspection of some of the machinery and workshop operations, but, unfortunately, time did not admit of more than a brief visit to the rolling mills.

The steam-tramway had been placed at the service of the party, for conveyance to the various points of interest; and it is with gratification that the Association records its appreciation of the kindness and courtesy shown by the Admiral Superintendent and officials of the yard.

A cold collation was served at the "Sun" Hotel, Chatham, at 5 o'clock, t o which 72 persons sat down; and the part returned to London, greatly pleased with the visit.

SATURDAY, JULY 10th

Excursion to Down.—The members and their friends availed themselves of the very kind invitation of Charles Darwin, Esq., LL.D., F.R.S., &c., &c., to spend the afternoon at his house at Down. Among the visitors on the occasion, were Herr Hesse-Wartegg and J. Jenner Weir, Esq., F.L.S. The party was received in the drawing-room by Mr. and Mrs. Darwin, Miss Darwin, and Dr. Francis Darwin. Here Mr. Darwin exhibited and described some of his most prized curiosities, prominent among which were the large Photographic Albums presented to him by his enthusiastic admirers in Germany and Holland. In the study, was shown the arrangement by which the great naturalist was making himself acquainted with the habits of the earth-worm. Wine and other refreshments were provided in the verandah. When Mr. Darwin at length felt fatigued and faint and was compelled to retire, he said, in bidding his visitors adieu, that he had felt very proud and happy in seeing them at his house that day.

At the "White Hart" Hotel, Orpington, dinner was provided for 43 ladies and gentlemen. Mr. Darwin's health was enthusiastically drunk, and the toast was responded to by Mr. J. Jenner Weir. Mr. Weir said that Mr. Darwin had introduced into the world a new system of philosophy. We had all long ago rejected the watch-making theory of Paley, and felt that, in some way or other, the animal and vegetable world had been evolved by a natural process. We knew that each species was derived by evolution from the ovum, but it was reserved for Mr. Darwin to show the great part which was played by "Natural Selection," or the "Survival of the Fittest." We found in the species around us constant variations from the normal type—if some were better fitted, or in other words responded more satisfactorily to their environment, they became favoured in the struggle for existence, and sometimes even displaced the normal type. Nature, Mr. Weir remarked, was always making what perhaps might be termed tentative experiments; and confining his observations to this action of nature in colour, and taking *white* for an example, he instanced white rabbits, which had often been produced on an estate near Eastbourne, and which, though much trouble was taken to preserve them, invariably died out, because, being so conspicuous in colour, they were easily observed by both mammalian and feathered foes. and fell victims to dogs, foxes, cats, and falcons. Again, white pigs, not having their olfactory organs so keen as those of the normal colour, ate poisonous herbs and died; so that in a state of nature there was no chance of such an aberration surviving. On the other hand. as a protective colour. was instanced the case of the northern hare *(lepus variabilis)*, which became white during winter in Norway. Sweden, and Russia, grey in Scotland, and in Ireland did not change colour at all.

Although one of the most painstaking of naturalists, and most genial of men, Mr. Darwin was, remarked Mr. Weir, perhaps the most vehemently abused person in existence, and it had been more than once said of him that he had done more mischief than any living man. Mr. Weir felt, however, that he was addressing an Association which thought very differently on the subject, and he was sure that Mr. Darwin would feel much gratified at the cordial manner in which the toast had that day been received.

A long and interesting account of this visit to Mr. Darwin, from the pen of the eminent traveller, Herr Hesse-Wartegg, appeared in the *Frankfurter Zeitung*, of Friday, 30th July, 1880.

TUESDAY, OCTOBER 5th.

A Lecture was delivered by Francis Bond, Esq., M.A., F.G.S., on "Glaciers and Glaciation."

Glaciers are most easily described as *ice-rivers*. They abound in mountainous parts of the world; being very numerous in Switzerland, on the Himalayas, and in New Zealand, while on the Andes they are rarer. In colder climates they are of immense size; in Greenland there is one which is at least 69 miles in breadth. The antarctic regions are covered by a veritable ice sheet, which is from 50 to 180 feet above the level of the sea.

The resemblance of a glacier to a river helps to realise some of its characteristics: like a river, it moves downwards and wears away its bed, and conveys stones, and sand, and mud. Many of the glaciers in Switzerland are covered with impurities, gathered from neighbouring rocks; those in Norway are less covered with *débris*, and their ice is clear. A glacier moves slowly down its inclined bed. As in the case of the river, its centre moves more rapidly than its sides, and the top more rapidly than the bottom. This movement is readily demonstrated by means of stakes driven at equal distances across the glacier in a straight line. Those in the middle of the glacier are found to advance the most rapidly.

The ice of a glacier, being formed of compressed snow, like a snowball, is not hard like the frozen water of pond ice. Independently of cracks and crevices in the ice itself, the glacier presents many irregularities of surface owing to the presence of stones, which have fallen from the rocks in the gorges through which it has passed. These stones are accumulated in lines which traverse the length of the glacier, and which are called "*moraines*." As the glacier moves downwards, the stones are carried with it, and are finally deposited in a large heap at the foot of the glacier, in what is known as a "*terminal moraine*."

Sometimes a stream of water forms on the surface and runs down the ice-way. If it comes to a crack in the glacier it disappears down the crack; and gradually widening the opening, forms a cascade which plunges with a tremendous roar into the very heart of the glacier. This is known as a "*moulin*," or "glacier-mill."

The sides of a glacier are usually very irregularly cracked and broken. The marginal "*crevasses*" are due to the fact that the ice at the side, immediately adjacent to the rock, does not move so rapidly as that a short distance away from it, and hence the ice becomes rent or creviced. This system of crevasses becomes extremely complex as the ice passes onward, but it is usually obliterated when the glacier passes through a narrower part. There is generally at the terminus of a glacier, a cave or grotto of ice, caused by streams of water running through it. This occasionally forms a continuous cavern of considerable length, extending far into the glacier.

Glaciers move with varying rapidity, faster, however, in summer than in winter, and faster by day than by night. A ladder, lost by De Saussure, travelled 4757 yards between 1788 and 1832; a knapsack lost on another occasion, moved 140 yards each year. In 1861, '63 and '65, the bodies of three guides were disgorged by the Glacier des Bossons; they had been advancing with the glacier since 1820, at the rate of 160 yards per annum.

The cause of the motion of a glacier is still a disputed point. Forbes was of opinion that it moves from its plasticity almost as if it were made of treacle; Tyndall teaches that it is owing to fracture of the ice in multitudinous points, and subsequent refreezing; while Croll thinks that heat variously derived passes through the glacier. This heat is partly carried by water, which permeates everywhere; and each particle of ice, as it is individually melted, utilises its momentarily liquid form to move forward, impelled by the laws of gravity.

It is found that when ice has passed over rough and jagged rocks, the latter present a rounded outline, so that they look almost like sheeps' backs. Such rocks are hence termed "*roches moutonnées.*" Several Highland valleys, also, have a rounded appearance when the rocks are viewed from the head of the valley, while they preserve much of their primitive roughness when seen from below. This condition of things is characteristic of certain districts, and shows that at some time or other glaciers have been in action there. An ice-sheet, in passing over a country, will often, on melting, deposit blocks at a vast distance from the rock which originally gave rise to them, and these are known as "erratics," or "*blocs perchés.*" Moraines and erratics abound in the British Isles, and are proof positive that at one time glaciers existed as far south as the Thames. Deposits, one above the other, of glacier-formed material or "Till," are evidence in our islands that several glacial periods followed successively.

The Lecturer then went into the subject of Lake Basins, and showed that there is much probability that many of these owed their origin to glaciers.

Glacial periods occurred in very remote geological times; their is proof of glaciation in the Permian, and it is believed, even in the Silurian, epoch. The causes of frequently recurring ice periods are probably astronomical rather than geological, and are to be found in the changes in the ellipticity of the earth's orbit, in the alteration in the position of the earth's axis, and in the variation in the obliquity of the ecliptic.

TUESDAY, NOVEMBER 2nd.

Dr. Armstrong, F.R.S., Sec. C.S., delivered a Lecture on "Coal Gas."

In the manufacture of gas, coal is heated at a high temperature in vessels known as "retorts;" decomposition ensues and a large amount of "gas" is given off, together with numerous liquid and solid substances in a state of vapour. From the retorts, this mixture of gases and vapours passes through tubes into the "hydraulic main," and thence to the "condensers," where, owing to the reduction in temperature, the chief part of the liquid and solid matters are deposited. The gas issuing from the condensers goės through the "scrubbers," which are towers filled with coke over which water or weak ammoniacal liquor constantly trickles; it there becomes thoroughly cooled and is deprived of ammonia. Lastly, in order to free it from sulphuretted hydrogen and carbon dioxide, it is passed through "purifiers" containing oxide of iron and slaked lime.

Notwithstanding the purification which the gas undergoes, it is still contaminated with a small amount of sulphur compounds and usually also contains traces of ammonia. When the gas is burnt, these become converted into sulphuric and nitric acids, which are extremely corrosive. The Lecturer considered that the public ought to insist on further efforts being made by the gas companies to remove these impurities, as they are the means of effecting the most serious damage to furniture, pictures, books, &c.

The matters deposited in the condensers consist of an aqueous portion—the so-called ammoniacal or gas liquor; and of an oily portion—the well-known coal-tar. The ammoniacal liquor is of value as a source of ammonia salts, many thouands of tons of ammonium sulphate being annually manufactured from it, and almost exclusively employed as an artificial manure. Coal-tar, which is an extremely complex mixture, affords the materials for the production of a large number of very beautiful dyes, popularly known as the aniline dyes, although the majority have little or no connexion with aniline. But few of the constituents of coal-tar, however, are at present utilized, and there is abundant opportunity for the discovery of new applications. Only quite recently a method of manufacturing indigo—one of the most important dye-stuffs known—from a constituent of coal-tar, has been elaborated and patented, and it is scarcely too much to expect that within very few years natural indigo will be to a large extent displaced by the artificial product, a result of no mean importance, as the annual value of the indigo produced in various parts of the world is over £3,000,000.

Coal gas consists chiefly of hydrogen and methane or marsh gas, in the proportion of about 50 of the former to 36 of the latter. In addition to these, it contains small quantities of nitrogen, carbonic oxide, and of certain hydrocarbons, *i.e.*, compounds of carbon and hydrogen. Hydrogen and methane burn with a non-luminous flame, and the illuminating power of coal gas is entirely conditioned by the presence in it of relatively very small amounts of hydrocarbons, such as acetylene, ethylene, benzolene and naphthalene.

The light furnished by coal gas of a given quality varies greatly, however, according to the manner in which it is burnt, the temperature of the air supplied to it, and to some extent also with the atmospheric pressure. Regarding the influence of atmospheric pressure, reference was made to some experiments of Prof. Frankland which showed that a fall in the barometer from 30·2 to 28·2 inches reduced the amount of light emitted by a given flame from 100 to 91·4, a further diminution in pressure of two inches reducing it to 80·6.

A very considerable increase in illuminating power is effected by heating the air supplied to the flame. Dr. Armstrong described a modification of the ordinary argand burner so arranged that this could be effected, the result being that instead of a light equal to that of 13 candles—the light obtained when the gas was burnt in the ordinary manner, the air supplied to it being cold, it furnished a light equal to that of 21·7 candles with the same consumption of gas.

The selection of the proper kind of burner is a matter of importance. In the ordinary "fish-tail," which is so universally employed, the gas issues from two circular orifices slightly inclined to each other, but if the orifices be not properly inclined, or if, as is commonly the case, they are obstructed by dirt or rust, the burner loses greatly in effectiveness. On this account, the "slit" burners are to be preferred. The so-called Argand burner is a far more perfect instrument than any of the flat-flame burners, but is much less frequently adopted on account of its cost and the trouble involved in cleaning the indispensable chimney; this burner is far superior to all others, as, by means of the chimney, a regulated supply of air for the combustion of the gas is secured.

More important, however, at least from an economical point of view, than the form of the burner is the regulation of the pressure under which the gas is burnt. The pressure of the gas in the mains varies considerably, being about balanced during the day time by a column of water one-half or three-quarters of an inch high, and during the busy time in the evening by a column about two-and-a-half to three inches high. As the pressure increases. the consumption of gas also increases, but the light does not increase in the same proportion. In illustration of this, Dr. Armstrong quoted a series of experiments with a burner consuming 5ft. of gas per hour under a pressure of eight-tenths of an inch of water, and giving a light equal to 5·25 candles; the pressure being increased to one and seven-tenths of an inch, the consumption increased to 8ft. per hour, and the light emitted to 9·13 candles; on further increasing the pressure to one and eight-tenths of an inch, the consumption increased to 8·4ft., but the light emitted was only equal to that of 8·9 candles; and under a pressure of two inches of water, the consumption being 8·9ft. per hour, the light emitted was equal only to 6·43 candles, being no more than that obtained by the consumption of 5·8ft. under a pressure of one inch. To obtain the maximum light from gas, it is, in fact, essential to burn the gas at a moderate and even rate, and consequently at a moderate and uniform pressure. The Lecturer exhibited several forms of gas-regulator from Mr. Sugg, by the aid of which the pressure under which the gas burns is maintained perfectly uniform whatever the variation in the pressure of the supply.

The influence of shades was next considered, and it was pointed out that a very large amount of light is sacrificed by their use. The following table shows the per-centage of light cut off by screens of different kinds of glass:—

Clear	12
Slightly ground in pattern	24
Half ground	35
All ground	40
Opal	60

The object of a shade is to maintain a steady flame and to prevent undue access of cold air. The bad effect of the bell-shaped shade, not unfrequently used, was alluded to; this form of shade was condemned by the Lecturer as worse than useless; and he questioned whether, under ordinary circumstances, it would not be better to dispense with shades.

Lastly, the means of increasing the illuminating power of ordinary coal gas were briefly alluded to, and the so-called albo-carbon burner was exhibited. In this burner, the gas before it is burnt is saturated with naphthalene vapour, and thus has its illuminating power very much increased. Some economy results from its use, as a good light is secured by the expenditure of considerably less gas than is ordinarily burnt, and although the burner in its present form has some serious disadvantages, the invention is an important one. There is an increasing tendency at the present time to employ gas as a fuel, but before this can be done at all universally the price of gas must be considerably lowered. If it were possible to supply gas for heating purposes alone and to render it illuminating where required by naphthalising, or some similar means, this result could be achieved far more readily than it ever can be so long as it is necessary to furnish illuminating gas to the consumer. The greater the heating power of the gas, the better suited it would be for napthalising.

TUESDAY, DECEMBER 7th.

W. Webster, Jun., Esq., F.C.S., gave a Lecture on "Dyeing."

The art of dyeing has been practised in the East Indies, Persia, Egypt, and Syria, for centuries. In the Pentateuch, frequent mention is made of cloths dyed blue, purple, and scarlet, and of rams' skins dyed red. The vestments of the High Priests were purple. The Tyrians were the only people of antiquity who made dyed goods their staple of commerce. An inhabitant of Tyre discovered the purple dye 1500 B.C., and, it is believed, extracted it from a shell-fish. The colouring matter when taken from the animal, by exposure to the air and light, became successively citron-yellow, green, azure, red, and, in the course of forty-eight hours, brilliant purple. It is unknown how the colour was obtained, and no attempts to manufacture the dye now-a-days have been successful:—it is a lost art.

Objects which appear coloured have no colour in themselves. The appearance of colour is due to the reflection of certain of the constituents of white light, and annihilation or absorption of the rest. The Lecturer exposed ribbons, which by white light appeared of various hues, to the yellow light of burning sodium, and it was seen that the yellows were very distinct, while the other tints looked black, owing to the absence of those rays which are necessary for the production of their special colours.

The processes of dyeing consist in staining textile fabrics so that the colour imparted to them is rendered insoluble in water. Cotton, wool, and silk are the chief substances which are operated upon by the dyer, and they require some little preparation before they can take the colour to be imparted to them. Cotton goods are prepared by boiling them in water for two or three hours, while woollen materials are steeped in soap lye or alkaline solutions to remove all oily and greasy matter. Silk is also boiled in a strong soap solution to remove the gummy substances found upon the surface of its fibres.

Few colours have any direct affinity for cotton or other goods; if they had, dyeing would be a very simple affair: for it would then be only necessary to immerse the things to be dyed in a solution of the colouring material. Unfortunately in this case the dye is not permanent, it is readily washed away by water; it therefore becomes necessary to impregnate the cloth with some substance which has an affinity for both the fibre of the fabric and the colouring matter,—something which will, in fact, bind them together. Such substances are termed "mordants." It is essential that a mordant should be capable of forming an insoluble compound with the colouring matter, so that when the coloured compound is precipitated in the fibre of the material it cannot afterwards be washed out. A solution of logwood and alum was shown precipitated by ammonia, and it was explained that the formation of this precipitate in the fibre of the several textures constituted the mystery of dyeing. It is, of course, necessary that the mordant should be in a soluble form when applied to the fabric, so that it may readily enter into the intercellular spaces. The mordants most generally employed are salts of tin, iron, and aluminium.

Of the vegetable matters used in dyeing, the following are the most important:—*Alkanet:* this was used by the ladies of Rome as a pigment for the face; and is still employed in the theatrical world. *Archil*, well known to the ancients. *Broom*, a yellow dye, which was used by the Celts. *Madder*, still used largely; formerly by the Egyptians, who dyed mummy-cloths with it; and by the Romans. *Nut-galls*, for dyeing black. *Woad:* Julius Cæsar states that the Britons of his day stained their bodies with the blue dye of the woad. *Indigo* is obtained from woad, which is largely cultivated in Lincolnshire. *Seeds of the Pomegranate*, mentioned in the Old Testament. *Logwood.*

Of the mineral matters used, sulphate of iron, with or without a native alum, and sulphate of copper, are the most important.

Cochineal is an animal dye. About 1560 it was discovered that by using a salt of tin with cochineal, a colour could be produced which far surpassed in brilliancy any of the ancient dyes. In 1667 logwood and indigo began to be employed in Europe. An Act of Parliament was passed in Queen Elizabeth's reign, which denounced as a dangerous drug the dye called indigo, which was stated to be "food for the Devil." This Act was fortunately repealed in Charles the Second's reign.

The chief improvements of the moderns consist in the employment of those splendid dyes obtained from coal tar,—the aniline dyes.

The Lecturer showed some samples of stuffs and silks, which had been obligingly furnished him by Messrs. Jay, of Regent Street. and he stated that that firm had favoured him with a description of the manner in which the black silks, so fashionable now and known as "loaded," are prepared. The skeins of silk are first soaked in a bath of acid nitrate of iron, then in a bath of carbonate of soda, and lastly in a bath of pure cold water. This is done three times. The silk is next placed in a bath of prussiate of potash and hydrochloric acid. It is now dipped in a hot bath of tannin and extract of chestnuts. By these processes the thread of the silk is opened so that it can take up a large quantity of dye. In order to give it weight, the silk is first washed in a bath of soap water; then, to give it brilliancy, some sulphuric acid, which decomposes the soap. is put into the bath, and consequently the silk freely takes the grease of the soap as well as the chemicals. The former of these gives the desirable brilliancy, and the latter cause the rustling which is produced when the silk is squeezed. When ladies buy rustling silks they buy also grease and chemicals, and it cannot be reasonable to expect that such materials will not "wear greasy." But ladies will not look at pure silks, they prefer the loaded ones. The Lecturer here showed a black silk loaded to the extent of 50 per cent., another loaded up to 20 per cent., and a third which was absolutely unloaded, and which was described as "grease proof."

TUESDAY, JANUARY 4th, 1881.

The Annual Meeting was held, and the Election of Officers and Council took place.

The duly audited Statement of Accounts was presented by Mr. E. W. Brabrook, the Acting Treasurer. Mr. Niemann Smith and Mr. George Readdy acted as Scrutineers.

The President stated that early in November, last year, a subsidence of the ground occurred on Blackheath; and on the 19th November a second and more serious subsidence took place. As it appeared to the Council very desirable that the causes of these subsidences should be carefully investigated, a grant of £10 was made by them, and approved by the Members of the Association at the ordinary Meeting held on 7th December, 1880. The removal of the fallen earth, in the case of the subsidence of the 19th November, was commenced by Mr. S. J. Jerrard, on the 18th December, but the operations were brought to a close on the 23rd, on the discovery that the exploration would have to be carried on on a scale of far greater magnitude than was originally contemplated. An appeal for subscriptions would probably before long be made to the Members of the Association, and to the public, when the work of investigation would once more be proceeded with.

The President then delivered the Annual Address. He congratulated the Association on the Reports just read, and the prosperous condition to which they bore witness. He then briefly reviewed the work of the Association during the past year; and going on to speak of scientific progress in general, noticed the photophone, which the spirit of prophecy would seem to have foretold to Coleridge when it compelled him to write, some 70 years ago, of

> "—— the one life within us and abroad,
> Which meets all motion and becomes its soul,
> A light in sound, a sound-like power in light,
> Rhythm in all thought, and joyance everywhere."

He referred also to the improvements which had been recently made in the electric light; and to the wide prospect now opening to chemical analysis by means of the spectroscope: on all which, and kindred subjects, he hoped that the Association might, in due time, have the pleasure of hearing Lectures by Members much better qualified to speak of them than he himself.

He then spoke of some numerical puzzles which have come into vogue during the year; more especially of the "Fifteen Puzzle," in which he showed that the solution of any given position is possible or impossible according as the total number of displacements is odd or even; and of the "Floral Alphabet," in which, by arranging six characters or colours along two sides of a square, the combinations of these, two together, may be made to denote the twenty-six letters of the alphabet and the ten digits; and that thus a nosegay of different coloured flowers, or a wreath of different shaped leaves, might convey a very exact and definite meaning.

He next shortly noticed some of the late attempts at "weather-foretelling," in contradistinction to "weather-forecasting;" and proceeded to speak, at greater length, of the present state and prospects of Arctic exploration,—a subject which he introduced as at once nautical, geographical, and meteorological; and especially meteorological; for, in the present state of meteorology, we are almost at a standstill, until we know the exact conditions within the unknown region, and can investigate the relation which these bear to our own climate, and to the changes of wind and weather to which we are subjected.

The desire for Arctic exploration is a very old national craving, and sprang suddenly into existence, when the Spaniards, after their discovery of the West Indies, and the Portuguese, after their discovery of the passage round the Cape of Good Hope, barred the way to the rest of the world. It was at once argued that the way to the coast of China, across the Pole, was much shorter than that round the Cape; and that by it the Portuguese monopoly was to be broken down. A series of attempts thus began, which continued into the 17th century, and placed on the map those brave old names such as Frobisher, Davis, Baffin, Smith, Lancaster, and others, or as Barentz or Hudson on the part of the Dutch. But the civil wars of the 17th century gave men something else to think of; Arctic voyaging ceased almost entirely during some 200 years; and though the traditions of it were kept alive by whalers and one or two

Government expeditions—such as that under Commodore Phipps in 1773,—at the peace in 1815 we knew less of the geography and conditions of Arctic land and sea than was known 200 years before. Much less; because Baffin's map had been lost. and his journal had been voted a tissue of lies. It was then, however, that the energy and influence of Sir John Barrow. the Secretary of the Admiralty, gave a new impetus to the work; and during the next thirty years exploration was carried on with something like regularity. In 1845 the expedition commanded by Sir John Franklin left our shores, never to return: for many years its fate was utterly unknown; nor was the mystery fully cleared away until, in 1859, Sir Leopold Mc Clintock, then commanding the private ship "Fox," succeeded in finding some few relics, which were sufficient to solve the very sad problem. During the last year, an American officer, Lieutenant Schwatka, with a small sledging party, re-visited the scene of Mc Clintock's discoveries. and ascertained that nothing of any interest or importance had been left behind.

It was in the course of the long search for this missing expedition that most of the exact geography of that region north of America was examined and charted: most of the islands west from Baffin's Bay were coasted round, either by ship or sledge; and long before the search was finished, the North-West Passage—if it can be called so—had been found by Mc Clure and his shipmates in the "Investigator." If it can be called so: for it was and is impassable by ship. No ship, sailing-vessel or steamer, has yet passed from the Atlantic to the Pacific, or from the Pacific to the Atlantic, north of the American continent. Ships have penetrated from the Atlantic to the coast of Melville Island, and the east end of Banks Strait. What Mc Clure did, was to force his ship from the Pacific into the Bay of Mercy; and after being frozen in there for nearly two years, to march across the ice to the "Resolute," then at Dealy Island in Melville Sound.

It was also in the course of this search that two small American expeditions, commanded, one by Dr. Kane and the second by Dr. Hayes, pushed far to the north through Smith Sound, and reported certain experiences which seemed to point to the conclusion that the climate sensibly ameliorated as the latitude increased. It was argued that the great length of a Polar day must more than compensate for the obliqueness of the sun's rays, and for the very long night; and this conclusion was apparently strengthened when the "Polaris," an old American river steamer, a weak ill-found ship, with a heterogeneous, undisciplined, and mutinous crew, notwithstanding all disadvantages, got farther north than any ship had previously done, and reported open sea and mild climate. Most geographers who had studied the conditions of climate, and most sailors of Arctic experience, doubted the correctness of these deductions. They knew that local conditions affect local climate everywhere, and in the Arctic to an extreme degree. It was known that the lay of the land in respect to the prevailing winds, the currents, and the tides, had a great deal more to do with the possibility of a comparatively open sea, than any effect of a long summer day,—an effect altogether wildly exaggerated; and it was within the bounds of certain knowledge that the possibility of passing further north must depend on the continuance of the land. Still, the reports of land seen far to the north of the winter quarters of the "Polaris," as well as the reports of open sea, bearing testimony to the stoppage of heavy ice, were sufficient to lead our more scientific and experienced geographers to recommend further exploration by this route.

It was by it, therefore, that the expedition under Sir George Nares (1875-6) was despatched, only to find that the northward trend of the land came to an end; that the coast ran away to the west or to the east, and that to the north was a sea of very old ice of stupendous thickness and exaggerated roughness; ice similar to what Mc Clure had encountered far to the west, when he endeavoured to push north from Bering Strait. This sea, covered with this tremendous old ice—which Sir George Nares called "the Palæocrystic Sea,"—put a very absolute stop to further progress northwards; and though, by extreme exertion, the sledging party did go a few miles beyond any former expedition, it was clearly established that nothing more could be done. The nature of the ice met by Sir George Nares, closely resembling that found more than 20 years before by Mc Clure, would seem to show that there is no barrier of land separating the sea north of Robeson Channel from that west of Banks Land; and if this idea is correct, further exploration in this quarter may indeed, in many ways, help to solve questions of scientific interest, but is not likely to lead us towards the Pole. So that whilst every one interested in Arctic exploration would countenance and support any well-devised plan of further examination of these coasts, those who would prefer absolute discovery of new ground to the more exact survey of old, are compelled to turn in another direction. Whether the facts will elsewhere be more favourable, we do not know; we cannot know till the thing has been tried.

As to what has quite lately been done, the newspapers have rendered Professor Nordenskiöld's success sufficiently notorious. It is therefore only necessary to mention that his ship, the "Vega," sailed along the north coast of Europe and Asia, without meeting any serious obstruction. What ice there was, was light and rotten; and it was not till she was close to Bering Strait, the goal of her voyage, that, on the 28th September, 1878, she was absolutely stopped. A day or two more would have cleared her. Possibly if she had started a day or two earlier, all might have been right. But the essential peculiarity of Siberian navigation is that it is about a month later than that of the seas west of Greenland. At the earlier season, when, from more westerly experience, the sea might be expected to open, the Kara Sea is blocked with impenetrable ice floes. It used to be known as the "ice-cellar." It not only had its own ice, but, through the early summer, the great Siberian rivers, the Obi and the Yenisei more especially, discharged into it their ice, borne thither by a westerly current. It is not till the summer is well advanced that these rivers, now bringing water warmed by a southern sun, counteract the ill they have formerly done, melt the ice out of the cellar, and, spreading out across the Siberian Sea, make all the ice more or less rotten; whilst further westward, west of Novaya Zemlya, the water of the Gulf Stream tends to produce a somewhat similar effect, and strengthens the influence of the rivers. This is the peculiarity which it was left for the Swedes, the Norwegians, and the Austrians of our own time to discover. The Swedes more especially, under the zealous direction of Nordenskiöld, have been working on this basis for about the last fifteen years. The Austrians also attempted it, and it was by them (Weyprecht and Payer) that the meaning of the extraordinary fact was first reasoned out. But when they attempted to take advantage of it, the theory seemed to prove false: their ship, the "Tegetthoff," was caught in the ice, and, fast held, was drifted wearily and helplessly to the till then unknown Franz Joseph Land, where, the following summer, the ship was abandoned; the party returning by sledge and boat to Novaya Zemlya, when they were picked up by some Russian fishermen. All this was not very promising: but more recent experiences have shown that the luck of the "Tegetthoff" was exceptionally bad. In 1879, a small Dutch sailing-vessel sighted Franz Joseph Land, and came back without serious difficulty; and again, this last year, Mr. Leigh Smith, a well-known yachtsman, pushed to this land in a steam-yacht, the "Eira;" examined the spot where the "Tegetthoff" was abandoned—all trace of which had disappeared; and coasting from there towards the north and west, found that the land extended in that direction to at least 43° E and 81° N. There seems no reasonable doubt that this chain of islands extends to the Spitzbergen group on the west; how far to the north we do not know. But if the northern point seen by Mr. Smith should be, as it appeared, the southern point of land stretching away to the north, then, according to the received canon of Arctic navigation, this land can be followed: it may be difficult, but can scarcely be impossible.

As to how far these islands extend to the east, we have no knowledge; but some years ago Professor Nordenskiöld argued that since the ice-fields of the Siberian Sea are driven backwards or forwards by southerly or northerly winds, it would seem to be probable that that sea is shut off from the Polar Sea by a chain of islands, of which Wrangel Land and New Siberia may be part. Whether this is so or not, we do not know; any more than whether on the west, the chain is continued to Greenland. If it is, it must be in a very high latitude; for, from Parry's farthest, in 82° 45′ north from Spitzbergen, no land was seen. Still, the late Sherard Osborn used to argue that as nothing at all resembling the heavy ice found by McClure to the west of Banks Land, or since found by Nares to the north of Robeson Channel, is found to the north of Iceland, in the sea between Greenland and Spitzbergen. there must therefore be a barrier. He was disposed to conceive this barrier as extending from the Parry Islands, across the Pole to New Siberia. Nares's experience shows that this cannot be: but the existence of some such barrier seems presumptively certain, and may perhaps extend from Greenland to New Siberia. What lies beyond Beaumont's Cape Britannia we do not know. Possibly the land is continued to the north-east or east, by islands stretching across towards the new lands sighted by Leigh Smith. What lies beyond Smith's Cape Lofley we also do not know, but we are anxious to go to see: if, in some form or other, the land stretches away to the north, much may be hoped; with an adequately organized expedition, much may be done: and it seems probable that it will be by this route that the Royal Geographical Society will advise the next attempt to penetrate the unknown region.

In concluding, the President said that while he was happy to think that his year of office had been one of distinguished success, he could not attribute this to his own merits, but rather to the zeal and energy of the Secretaries, to the willing co-operation of the Acting Treasurer, to the cordial unanimity of the Council, and to the inherent vitality of the Association itself; and he now quitted the Chair with every hope and confidence that the coming years would be no less prosperous than the past.

The following Report was presented by the Treasurer:—

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31*st December*, 1880.

RECEIPTS.	£.	s.	d.
Balance brought forward from last year ...	7	3	6
12 Subscriptions for 1879	6	6	0
89 ,, ,, 1880	46	14	6
14 ,, ,, 1881	7	7	0
	£67	11	0

PAYMENTS.	£.	s.	d.
Hire of Room, &c.	11	9	0
Expenses of Lectures	12	17	0
Printing	15	9	0
Postage and Stationery	7	12	7
Sundries		16	10
Donation to Blackheath Subsidence Exploration Fund	10	0	0
Excursions	4	7	5
Balance in hand ...	4	19	2
	£67	11	0

Audited and found correct,—A. B. HOSKINGS.
WM. HODGETTS.

1*st January*, 1881.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

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THIRD ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1881,

AND

LIST OF MEMBERS.

Greenwich:

H. S. RICHARDSON, STEAM PRINTING WORKS,

CHURCH STREET.

THIRD ANNUAL REPORT

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OF THE

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Elected at the Annual Meeting, 3rd January, 1882.

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TUESDAY, FEBRUARY 1st.

J. Jenner Weir, Esq., F.L.S., F.Z.S., gave a lecture on "The Evolution of Life, with especial reference to Dr. Charles Darwin's Theory of Natural Selection."

Mr. Weir, at the outset of his discourse, desired to limit himself strictly to the consideration of the Evolution of some of the various forms of animal life which we see around us, and disclaimed any intention to go into the question of the origin of life. He expressed himself as an unbeliever in spontaneous generation, and asserted that Dr. Bastian's experiments only proved conclusively to him how difficult it is to exclude life, even when the greatest possible care is taken to do so. All animals and vegetables are evolved from ancestors which very closely resemble them, and, until quite recently, it was believed that each creature or plant was created by special *fiat*, and placed on those parts of the earth which are best adapted for it. Mr. Weir proposed to limit his arguments by drawing illustrations from the animal kingdom—chiefly from the vertebrata, or creatures possessing a backbone.

If the Doctrine of Evolution is to be accepted, it must be shown to be supported by evidence gathered,—

1. From Development from the Ovum—Embryology.
2. From Similarity in Structure—Morphology.
3. From Distribution in Time—Palæontology.
4. From Distribution in Space—Zoogeography.

Embryology.—As far as the higher animals are concerned, all life proceeds from the egg; and Von Baer pointed out that during the egg state of existence, while growth is going on, the development of differences is also going on; and that these differences become of greater and greater importance until birth takes place. Thus the embryo of a dog, of whatever variety, would, up to a certain stage, resemble other embryos of the same species—a bull-dog for example, would resemble a greyhound; at birth a difference would be very apparent; and at a month old the difference would be greater still.

Birds are more closely allied to reptiles than is usually believed, and Anatomists have found rudiments of teeth of reptilian character in some unhatched birds. This fact has recently been invested with deep interest, by the discovery of fossil birds in America with teeth in the jaws. Again, in efts, toads, and frogs, the embryonic form is that of a fish, and in the tadpole state they are still true fishes, living in the water and breathing by means of gills; but when their lungs are developed they leave the water, and breathe air like reptiles and the higher vertebrata.

The subject of Embryology is a vast one, nevertheless, all the arguments that can be drawn from it appear to be in favour of Evolution. Professor Allen Thomson, when President of the British Association for the Advancement of Science, in referring to the subject, said:—"I consider it impossible for any one to be a faithful student of Embryology, in the present state of science, without at the same time becoming an evolutionist."

Morphology.—From a consideration of the structure of animals, it will be seen that the main argument lies in the very few types or patterns out of which the forms have been evolved. Insects differ greatly in appearance—for example, the dragon-fly and the lady-bird—and yet their bodies are built up of the same number of segments, viz., 20. Even the crustaceans resemble the insects in possessing 20 segments; and it is worthy of note that when these creatures have a complex mouth and large claws, a greater number of segments are involved in their production; while a less number being available for the legs, the latter organs are reduced in number. On the hypothesis of Evolution from a primordial germ possessing 20 segments, the case is clear enough, but we can hardly conceive, on the hypothesis of creation, that the same number should be always adhered to.

Mr. Weir then referred to useless rudimentary members, such as the nails on the fore-paws of the seal and manatee, and the hind legs of certain true serpents, and considered that the suppression of unnecessary organs, and the unusual development of others, had brought about the wonderful differences we see in their structure.

The Lecturer then passed on to the evidences of Evolution as exhibited in the limbs of animals, and spoke of the numerous and remarkable links between the palæotherium and the horse, which have recently been discovered in America.

Palæontology.—It must be evident to all that a very small portion of the earth has been examined below the surface, and that, therefore, the evidences in support of the theory of the Evolution of life, which can be derived from Palæontology, is of necessity very incomplete. Still that evidence, as far as it goes, is in support of the theory.

The oldest fossil-bearing rocks contain the remains of creatures which differ most from those now inhabiting the earth, and this difference decreases as we approach the more recent deposits, until, in the drift, few genera are met with, perhaps even none, which have not living representatives; and often the fossil species found in this deposit are identical with those still existing. Another very interesting and instructive fact is also exhibited—many of the forms of animals which are now perfectly differentiated into distinct families or even orders, were, in the earlier deposits, not so differentiated. On the contrary, remains are constantly found in which the characters of totally distinct families are blended—in other words, a generalised type then existed which, in more recent deposits, and in living species, has given way to more specialised types.

In a few cases the pedigree of a species has been well made out, the fossil links in the chain of evolution being almost perfect. The development of the horse, a one-toed animal, from a four-toed ancestor, is a case in point.

Zoogeography.—With regard to the distribution of life on the earth, there are two branches of the subject. 1st, the distribution of animals on land (aërial), and in water (aquatic); and 2nd, their distribution over different areas of the earth's surface. On the theory of separate creation, we ought to find that among the aërial animals, differentiated as they are into groups adapted for that mode of life, aquatic animals would not be found, and on the other hand, those groups eminently adapted for aquatic existence would be expected to confine themselves to the water; but we do not find such to be the case. For instance, the swans, geese, and ducks are all web-footed and clearly adapted for an aquatic life. Now the swans leave the water but rarely, and progress on land with difficulty; the geese spend much of their time out of the water, and in Australia we find the ceriopsis goose, which very rarely, if ever, seeks the water, and is as much a land bird as a partridge. It is, however, clearly a goose, and has webbed-feet. Among the ducks there is the tree-duck, which habitually frequents trees, and several species breed in holes of trees, like woodpeckers. Still more startling is the mode of life adapted by certain species of thrushes, a thoroughly aërial and generally arboreal group, yet the dippers—genuine thrushes—dive exceedingly well, holding on to the stones at the bottom of rapid streams, using their wings to swim with, and feeding almost entirely on aquatic insects, small shell-fish, and it is said, the spawn of fishes. Mr. Weir stated his conviction that no Naturalist could ever have deduced the aquatic habits of these birds from an examination of their structure. In the weasel group we find that the stoats and polecats are ground animals, the martins arboreal, and the otters thoroughly aquatic. Mr. Weir gave a large number of such examples, and said that, on the theory of a community of descent with modification, all the cases were clear; but on the hypothesis of special creations, he did not see that they could be explained. Want of space prevents any report on geographical distribution, into which the Lecturer entered at considerable length.

Dr. Darwin's Theory of Natural Selection.—The Darwinian theory—"The origin of species by means of Natural Selection, or the preservation of Favoured Races in the Struggle for Life"—is something quite distinct from the theory of the Evolution of Life. Natural Selection is, by the Darwinian theory, held to act in producing species, much in the same manner as artificial selection acts in producing different herds of domesticated animals: man, by selection, has produced from one species, animals differing as a race-horse does from a cart-horse; as pouter, carrier, and tumbler pigeons differ from each other, and from a blue-rock their ancestor; a greyhound from a bull-dog; a cochin-china fowl from a bantam; and a lop-eared rabbit from the wild species.

Mr. Weir illustrated the preservation of favoured races by the modes of escaping destruction in the case of the hare, and of the rabbit. The hare produces its young perfect and quite capable when a few hours old of running with considerable swiftness; this power of escaping from its enemies has increased to such an extent that the hare has no wild enemy that can overtake it, and man is obliged to produce a swift breed of dogs to render its capture by animal aid possible. The rabbit, on the other hand, produces its young underground blind and feeble, and when mature the creature habitually resorts to its burrow for security. Here we find that the struggle for existence has brought about two quite different modes of escaping destruction.

As another illustration, crabs were mentioned. Some of these have swimming legs and live at a distance from the shore. Others may be found running about like land animals in the rocks exposed by the falling tide, and this habit of leaving the sea becomes more and more developed until we find land crabs which live miles away from the sea in crevices among the mountains. But such crabs are no less sea crabs than the swimming crabs first mentioned, they are all produced from eggs deposited in the sea, they pass through the zoea form in the water, and they undergo changes as marked as do the caterpillar, chrysalis, and butterfly. Even on land they do not cease to breathe by gills, for they have a means of keeping them moist so that they perform the functions of lungs.

Mr. Weir concluded his lecture by remarking that, of all our living men of Science, none have laboured longer, and to more splendid purpose, than Mr. Darwin.

TUESDAY, MARCH 1st.

A lecture was delivered by John Edward Price, Esq., F.S.A., M.R.S.L., a Member of the Association, on the Discoveries of Roman Remains made by him and F. G. Hilton Price, Esq., F.G.S., at Morton Farm, near Brading, in the Isle of Wight.

The history of these Discoveries was stated as follows :—In the early part of 1880, Captain Thorp, of Yarbridge, found in a field, the property of Mrs. Munns, some Roman Remains, including a very remarkable tesselated pavement. "On the western side are two gladiators, the Secutor or one with a trident, and the Retiarius enveloping the other with a net, in combat. On the north side is a fox under a tree. A building with a cupola completes this. On the south side, in front of a pair of steps, is a man with the head and eye of a cock, on his right hand are two griffins, called by some 'winged panthers.' In the centre is the head of Bacchus or of a Bacchante, and occupying two of the angles are like figures, holding in their hands a staff with a cross upon the top." The Lecturer having visited the scene of this discovery and closely examined the remains, formed a strong opinion that further remains of great importance would be discovered in the adjoining field, and applied to Lady Oglander, the proprietress of it, for permission to dig. After some time this was very graciously accorded, and thereupon ensued the discoveries which were the subject of the lecture, and which have attracted so much public attention, and are still being pursued with undiminished interest and zeal. The centre of an apartment 51 feet long, was occupied by a mosaic pavement representing Orpheus playing upon his lyre, wearing a Phrygian cap and flowing pallium or cloak; attracted by his music are quadrupeds and birds. Near to the left shoulder is a monkey wearing a red cap, the other animals are a coot, a fox, and a peacock. The attention of the animals appears rivetted upon the player. The remainder of the floor of this long room is covered with black and white tesseræ. Underneath is a subway 6ft. 8in. long by 2ft. wide and 3ft. 2in. deep, which had been covered with flat slabs of native tertiary limestone, the stones forming it are of various dimensions but are all 8in. thick. This subway has evidently something to do with the heating apparatus for the other apartments subsequently disinterred.

The most remarkable pavements discovered, however, were those in a chamber 39ft. 6in. long, and of varying width, divided by piers in the centre. At the west end the mosaic floor is very nearly square, its dimensions being 13ft. 6in. by 13ft. 10in., and is divided into compartments, all edged by a border of the "guilloche" pattern,—a form of tasteful interlacing usual in Roman mosaic work,—in half-inch tesseræ of white, black, and red. The central design of this portion of the pavement has been destroyed, but it seems to have contained a little house similar to that in the first pavement found. At the corners are busts representing the four seasons, and in one of them is also the figure of a peacock with flowing tail, pecking at flowers in a vase; the plumage being worked in many colours. There were doubtless similar figures in the three corresponding corners, but these have been destroyed. Between these were probably mythological subjects, one resembling Perseus and Andromeda alone being preserved. Between the stone piers which divided the apartment into two, and probably supported an arch across which a curtain could be drawn, is a very interesting pavement, in the centre of which is a square panel, containing a male seated figure, very slightly draped; at his left side stands a pillar, surmounted by an object apparently having reference to the Signs of the Zodiac. Beneath is a globe supported on three legs, to which the figure is pointing with a wand as though casting a horoscope; at his right hand is a cup or vase, and an object resembling a pen. This figure appears to represent therefore an astrologer in the exercise of his profession.

The largest and most important mosaic, however, is that in the eastern division of this spacious apartment. In the centre is a medallion containing the head of Medusa; springing from this centre are four compartments arranged crosswise; at the angles are triangular compartments, containing bucolic figures blowing the buccina or neatherd's horn; on their heads is the petasus of Mercury, over their left shoulder a pallium or cloak. The four panels each contain two figures, male and female, apparently of a pastoral character. Drawings of all these pavements were exhibited and the Lecturer drew particular attention to one of these groups, where the female figure, partially draped after the manner of the dancing girls among the ancients, is playing upon a musical instrument, a sort of drum or tambourine; and her companion, the male figure, wears a Phrygian cap, a skirted tunic with a small cloak or pallium fastened on the right shoulder, and the very unusual accompaniment of braccæ or trousers, which are loose and plainly distinct above the boot or shoe. The peculiarity of this dress led to the suggestion that it might have been that in fashion among the natives of the Island at the time the mosaic was laid down. A pandean pipe is held in the right hand, and a shepherd's crook in the left. Another panel is interpreted to represent Ceres offering the fruits of the earth to Triptolemus, who (perfectly nude) holds the hinder part of an ancient plough. Another was suggested to contain a representation of Lycurgus, King of Thrace, persecuting a Bacchante. The fourth panel is too much injured for the subject to be identified. One remarkable adornment of the border round this room is at the head of it, where a Swastica or Vedic cross is represented. This ubiquitous symbol has been found in India, China, Japan, on Greek coins, on Etruscan vases, on Celtic monuments, as well as on the pottery discovered by Dr. Schliemann on the site of Troy. The Lecturer had likewise met with it upon

Roman glass from London excavations. It was remarked as an interesting feature, in all the mosaics found, that they are made from native materials, the various coloured stones selected for the plumage of the birds, drapery, and costumes being such as may be picked up on the shore at Whitecliff and Sandown at the present day.

The Lecturer proceeded to describe the other chambers discovered, about thirty in number, and gave full information as to the apparatus for heating—the hypocausts, flue-tiles, &c. The operations, conducted with so much skill and success up to this point, are still continuing, as probably hardly a third of the whole number of chambers are yet exhumed. The lecture was illustrated with careful drawings to scale, and many of the objects discovered in the excavations were exhibited. A complete account of the discoveries has since been published by the Lecturer and his colleague in the Transactions of the Royal Institute of British Architects, 1880-81.

TUESDAY, APRIL 5th.

A paper by the Rev. H. H. Higgins, M.A., of Rainhill, was read by Mr. Jackson, one of the honorary secretaries.

The object of the author was to show that the lowest forms of animal life, viz., the Monera, Amœbæ, Arcellæ, Foraminifera, and Polycystina, exhibit certain well-marked characteristics, which entitle them to higher consideration than they have hitherto received.

The Monera possess,—

1. *Individuality.*—The nearest semblance of Individuality in lifeless matter may perhaps be found in a crystal. But a crystal does not undergo a series of internal changes having reference to its totality, while an animal does; and this peculiarity is found among the organisms now under consideration.

2. The moneron exhibits *periodicity*—the old form inevitably dies and gives place to new forms. Its life cannot be prolonged

beyond a certain time. Periodicity is unknown in lifeless matter, any kind of which may, under certain conditions, be preserved for ages.

3. It has the power of *reproducing its like*, certainly in two ways, probably in more than two.

4. It can *digest and assimilate food* unlike its own substance. Such processes as solution, chemical decomposition, and crystallisation, afford us no parallel with assimilation.

5. It is capable of *feeling hungry*. When the tiny speck of living jelly comes into contact with a particle of food, the animal proceeds to enclose the morsel by flowing round it. In its starved condition the creature spreads its root-foot in every direction, until at last it touches something it can feed upon.

6. Perhaps as a sixth characteristic of the monera, we may admit a *tendency to assume a condition of rest*. What that is, in the cycle of the creature's history, which inclines it to give up feeding and motion, and to repose for a while before breaking up into a swarm of progeny, it is hard to say. It may be induced by changes in the temperature of the medium in which it lives, but this does not seem altogether probable. Perhaps this desire to rest may be admissible as the manifestation of a low form of instinct.

We now come to a creature, the Amœba, which is higher in organization than the Moneron. The Amœba,—

7. *Possesses a Nucleus.*—In the ascending scale of life, it is the first example of a complete cell with nucleus.

8. Besides the nucleus, and quite unlike it, the microscope detects within the body of the animal, a clear space which is known as the *vesicle or pulsating body*. This may be observed alternately to contract and expand. The pulsation is rhythmical as in the heart of a mammal.

The next creature in order of complexity is the Arcella. It is essentially an Amœba, but it is able,—

9. *To encase its body*, doubtless for protection, with hard particles, such as grains of sand. Thus it forcibly reminds us of the tubes, coated with small shells, inhabited by the larva of the Caddis-fly. Surely this selection of suitable materials for the purpose of constructing a covering, is worthy of the name of instinct.

In the next advance, the Foraminifera, we find,—

10. *The development of families and genera.* These animals form an order, but in the order there are sub-orders, in the sub-orders, families; in the families, genera; in the genera, species—hosts of them. The creatures themselves are structureless, they have no organs of any kind, but the shells which they construct are exquisitely beautiful.

Finally, in the Polycystina we observe,—

11. *A development of a profuse variety of curvilinear forms.*—These are indeed pre-eminent in beauty, but what is remarkable is this—that the elegant form of the glassy shell is far in excess of its apparent utility, and, in the present state of our knowledge, the beauty of the polycystin shell cannot be accounted for by any advantage it can confer on the animal.

12. *Constitutional differences* between specimens of the same species in the lower classes of organisms, form an almost unexplored field in Biology. Even among the lovely creatures now under our notice, the existence of some kind of idiosyncrasy may be recognised.

The author of the paper concluded by saying, "I feel strongly that the assumption that we possess complete theories, such as Evolution is by some supposed to be, does infinite mischief, inasmuch as gigantic speculations dwarf and disparage the hard-earned stores of true knowledge."

TUESDAY, MAY 3rd.

A Lecture on "The Eye as an Optical Instrument" was delivered by J. W. Waghorn, Esq., R.N., B.Sc.

The formation of an image by a convex lens was explained, and illustrated by a gas flame placed on one side of the lens, and on the other, a screen on which the image of the flame was received. It was shown that the more distant the object the smaller is the image, and the closer must the screen be placed to the lens. In all cases the image received on the screen is inverted. The photographer's camera is essentially such a combination of a lens and a screen, and the human eye exhibits in many respects a close analogy with the camera.

The outer coat of the spherical eyeball, called the "Sclerotic," or in more popular language "the white of the eye," serves to protect the more delicate interior parts from injury. The front portion, which is transparent, allows rays of light from an object to fall upon the crystalline lens, contained within the eyeball. This lens, which is "double convex" and very transparent, forms a small inverted image on the sensitive screen called the "Retina:" the "Optic Nerve" entering the eyeball at the back spreads over two-thirds of its interior surface to form this inner film of the retina. Wherever the light falls on the retina it effects chemical changes in certain microscopic structures known as the "Rods" and "Cones," and the stimulus caused by these changes is conveyed by minute nerve fibres to the brain.

One of the principal difficulties met with in the construction of optical instruments, arises from the fact, that the rays, which pass through a lens near its circumference, are not brought to a focus at exactly the same point as those which pass through the central portion—the lens is in fact weaker at the centre than at the edge. This difficulty is met in glass lenses, by cutting off, by means of a screen, all those rays which do not pass near the centre, and thus exactness of outline in the image is obtained at the expense of brilliancy. In the eye there is a similar opaque screen called the "Iris," in the centre of which is an aperture known as the "Pupil." The pupil dilates when the light is feeble, and contracts under a strong light, and these changes are performed instantaneously and quite unconsciously. The photographer imitates this action, though in a far less efficient manner, by altering his "stop" or circular screen according to the variation in the intensity of the light.

But the imperfection alluded to is again very much lessened in the eye, by the manner in which the crystalline lens is constructed of layers of decreasing density outward, something like those of an onion. As white light, on passing through a lens, is broken up into prismatic colours, the optician, to avoid the coloured edges which would otherwise be seen in the images of all objects, uses a combination of two or more lenses of different kinds of glass. In the eye no such compensation exists, and, in this respect, the instrument maker has perhaps improved on nature's handiwork. It was mainly, in respect of this defect, that Helmholtz made his well known remark, that if a workman had sent him such an instrument as the eye, he should have returned it to him for a few alterations and improvements. Under certain conditions we do see objects with coloured margins, but the inconvenience from this cause is so slight, that the fact itself has only comparatively recently been discovered. These defects and the methods of removing them, were illustrated by experiments.

To obtain an image in accurate focus on the glass screen of the camera, the photographer must alter the distance of the lens from the screen for every change in the position of the object. It is obvious that no such motion is possible with the lens of the eye, but a far more beautiful mechanism exists by which the range of the lens is altered automatically, so that the image of the object however distant, is always focussed on the retina. After many years' discussion it is now accepted as a fact, that the shape of the lens is altered by ligaments attached to certain muscles, so that the lens is compressed and rounded when the eye is looking at near objects. By age the lens becomes more dense and loses this power of "accommodation," until finally only distant objects can be seen distinctly, and the person is said to be "long sighted."

At 21 years this normal sight has a range from 4½in. to an infinite distance, while at 40 the "near point" has increased to 9in. But for a sustained effort of vision the object should, if possible be always at twice this distance. The causes of short and long sight were explained and illustrated by experiment, and the very great injury and danger to the eye often caused by the disinclination to use spectacles were pointed out.

It is a common error to suppose that short sight improves with age, the fact being that short-sighted people like all others, lose the power of looking at near objects, and as they grow old do not gain anything at any time. Certain other small defects in vision were next referred to: these were "astigmatism," or the inability to distinguish, with equal clearness at the same time, horizontal and vertical lines; *muscæ volitantes* produced by dark specks which float in the transparent humour which fills up the space between the lens and retina; and the star-shaped appearance of a bright light, caused by the radiating structure of the lens, &c.

Of the parts of the eye which receive the image, the most important structures are believed to be the rods and cones, spread like a very fine mosaic over the inner surface of the retina. Two points looked at, at the same moment, can only be seen as distinct from each other when the images fall on separate cones, but we have little cause of complaint in this limitation of our powers, when we learn that there are nearly a million of these cones in the hundredth part of a square inch. The portion of the retina where the bundle of optic nerves enters, is totally insensitive to light, and forms a "blind spot" of about one-twelfth of an inch in diameter, but the defect is not generally noticed in our vision, as the portion of the image lost on the blind spot of one eye does not fall on the blind spot of the other eye. For accurate observation, only a very small part of the retina is used. This portion, known as the "yellow spot," lies near the blind spot, and is also about one-twelfth of an inch in diameter. Almost all the elements of the retina, except the cones, are absent from this spot; even the blood vessels, which are present everywhere else, form a ring round this "holy of holies." Man shares with the monkey alone the possession of this peculiar structure.

A purple red fluid formed on the rods and cones, is bleached by the action of light (just as the silver salts of the photographer's negative are acted upon in the camera), and these bleached images of external objects have been observed and rendered permanent by a solution of alum, in the case of rabbits decapitated immediately after exposure to a strong light: a recent attempt to present Helmholtz with a photograph of himself obtained in this way was, however, a failure.

Young's hypothesis, that to every cone are attached three nerve fibres, which, respectively, convey the sensation of red, green, and violet light, was explained. Thus, the impression of white light is believed to be obtained when all the fibres are acted on in due proportion, and that of colour when there is an unequal excitement of the fibres. It is supposed, however, that even a perfectly homogeneous colour, red for example, excites, though feebly, the fibres conveying green and violet. Consequently it is believed that a perfectly pure colour has never been seen.

"After images" due to the fatigue of nerve fibres recently excited, were shown by aid of the magnesium light.

Colour blindness is supposed to be due to the paralysis of one set of the fibres just described, generally of the red, with the result that there is inability to distinguish between scarlet and green, and rose tint and blue. About twenty men, but only one woman, in a thousand, are colour blind. Alcohol, tobacco, and santonate of soda can temporarily cause colour blindness.

The lecturer, finally, endeavoured to explain why, since our vision is limited to the formation of a very small inverted image on a plane surface, we see objects as if erect, and solid; and how we are enabled to estimate their distance and position.

SATURDAY, JUNE 18th.

The members and their friends spent the afternoon at Kew Gardens, which they visited under the guidance of W. T. Thiselton Dyer, Esq., F.R.S. At 6 o'clock a cold collation was provided at the "Coach and Horses Hotel," Kew Green.

SATURDAY, OCTOBER 22nd.

The members and their friends visited the Zoological Gardens, Regent's Park. The party assembled at the north entrance of the Gardens, at 2.30 p.m. Here they were met by J. Jenner Weir, Esq., F.L.S., F.Z.S., who conducted them round a portion of the grounds, and gave a most instructive account of the more important and interesting of the animals. The party dined in the evening at the Café Restaurant Royal, Regent Street.

TUESDAY, NOVEMBER 1st.

F. C. J. SPURRELL, Esq., F.G.S., read a Paper on "Dene Holes, with special reference to the Subsidences which have recently taken place on Blackheath."

Mr. SPURRELL described the Dene Holes (pronounced Dane Holes) of Kent and other parts of England. He also gave a short account of the Caves having vertical shaft-like entrances, which are found in various parts of Europe, Asia, and Africa.

With respect to the County of Kent, the strip of land to the north of the Weald is the chief site of the Dene Holes. They are found over the whole district, whether the soil be chalk, tertiary rocks, or deposits of later age. They present several differences, which may be seen in general to depend upon the period at which they were constructed.

The oldest and simplest are those which were worked without metal tools; they are usually in chalk which is at or near the surface, they contain, in the lowest stratum of the earth which has fallen into them, flint flakes and relics of Neolithic times, and, in the smoothness and regularity of their walls, show signs of lengthened occupation and use. They are comparatively of slight depth, and were not commonly descended by foot-holes.

The caves which are very much deeper and larger than the preceding, were next considered. These were apparently made with metal picks, and were generally descended to the bottom by foot-holes, though some of them doubtless required the aid of a tree, or other ladder-like arrangement, for the accomplishment of the last part of the descent.

The caves which penetrate the London clay, the pebble beds of Blackheath, &c., appear to be of later origin, the beds passed through being often of great thickness—considerably over 100 feet. From the nature of these soils, the shafts could not be descended by foot-holes. The appearance of some of these, as, for example, the one at Eltham, points to their late adaptation as refuges in mediæval times; and possibly, many of these chambers may have been reworked and enlarged for such a purpose.

The origin of these pits dates probably from the neolithic period, they were, perhaps coæval with the works at Cissbury.

The caves were habitations, and, to a certain extent, served the usual purposes of a dwelling.

The next form of Dene Hole noticed by the Lecturer, was one which, from the roughness of the excavation, and from the great increase of size, removes the probability of its having been used as a dwelling. It served perhaps as a store-chamber, and, on emergency, as a refuge from an enemy. Perhaps a use was beginning to be found during this period for the excavated chalk soil; and a later form appears to indicate that chalk was dug from these chambers for manure. This conclusion is rendered the more probable from the fact that such holes are found where the chalk lies at a considerable depth from the surface, and where it would obviously be of value in softening the sticky clays of the district. It is in the neighbourhood of the great old roads which lead to London from the Continent, and which converge about Shooter's Hill, that this laborious method of extracting marl (*i.e.* marrow) from the depths of the earth was practised; and it is known that this marl, partly from a real and partly from a fancied value, was much employed abroad.

These deep pits, from their position near the great highways to the Continent, would be likely to attract the notice of Roman travellers; and such travellers, on their return to Rome, would be "pumped" by the insatiable Pliny, and much valuable information derived from them. From Pliny we learn that marl was dug for manure in pits a hundred feet deep, and Mr. Spurrell asserted that nowhere else but near the great Roman way, and around Shooter's Hill, are shafts of this great depth to be found.

Long before the late discussion respecting the Subsidences on Blackheath, Mr. Spurrell had included Blackheath and its vicinity as a locality for Dene Holes, and he had formed this opinion from personal observation of the earth-falls on the Heath itself, and on the lands around. The subsidence of these places is a common occurence, and the Lecturer explained the different phases of the event.

The Paper was illustrated and elucidated by a large number of diagrams.

Note.—This Paper is now being published *in extenso* in the Journal of the Royal Archæological Institute.

TUESDAY, DECEMBER 6th.

A lecture was delivered by F. W. Rudler, Esq., F.G.S., on "Diamonds, Natural and Artificial."

After a brief notice of the history of the diamond, with special reference to its mention by Pliny and other Roman writers, the Lecturer addressed himself to the study of its physical characters, commencing with its crystalline form. By aid of diagrams and illustrations on the blackboard he explained the principal features of its crystallization. All the forms of the diamond may be referred to the cubic system. It was pointed out that the crystals are often "twinned," and the faces strongly curved. However diverse the external forms of the diamond may be, it invariably admits of being split, or "cleaved," in directions parallel to the faces of a regular octahedron. Advantage is taken of this cleavage in trimming a rough diamond, so as to remove flaws and to reduce an irregularly shaped stone to symmetrical proportions.

The old popular notion that a diamond, if placed on an anvil and struck by a hammer will resist the blow, arose from confounding the property of hardness with that of toughness. Although the diamond is so brittle as to be broken by a gentle tap, it is yet so hard as to resist abrasion by any natural substance. Its supreme hardness has led to its use by the lapidary, by the glazier, and by the engraver. The diamonds which are mounted in the steel crown of the "Diamond Rock-drills" are not crystals, or crystalline splinters, but merely fragments of the black uncrystallizable variety, known in Brazil as *Carbonado.*

The Lecturer described the various steps in cutting and polishing a diamond, and referred to the recent revival of the trade in Clerkenwell. The distinction between "brilliants" and "roses" was pointed out. When cut as a well-proportioned brilliant, and polished, the diamond displays to the greatest advantage its extraordinary brilliancy of lustre; while its high dispersive power contributes largely to its beauty. Although the purest diamonds are colourless, the stone frequently exhibits slight tints, and in some cases pronounced colours. Diagrams and models of the blue

"Hope," the green "Dresden," and the yellow "Austrian," were exhibited.

The geographical distribution of diamonds was traced upon a map, and the principal localities—the East Indies, Brazil, and South Africa—were described in detail. The history of the discoveries in South Africa was especially dwelt upon, and a large map of the district was exhibited; while the methods of working and washing the diamonds in Brazil were illustrated by scenic diagrams.

The Lecturer then gave a sketch of the history of our knowledge of the chemical composition of the gem, referring first to the early experiments of Boyle, of the Florentine Academicians, and of the Emperor Francis I. Until Bergman's researches in 1777, it was generally believed that diamond was a kind of rock-crystal, but he first showed that it contained no silica. Afterwards Lavoisier, with some other French chemists, demonstrated that the gem is carbon, practically pure. In conclusion the Lecturer described the various attempts which have been made, from time to time, to induce carbon to crystallise artificially in the form of diamond, and to assume the other physical properties of the gem. The recent investigations of Mr. J. B. Hannay, of Glasgow, were described, and reference made to his papers "On the Artificial Formation of the Diamond," as published in the *Proceedings of the Royal Society* (Vol. XXX, pp. 188, 450.)

A large series of models in paste, illustrating the principal diamonds in the world, had been lent to the Lecturer by Mr. E. W. Streeter, of New Bond Street; and were exhibited and explained at the conclusion of the discourse.

REPORT OF THE COUNCIL FOR THE YEAR 1881.

PRESENTED 3rd JANUARY, 1882.

The number of members at the end of the year 1881, was 121.

Six Lectures were delivered at the ordinary evening meetings, and the attendance of members and their friends was very satisfactory.

Two excursions were arranged during the summer, and both were well attended.

The investigation of the causes of the Subsidences on Blackheath, has been carried out, as far as the limited funds placed at the disposal of the Executive Committee would permit; and a Report, the joint production of Mr. J. K. Laughton (Chairman of the Committee), and Mr. T. Vincent Holmes, has been printed and circulated among the members of the Association and others interested in the inquiry. It will be seen that the expense of printing and advertising in connection with this work has been considerable.

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1881.

Receipts.	£	s.	d.
Balance brought forward from last year ...	4	19	2
Subscriptions received	37	5	6
	£42	4	8

Payments.				£	s.	d.
Hire of Room				8	15	0
Expenses of Lectures					18	4
Expenses of Excursions ...	£17	1	11			
Less Receipts	17	1	6			
net						5
Printing and Stationery				16	8	$8\frac{1}{2}$
Postage				4	9	$10\frac{1}{2}$
Balance in hand				11	12	4
				£42	4	8

Audited and found correct,—WM. HODGETTS.
WILLIAM LAMB.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

MEMBERS, 1881-82.

Adkin, Robert, Lingard-road, Lewisham, S.E.

Airy, Sir George B., K.C.B., M.A., LL.D., D.C.L., F.R.S., F.R.A.S., &c. late Astronomer Royal, White House, Greenwich, S.E.

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Carline, John, Ryecroft-road, Lewisham, S.E.

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Chandler, W. A., 3, Lansdowne-villas, Eastdown-park, Lewisham, S.E.

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Clarke, Reginald, M.R.C.S.E., South-lodge, Lee-park, Lee, S.E.

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Draper, G., 15, Camden-road, Lewisham-hill, Lewisham, S.E.
Drury, Frederick Dru, Devon-cottage, Blackheath-park, S.E.
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Frean, G. N., The Orchards, Blackheath, S.E.
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Geveke, George, Brunswick-house, Camden-road, Lewisham-hill, S.E.
Gibb, J., Ormiston-house, Victoria-road, Blackheath-rise, S.E.
Giessen, Andreas, 1, Dunbar-villas, High-road, Lee, S.E.
Goedecker, F., 143, High-street, Lewisham, S.E. (*Council*).
Greenhill, A. G., M.A., Professor of Mathematics, Royal Military Academy, Woolwich ; Moti Bagh, Lingard-road, Lewisham, S.E.
Grove, W. H., Norman-lodge, Blessington-road, Lee, S.E.
Guy, Albert L., 195, High-street, Lewisham, S.E.
Haddon, A., Demonstrator in Physics, Royal Naval College, Greenwich, S.E.
Hammersley, Joseph, M.R.C.S., Eng., 2, Norfolk-villas, Rushey-green, Catford.
Hart, Harry, M.A., F. Math. Soc. Lond., Mathematical Instructor, Royal Military Academy, Woolwich ; Cromer-house, Lee-terrace, S.E.
Harvey, William C., F.R.G.S., The Sycamores, Eastdown-park, Lee, S.E.
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Hearson, T. A., R.N., F.R.S.N.A., Instructor in Applied Mechanics, Royal Naval College ; 4, Glenmohr-terrace, Greeewich, S.E.
Hesse, F., 23, Manor-park, Lewisham, S.E.
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Hoskings, A. B., Ventnor-cottage, Bonfield-road, Lewisham, S.E.
Hutchinson, C. H., 39, Granville-park, Lewisham, S.E.
Hutchinson, C. L., 39, Granville-park, Lewisham, S.E.
Jackson, H. W., M.R.C.S., F.R.A.S., F.G.S., Membre de la Société d'Anthropologie, Paris ; 159, High-street, Lewisham, S.E. (*Hon. Sec.*)
Jerrard, S. J., High-street, Lewisham, S.E.
Jones, Rev. J. Morlais, College-park, Lewisham, S.E.
Karlowa, Otto, Benbraden-lodge, Hither-green-lane, Lewisham. S.E.
Keen, Percy, 34, Manor-park, Lee, S.E.
Laker, Abbott G., 4, Endwell-road, Brockley-rise, Brockley, S.E.
Lamb, W., M.D., C.M., 203, High-street, Lewisham, S.E.
Lambert, Carlton J., M.A., F.R.A.S., M.P.S., Professor of Mathematics, Royal Naval College, Greenwich, S.E.

Lambert, Rev. Brooke, M.A., B.C.L., Vicar of Greenwich ; The Vicarage, Greenwich, S.E. (*President*, 1882).

Laughton, John Knox, M.A., F.R.A.S., F.R.G.S., President Meteorological Society, Mathematical and Naval Instructor, Royal Naval College, Greenwich, S,E. (*Vice-President ; President* 1880).

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Legge, Rev. Hon. Augustus, M.A., Vicar of Lewisham, Lewisham, S.E.

Leoni, Bernard, 4, Manor-park, Lee, S.E.

Leunig, F., 31, Belmont-hill, Lee, S.E.

Lockhart, William, F.R.C.S., 67, Granville-park, Lewisham, S.E.

Lotz, W. F., The Hollies, Avenue-road, Lewisham, S.E.

Low, Edwin, Aberdeen-house, Blackheath, S.E.

Lubbock, Sir John, Bart., M.P., F.R.S., High Elms, Farnborough, Kent.

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Newman, Arthur, 1, Carlton-road, Brockley, S.E.

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Penn, John, Greenwich, S.E. (*Council*).

Penn, T., Grove-house, Lewisham, S.E.

Phillips, Edward, Athena-house, Morley-road, Lewisham, S.E.

Pitter, Joseph, 5, Bonfield-road, Lewisham, S.E.

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Potts, William, 34, Limes-grove, Lewisham, S.E.

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Purvis, Prior, M.D., Landsdowne-place, Blackheath, S.E.

Reed, Fred. H., 10, Belmont-hill, Lee, S.E.

Ritchie, J. H., Cedar-bank, Hyde-vale, Greenwich, S.E.

Robinson, Henry, Eliot-park, Blackheath, S.E.

Rome, William, The Red-lodge, Putney, S.W.

Roper, Arthur, M.R.C.S., Lewisham-hill, S.E.

Rudd, Charles, R.N., 6, St. Thomas's-terrace, Charlton, Kent.

Rudd, Rev. Thomas, Congregational College, Lewisham, S.E.

Sampson, James, Phœnix-villa, Morley-road, Lewisham, S.E.

Saunders, H. S., 36, Lee-terrace, Lee, S.E.

Saunders, Martin L., 36, Lee-terrace, Lee, S.E.

Saundry, Dr., Royal Kent Dispensary, Greenwich, S.E.

Short, Frederick Hugh, 1, Marlborough-road, Lee, S.E.

Simpkinson, Rev. C. H., B.A.,Holy Trinity Vicarage, Greenwich, S.E.

Smale, G., Ormond-house, Granville-park, Lewisham, S.E.

Smith, Henry Francis, Slaithwaite-road, Lewisham, S.E.

Smith, Niemann, 87, Granville-park, Lewisham, S.E.

Stanley, J. H., Napoleon-cottage, Rushey-green.

Tate, H. T., 1, Leicester-villas, Thornford-road, Lewisham, S.E.

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Turner, Neville, 8, Ringstead-road, Catford.

Tustin, J. J., 9, Paragon, Blackheath, S.E.

Waghorn, J. W.. B.Sc., F.R.S.N.A., Instructor in Physics, Royal Naval College, Greenwich, S.E.

Watchurst, Charles, 32, Blessington-road, Lee, S.E,

Webster, W., Jun., F.C.S., Wyberton-house, Lee-terrace, Lee, S.E. (*Council.*)

West, Rev. Thomas J., M.A., College-park, Lewisham, S.E.

Westrup, W. H., 20, Dartmouth-terrace, Lewisham-hill, S.E.

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Whomes, Robert, Brook-house, Lewisham, S.E.

Wilson, Edward, 59, Lee-park, S.E.

Wiltshire, Rev. Thomas, M.A., F.G.S., F.R.A.S., F.L.S., &c., Professor of Geology and Mineralogy, King's College; 25, Granville-park, Lewisham, S.E.

Wire, Travers B., May's-buildings, Crooms-hill, Greenwich, S.E.

Wolffgang, Ernest, Greenbank, Queen's-road, Forest-hill, S.E.

Yeo, John, F.R.S.N.A., Lecturer on the Steam Engine, Royal Naval College, Greenwich; Kingswood-lodge, Lewisham-road, S.E. (*Honorary Secretary.*)

FOURTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1882,

AND

LIST OF MEMBERS.

Greenwich:
H. S. RICHARDSON, STEAM PRINTING WORKS,
CHURCH STREET.

FOURTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

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LIST OF MEMBERS.

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CHURCH STREET.

LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 2nd January, 1883.

President:

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Vicar of Greenwich.

Vice-Presidents:

ARMSTRONG, Dr. HENRY E., F.R.S.,
Sec. Chemical Society.

LAUGHTON, J. K., R.N., M.A., F.R.A.S., F.R.G.S.,
President Meteorological Society; Mathematical and Naval Instructor, Royal Naval College, Greenwich.

Council:

BUSHE, C. K., Colonel.

CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.M.S.,
Astronomer Royal, Royal Observatory, Greenwich, S.E.

GOEDECKER, F.

HOLMES, T. VINCENT, F.G.S.

PENN, JOHN, M.I.C.E.

WEBSTER, WILLIAM, Jun., F.C.S.

Honorary Treasurer:

BRABROOK, E. W., F.S.A., M.A.I.,
Barrister-at-law, Assistant Registrar of Friendly Societies for England.

Honorary Secretaries:

JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., F.G.S., &c.,
159, High Street, Lewisham.

YEO, JOHN, R.N., F.R.S.N.A.
Royal Naval College, Greenwich, S.E

REPORT OF THE COUNCIL

FOR THE YEAR 1882.

In presenting their Report, the Council are glad to be able to congratulate the Association on the continuance of its prosperity and usefulness.

Lectures of much interest and importance were delivered at the ordinary Evening Meetings held on the first Tuesday of the month, and were well attended by the Members and their friends.

Two Excursions took place during the Summer, the first to explore a Denehole in Jordan's Wood, near Dartford, the second, to visit the Royal Arsenal at Woolwich.

At the ordinary Meeting of the 2nd May, a Sub-Committee of the Association was formed in order to organize a systematic search for evidence of prehistoric man in the valley of the Ravensbourne.

The following are the Members of the Committee:—The Officers and Council of the Association, Col. Bushe, Mr. John Carline, Mr. J. Hammersley, Sir J. Lubbock, and Mr. F. C. J. Spurrell. Mr. E. W. Brabrook is Secretary.

At the ordinary Meeting of the 7th November, the President announced that it was the intention of the Essex Field Club to explore some of the Deneholes in Hangman's Wood, near Grays, and as it was probable that much information respecting the habits of prehistoric man would be derived from the investigation, he suggested that a sum of five pounds should be offered to the Club in aid of the work. The suggestion was approved by the Members generally, and the sum was voted by the Council.

At the spot on Blackheath where the Subsidence which was examined by the Association, occurred, a memorial plate has been laid down by the Metropolitan Board of Works. The inscription runs thus:—

SUBSIDENCE EXAMINED,
LEWISHAM AND BLACKHEATH
SCIENTIFIC ASSOCIATION,
1881.

The plate was placed there at the suggestion of Sir G. B. AIRY, and the cost was borne by the Board of Works.

Lewisham and Blackheath Scientific Association.

Treasurer's Report for the year ending 31st December, 1882.

Receipts.	£.	s.	d.
Balance brought forward from last year ...	11	12	4
Subscriptions received	51	9	0
Total ...	£63	1	4

Payments.				£.	s.	d
Hire of Room				10	2	6
Expenses of Lectures				9	4	0
Expenses of Excursion to Woolwich Arsenal				1	3	0
Printing and Stationery, 1881	£16	14	3			
" " 1882	14	15	1			
				31	9	4
Postage				2	9	1
Sundries					5	6
Balance				8	7	11
Total ...				£63	1	4

Examined and found correct,—THOS. H. LAVERS.
WILLIAM LAMB.

PROCEEDINGS, 1882.

TUESDAY, JANUARY 3rd.

A lecture was delivered by C. H. HUTCHINSON, Esq., on the "Domestic Fireplace: the advantages and disadvantages of the present form."

The Lecturer referred to the fact that in too many cases the open fireplace is wasteful and obnoxious:—it is wasteful because the heat produced in a room by the consumption of a given weight of coal is far less than that required by theory, and obnoxious because a large quantity of fuliginous products are evolved and sent into the atmosphere. He believed, however, that these drawbacks were capable of being overcome by a judicious application of fuel. The action of air in burning carbon was then considered, and the reaction between carbon and carbonic acid gas with the production of carbonic oxide, was illustrated experimentally. The properties of both these gases were next referred to, as was also the action of steam on heated carbon, by which the so-called "water-gas" is formed.

In all these reactions the most important fact for the subject under consideration is the generation of heat, and the way in which heat travels from the sun to the earth gives the clue to the most natural way of warming our rooms. Radiant heat can pass through air without warming it, and consequently we may feel warm in a room where the walls are warm although the air may be cool, and even feel cold in one where the air is warm and the walls are cold, on account of the radiation of warmth from our bodies. The great disadvantage of attempting to warm by hot air is due to the increased power of absorbing moisture which such air possesses. In order to obtain radiant heat in our rooms, it is necessary to establish considerable local heat, and such heat can be generated by the combustion of a non-volatile fuel such as charcoal, anthracite, or coke. Charcoal, as being too expensive in this country, is unsuitable. Anthracite, however, is certainly worth attention; that it generates heat locally is admitted by engineers, who complain that their bars are burned out without the production of enough steam. Coke is considered inferior to anthracite on account of its containing more ash, but is superior on account of its lower cost, and the fact that economy has already been effected by separating some valuable constituents during its preparation. The disadvantages attending the use of bituminous coal are twofold:—firstly, it contains volatile substances which absorb heat when assuming the gaseous state, and carry that heat away from the local centre, and secondly, because these volatile constituents are only partially consumed before going into the atmosphere, and therefore contribute to a dirtying of the air we breathe—a fact which is only too apparent in all large cities where coal of this character is employed. With regard to the difficulty of consuming anthracite or coke in houses, this cannot be insurmountable, as the use of anthracite is common in some parts of Wales, and in some cities in the United States. But, unfortunately, in a very large proportion of our English grates, the consumption of these fuels is difficult or impossible because the grates have only too often been made with a false economy in view, and with an utter disregard of the functions a grate should fulfil. Bearing in mind that a highly heated surface of carbon is the best means of attaining ample radiation in a room, the heat engendered by the fuel should, by a judicious employment of firebrick, or other nonconducting substance, be localised as much as possible. A brief consideration of the ordinary firegrate shows that these conditions have not been attended to, for instead of a preponderating employment of a non-conducting substance, we find a large use of iron—iron back, iron sides, iron grid, iron bars—in direct communication with the large surface of iron of which the whole front of the fireplace is made. By means of all this metal, heat is conveyed from the fire, and then given up to the large volume of air continually passing up the chimney. Nor are these the only drawbacks, for the fire is usually set so far back that a considerable proportion of the walls of the room never receive any of the radiant heat. A move in the direction of improvement has been made by the introduction of firebrick linings to the stoves, and by the use of polished steel cheeks. At the present time considerable progress is being made in the production of a more perfect grate. Three of the best forms of grate are the following :—1. Crane's patent grate for the use of anthracite and coke, an arrangement by which all the air passing up the chimney is made first to go through the fire. 2. For the partial diminution of the amount of smoke produced by bituminous coal, a simple plan has been devised in which the fuel is fed into the fire at the bottom. In this arrangement the smoke evolved, by passing through the layer of burning coal, becomes sufficiently heated to render its combustion at the surface more perfect. 3. Finally, there is the combination gas-and-coke grate, invented by Dr. Siemens. In this, the fire is lighted by turning on illuminating gas, which plays on a surface of coke ; this not only radiates very well under such circumstances, but increases the amount of heat evolved by reason of its own combustion. The special arrangement of the solid bottom of the grate so as to cause the air entering the fire to do so simply in front, and the application of the "regenerative" system by employing the waste heat from the back of the stove to heat the air thus entering, were illustrated by means of a grate constructed on this principle. The advantages of such a system are numerous,—the production of a non-smoking fire, economy, (the consumption of coke being about one-third that of coal, leaving, of course, an ample margin for the gas used), and trouble saved in lighting.

In conclusion, the Lecturer expressed the hope that before very long a large employment of gas for heating purposes would make our cities and towns healthier, and at the same time leave the time-honoured centre in every home—the open fireplace—not untouched, but improved in efficiency, and as cheerful as before.

TUESDAY, FEBRUARY 7th.

A lecture on "The Recent Progress of Anthropology at Home and Abroad," was delivered by E. W. Brabrook, Esq., F.S.A., F.S.S., F.R.S.L., M.A.I., Assistant Registrar of Friendly Societies for England, Treasurer of the Association.

The Speaker referred to the appeal made by Professor Flower from the Chair of the Department of Anthropology at the York Meeting of the British Association, for increased support to the Anthropological Institute. He pointed out that that appeal had been successful in two respects; it had led to donations of considerable sums of money, and to an accession of members to the Institute. In the opinion of the speaker, however, it was not in these directions that the means of further progress in anthropological study were to be sought. The Institute had funds, and the Anthropological Society which formed part of it had never been more active or more useful than when it had no funds, and was heavily in debt. The mere accession of members, of whom several were ladies, was in itself a source of weakness rather than of strength, for many anthropological subjects could not well be discussed in the presence of ladies. Of many savage people it might be said in the words of the young midshipman, "Manners they have none, and their customs are beastly." Here and there a lady might be found who was a serious anthropological student, but they were quite exceptional.

The real want of Anthropological Science in England was in another direction to which Professor Flower had also referred—the want of workers, of whom as he said "we may say we have not one." "A school is just what we have not and what we want." This led the speaker to refer to the School of Anthropology established by the late Professor Broca in Paris, and to the success which had attended the labours of that remarkable man. After a brilliant career as a medical student and officer of the State Hospitals, in the course of which he had published many valuable original memoirs, he founded the Society of Anthropology in 1859, of which he continued to be the central figure during the remainder of his life. Not content with this, he devoted his untiring energies to the establishment, in connection with the Society, of a School, a Laboratory, and a Museum, constituting together the Anthropological Institute in France. His services to science had the unique recognition of his election as a Senator of France, and in that capacity would doubtless have been followed by services to the State as memorable as that in which he saved the funds of the Hospitals from the cupidity of the Communard Government, had life been spared to him. The museum he founded has aptly been named the "Musée Broca."

The speaker proceeded to note some respects in which real anthropological work is even now being done in England; and specified that undertaken by the Anthropometric Committee of the British Association as satisfactory so far as it has gone, and giving promise of good results in the future.

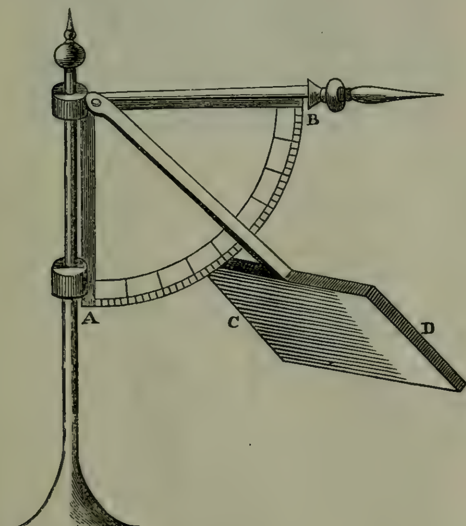
TUESDAY, MARCH 7th.

A lecture on "Communicable Diseases," was delivered by Dr. Armstrong, F.R.S., Sec. C.S., Vice-President of the Association.

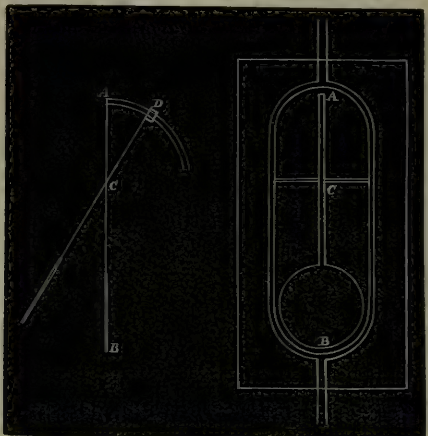
TUESDAY, APRIL 4th,

A Lecture on "Wind Force, and the way it is Measured," was given by J. K. Laughton, Esq., R.N., M.A., President of the Meteorological Society, Vice-President of the Association.

The force of wind must have been noticed from the very earliest times, and the men whose huts were blown down or whose boats were dashed to pieces had, beyond doubt, in all languages special names indicating the degrees of violence of a storm. But no attempt seems to have been made to measure this force till towards the middle of the 17th century. The first instrument of which we have any knowledge was mentioned to the Royal Society in 1667, by Dr. Hooke, who described it as used by seamen. It



consisted of a plate C D suspended by a bar from a pivot, and thus able to swing upwards along a graduated quadrant A B, the quadrant itself, together with the plate, turning freely, as a vane, on a vertical shaft. The same kind of thing has been reproduced since in many different forms, and closely corresponds with the swinging sign—"The Red Lion" or "The Dun Cow,"—such as may be seen commonly enough at the door of a country public house. One of the neatest instruments of this class was invented by Dr. Schmidt of Giessen, in 1828. A rod A B which has a

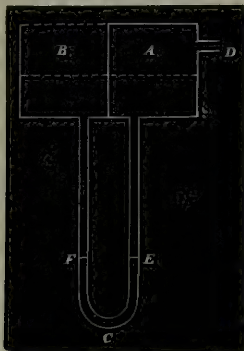


circular plate at its lower extremity, is pivoted at C about one-third of the way down. As it swings back before the wind, its upper end slides along a quadrant and pushes forward an index D, which remains to show the maximum effect of the gusts. In order to keep the plate face to the wind, the rod is pivoted at C in a light frame, which itself forms part of the spindle of a vane or weathercock, and turns with it. Another very pretty modification of the same principle is that introduced by Mr. Howlett in 1868: in this, a sphere, about the size of a child's head, takes the place of the plate, and is ready to catch the wind from whatever direction it may come. This sphere is at the upper end of a rod which is pivoted in the middle, on a universal joint, and bears a weight, as a sort of counterpoise, at its lower extremity. As it swings with the wind, a pencil traces the directions and extent of its motion on a slate or card placed below.

An instrument of this type is still used in Russia, for measuring the force of the wind. In this country, however, they have not been generally approved of, and the instrument by which "pressure" is here more commonly measured is a plate bearing back on a spring, in the same way as the machines for trying "how strong you are," which come on Blackheath every Easter Monday. The first of these, which was made about the year 1746, by M. Bouguer, in France, was simply a piece of card-board, 6 inches square, fixed perpendicularly across the end of a light rod which pressed into a tube against a spring. The observer was to hold it in his hand, present the face of the card to the wind, and notice the pressure as shown by the graduation of the rod. From this very primitive beginning has, in successive stages, been developed the instrument now used here, at Greenwich, and elsewhere. This was brought out by Mr. Osler, of Birmingham, in 1836; the principal improvement being the causing the pressure to act on a wire which passes down the spindle and registers its motion below. Instruments of this class are subject to a very serious objection, which is that the wind, as it blows past the edge of the plate, sucks away the air from behind, thus causing a partial vacuum, and permitting the pressure on the face of the plate to show too great an effect. No satisfactory attempts have been made to get the exact value of this error, which has been variously estimated, from something scarcely worth noticing up to nearly 100 per cent.: it probably lies between these two extremes, but it is impossible to say with any certainty what its amount really is. To do away with this source of error, the late Mr. Charles Cator, of Beckenham, adopted the device of filling in the back of the plate, which thus became the base of a cone, but whether the instrument, so modified, is indeed more trustworthy, has perhaps not been fully tried.

A totally distinct type of instrument is that by which the pressure is brought to act on a column of water, mercury, or other liquid in a glass tube. The first and simplest form of this was brought out by Dr. Lind in 1775, and consisted of a U tube, swinging freely on a vertical spindle, so as to form a direction vane: the tube nearest the spindle is bent at right angles so as to present its mouth to the wind, which, entering therein, brings pressure on to the surface of some water in the tube, forcing it up the other leg; the difference of level in the two tubes gives a measure of the force of the wind. The simplicity of this instrument renders it a favourite, but it is subject to the disadvantage of having an exceedingly contracted scale. To remedy this, various attempts have been made.

Of these, a very ingenious one was made by Dr. Wollaston early in the present century. A U tube C has its legs leading into A and B the two divisions of a box, of which A is air-tight, except as regards the opening D, whilst B is lightly covered. (Fig. 3.)



The lower part of the tube C contains water to the level E F, but the upper part of each leg contains oil, which reaches for some way into each of the divisions A and B. When the opening D is presented to the wind, the water is depressed at E and raised at F; but the head of water at F is partially balanced by the oil above E, so that it indicates a pressure corresponding, not to its own specific weight, but to the excess of its weight above that of the oil. In this way the scale was magnified some 10 times, but the simplicity of the original instrument was destroyed; and instruments of this type have not been received with any great favour.

All together, the difficulties in the way of satisfactorily measuring the pressure of the wind on a flat surface are so great that in this country they have been virtually given up. At the present moment there are probably not more than a dozen "Osler's Anemometers" actually fitted; certainly there are not more than twenty. What has been almost universally accepted is the endeavour to measure the velocity of the wind, and from the velocity to calculate the pressure. The leading feature of all velocity anemometers is a fan, which is turned round by the wind; the fan may be of different forms, resembling the sails of a windmill, or the paddle-wheel of a steamer; but that now adopted by general consent not only in England but all over Europe and America, is that form suggested by the late Dr. Robinson, and known familiarly as Robinson's Cups. It consists of four hemispherical cups or bowls, with their mouth vertical, carried on the arms of a horizontal cross which is fitted to turn on an upright spindle. Such a fan turns only in one direction, and with a velocity estimated to be one-third of the velocity of the wind. About this however there is very great doubt, and whether the register ought to be multiplied by 3, as it now always is, or by some smaller number, such as 2·5, has not been satisfactorily determined. The velocity of the wind can thus not be measured with greater accuracy than the pressure; and though the papers frequently say with great pretence of exactness, that the wind had a pressure of so many pounds, or was moving at the rate of so many miles an hour, it must be remembered that these measures are little better than guesses. The whole subject of anemometry is in a most unsettled and unsatisfactory state; to have a clear idea of how unsatisfactory it is, it is only necessary to read the evidence on the subject given before the Committee for enquiring into the causes of the Tay Bridge disaster. The attention of the public has been now fortunately aroused, and probably some energetic steps will be taken to arrive at a knowledge of the truth. Meantime, those of us who know most about it are perhaps the most painfully conscious of our ignorance.

TUESDAY, MAY 2nd.

A lecture on "Aërial Navigation" was given by FREDERICK W. BREAREY, Esq., Hon. Sec., Aëronautical Society of Great Britain.

In introducing the subject, the Lecturer remarked that he knew of no branch of science which was more worthy of the attention of Students, than Aëronautics. He then went on to speak of the interesting information which could be obtained from the study of the construction of birds, and from the observation of their flight. The belief that it is necessary to have, for aërial locomotion, gas which is lighter than the atmosphere, is an error. The resistence of a balloon to progress in the air, would be too great for satisfactory results, while any other shape than that of a balloon, would add too seriously to the weight for the matter to be worthy of consideration. It is found that birds are about four hundred times heavier than the air they displace, and if a fish were as heavy as platinum, it would be light in comparison with the bird in the air. The fish is able to make itself heavier or lighter, to a certain extent, and this is a quality that is absent from the balloon. At present, the power of ascending or descending cannot be obtained without loss of either ballast or gas, neither of which can be replaced.

The lecturer described the requisites of flight to be weight, surface, and force. He argued that if man could construct the necessary surface of strength sufficient to insure safety, he ought to be able to add, by the aid of engine power, sufficient velocity to obtain support on the atmosphere. There is no difficulty in imitating the flight of birds, as the mechanical action of the wing is not complicated.

Mr. Brearey looked forward with much hope to this question of bird-like flight, and considered that it was not so much power that was wanted, as a right application of it. After demonstrating the propelling action of a vertical screw, he went on to remark that there seemed to him a lack of the appearance of safety in any of the plans hitherto proposed in which gas was dispensed with. He had turned his attention to the parachute, and had invented what he termed a "Wave Action Aërial," which could carry a considerable weight in proportion to its surface. He exhibited this apparatus to the audience; it had a loose and rather extensive surface, and its flight exhibited a wave action similar to the movement of a skate in the water.

The lecture was illustrated by experiments with models of various forms and dimensions, illustrating flight by projection, by gravity, by screw action, and by wing action. The want of space considerably interfered with the experiments, but the models flew a sufficient distance to show the lecturer's intention, and their flight excited a good deal of interest.

SATURDAY, MAY 20th.

A party of Ladies and Gentlemen, conducted by F. C J. Spurrell, Esq., F.G.S., visited the Deneholes in Jordan's Wood, Dartford. One of these Chambers was entered and examined. It was nearly 50ft. across, and was reached by a shaft 2ft. 6in. in diameter, and rather more than 60ft. in depth. The shaft had been cut through the "Thanet Sand," but the Chamber itself was in the chalk. Foot holes, reaching from the top to the bottom of the shaft, showed how the former inhabitants of the cave ascended and decended. Part of the roof had in one place fallen in, and the *débris* formed a conical mound which covered about one-half of the floor. The proceedings of the day terminated with an excellent dinner at the Bull Hotel, Dartford.

THURSDAY, JUNE 27th.

A party, consisting of rather more than a hundred Ladies and Gentlemen, visited, by permission of the War Office, the Royal Arsenal at Woolwich. Several grand "operations," specially arranged for the Association, were exhibited. The processes of casting, rolling, and coiling large masses of iron, and the welding of a white hot coil for a gun of great size by means of the Nasmyth hammer, were shown. Guns in various stages of manufacture, and the numerous inventions and appliances for warfare, were exhibited. For the opportunity of seeing many of the great operations which took place that day, the Members feel much indebted to the kindness of Major C. D. Davies, of the Royal Gun Factory.

TUESDAY, OCTOBER 3rd.

A Lecture on "Early Man, or our Rude Forefathers," was delivered by the Rev. Brooke Lambert, M A., B.C.L., President of the Association.

The lecturer began by asking what remains would presumably be found of early man, supposing him to have existed in remote times. Man as he is now to be found, leaves behind him the indigestible parts of his food such as bones and shells, and the harder parts of his clothing such as buttons and ornaments. Precisely the same sort of remains of primitive man were found. Side by side with the weapons he used to kill the animals, were found their bones, sometimes split to get at the marrow, and later, traces of ornaments.

The weapons man used might be divided into three classes, which were found under different conditions. Roughly speaking *Palæolithic* weapons (unpolished) were found with river drift and cave man; *Neolithic* (polished) with the man of kitchen middens and tumuli; *Bronze* with man of the lake dwellings and of some cromlechs. If the bones of the men themselves were not so often discovered, that was because man bore but a small proportion, as regards bulk, to the mass of refuse which would accumulate during his life. He moved little in those days, but he probably did not die just where he lived.

The lecturer went on to prove the existence of early man from these weapons, both because they were found under the same conditions all over the world, and because the weapons showed traces of gradual development; and further because these weapons were still in use among savage tribes. Having quoted from Sir John Lubbock as to the habits of the Fuegians and Esquimaux, to show in what low estate man even now existed, the lecturer went on to show what traces of man's food and dress, at various times, could, in fact, be found. Investigation showed that man lived on animal food at first, on the beasts killed in the chase, or the fish caught in river or sea. It was not till very much later that traces of corn were found. Schoolcraft was quoted to shew that the Indians did not believe their *zea* (maize) to be indigenous. There was one sort of habit which seemed very terrible—cannibalism. It should be remembered however that even civilized men, under stress, similar to that under which primitive man lived, had been driven to this resort, and further that savages ate the bodies of warriors, in the hopes of partaking of their courage—the old and not the young were the subjects of cannibalism. The first form of dress was ornament—painting and tattooing, and adding rings to the nose, or wooden blocks to the lips. But these would leave no trace. Skins were much used for dress amongst savages, and special weapons for preparing skins were found with their remains. Having described the various forms of weapons, and their development, the lecturer remarked that stone weapons would be shown to have survived after the use of metal was known. We had stone hammers and hatchets prepared with metal tools. This was an instance of the common survival of custom. Men did not work metal at first, because fire was difficult to procure. It was only late in the history of man that fire was largely used. The story of Prometheus had its counterparts, showing that man at one time looked on fire as a supernatural gift. With fire came cooking by means of heated stones, baskets being covered with clay to hold water; the accidental baking of these vessels gave rise to pottery, which often preserved as an ornament the impression of the basket-work in which it was first made. The lecturer then proceeded to point out how man went from ornamentation to represent thought by written figures. The sculptures on the stones in Brittany were exhibited on diagrams, and though nothing like numerals was in the present state of knowledge represented, yet it was clear from the way in which celts, axes, &c., were arranged, that there was a desire to represent number. This was compared with the Indian census, in which each tribe, represented by the totem of its chief, had the numbers placed beneath that totem. An Indian love song, and a curious picture of a petition of five chiefs to the President of the United States with reference to the possession of certain lakes, showed the link between written and spoken ideas. Finally the lecturer described man's dwellings, and the imitation of natural caves, in wigwams, and tents, and of the mountains in which those caves were found, in tumuli and pyramids. The home of man was also his grave. In such buildings as Stonehenge, and in the more extensive remains found at Carnac, and throughout the peninsula of Morbihan, the lecturer fancied he traced the prophecy of Egyptian architecture—long lines of stones leading up to a central monument. Connecting this with the undoubted use of tumuli and cromlechs for burial, the lecturer saw in these the expression of man's desire for immortality. As with the dead man were buried his ornaments, and sometimes his wife (Suttee), as with the woman was sometimes (nowadays) buried her child, so in the externals, men sought to represent their belief that the fame of the warrior would be as great as the large monuments of Brittany, and they made their monuments grand in proportion to their love and respect for the deceased.

At the conclusion of the lecture, Mr. F. C. J. Spurrell, F.G.S., made some remarks on the method of making flint weapons, and exhibited, in illustration of the manufacture, a collection of palæolithic and neolithic knapping tools, hammers, and flakes, as well as some imperfect and perfect hâches, &c.

TUESDAY, NOVEMBER 7th.

A short account of the great Comet of 1882 was given by the Astronomer Royal, W. H. M. Christie, Esq., F.R.S., V.P.R.A.S., Member of the Council of the Association.

The great Comet of 1882 was first observed by Dr. Gould, of Cordoba, on Sept. 6th. It was also discovered independently by Mr. Finlay at the Cape on Sept. 8th, in Australia on Sept. 9th, and by Mr. Common at Ealing on the 17th. In the Southern Hemisphere a number of satisfactory observations of its position were obtained before the perihelion passage on Sept. 17th.

The Comet seems to be pursuing very nearly the path of that of 1843, and that of 1880, though so quick a return of the Comet of 1880 seems hardly to be reconciled with the orbit of that comet. It is, however, just possible that in its near approach to the Sun, the Comet of 1880 was so entangled in the solar atmosphere that its path was changed to one of short period. It passed within about 300,000 miles of the surface of the Sun (two-thirds of the Sun's radius), and must in consequence have experienced considerable retardation. The Comet of 1843 also passed very close to the Sun, and it is not improbable that it broke into two fragments—that known as the Comet of 1880 and that of 1882. The determination of the orbit of the Comet of 1882 has been attended with great difficulties, owing to its proximity to the Sun when in perihelion.

A small companion Comet was subsequently discovered by Schmidt at Athens on Oct. 9th, and seen on the two following days, after which it disappeared; it was very much smaller than the large Comet, and as it was only 3 or 4 degrees distant, and was travelling on nearly the same track, it was probably a portion which had been thrown off from the great Comet.

It is difficult to conceive what would be the effect of the Sun's heat upon the Comet at perihelion, it probably would to a great extent dissipate the nucleus into vapour, giving rise to the remarkably bright tail. The spectrum, when first observed soon after perihelion, showed the lines of sodium, and afterwards the ordinary cometary bands of the hydrocarbon flame. The sodium lines are now absent, while the hydrocarbon remain. On the morning of the 23rd October, when the Comet was remarkably brilliant, the tail must have been upwards of 70 million miles in length. It is of interest to know whether we shall see this Comet again, and this at present cannot be stated as a certainty. It is not unlikely that it will be a conspicuous object for two or three months; it will then be seen earlier in the night, and be more conveniently placed for observation.

Then followed a Lecture on "The Transit of Venus," by E. W. Maunder, Esq., F.R.A.S., Royal Observatory, Greenwich.

The Lecturer commenced by remarking on the great importance attaching to the determination of the Sun's distance. So long as that was unknown, we did not know the distance, size, or weight, of a single astronomical body with the exception of the Moon. But if that could be ascertained, the dimensions of the solar system, and of its members, were known at once; and it was even possible in a few cases to make a rough approximation to the distances of the stars. It was the high importance of this problem which made astronomers take so much interest in a Transit of Venus, for this occurrence offered a means—at one time the best means—for obtaining its solution. And an especial interest attached to the Transit of the 6th of December, 1882, since it was the only Transit which would be visible in this country during a period of 235 years, and it would probably be the last which would be employed for the determination of the Sun's distance, as there could be no doubt that long ere the next in 2004, a more accurate result than this method could afford, would have been already attained in a different way.

The principle involved in the determination of the distance of a celestial object, like the Moon, in no way differs from that upon which a surveyor bases his determination of the distance of some inaccessible object. Just as he takes the bearing of the object from each end of a measured base line, so the astronomer takes the bearing of the Moon from two observatories, say at Greenwich and at the Cape, whose distance apart he already knows. In this way the distances of the Moon, of Mars, and of some of the minor planets, have been ascertained. But there are difficulties in the way of observing the Sun, which prevent the method being directly applied in its case. Since, however, the *proportions* of the distances of the Sun, and of the various planets, are well and accurately known, to ascertain the distance of one is to ascertain those of all; and not a few astronomers consider that the best method of obtaining the Sun's distance is first to find that of Mars, or of a minor planet, and then to infer from it that of the Sun.

Venus, however, comes much nearer to us than does Mars or any other planet, but as she turns her dark side towards us at her nearest approach, she is invisible unless she is seen on the bright background of the Sun. The lecturer then explained the laws regulating the recurrence of Transits, and showed that they must happen either in June or December, and at intervals of 8, 105½, 8, and 122½ years; the same intervals then occurring over again.

The most direct method for utilising a transit is as follows:—The following facts are already known—the *proportion* which the distance of Venus from the Earth bears to the distance of the Sun, the *proportion* the diameter of the Sun bears to its distance, and the actual size of the Earth. If then, Venus is watched from two stations on the Earth, the distance between the two positions which she seems to occupy on the disk of the Sun, will bear a known proportion to the distance between the stations. Thus, if the stations on the Earth were 7,000 miles apart, the positions which Venus appeared to occupy would be 18,000 miles apart. It is only necessary to measure the proportion this distance bears to the whole diameter of the Sun, to arrive at the true value of the latter; and the diameter of the Sun known, its distance can be readily inferred. But in practice it is difficult to measure the position of Venus on the Sun, indeed until the invention of photography it was impossible to do it with the requisite accuracy. Photography, though enabling us to compare the observations made at different stations with the greatest ease, has yet its own peculiar difficulties and drawbacks, and though the American astronomers place great reliance on the method, English astronomers are as a rule disposed to regard it as inferior in precision to the methods which were used in the Transits of last century.

The first of these, called Halley's method, depends on the fact that Venus as seen from some stations must seem to pass along a shorter line on the Sun's disk, than when seen from others. The Transit, therefore, does not take so long a time when seen from some places as from others. The earth's rotation also makes Venus seem to travel more quickly, as viewed from some places, than from others; and it is often possible to choose stations such that both causes work the same way. In this case, if the duration of the Transit be carefully noted at each station, the difference between these intervals would, by the proportion it bears to the whole duration, give a means of determining the proportion between the distance separating the two apparent paths of Venus, and the entire diameter of the Sun, the very thing sought to be accomplished by direct measurement in the photographic method. The other, or Delisle's method, depends on the fact that the Transit seems to begin or to end at different times when viewed from different places, and the differences of the times of the planet's entering on or leaving the Sun's disk are used in a somewhat similar manner as the differences of durations on Halley's method, to give the needed proportion.

Both methods depend therefore for success on the accuracy with which the time of Venus's entry on and exit from the Sun's disk can be determined. Unfortunately, a good deal of difficulty is experienced in making this determination, partly owing to what is known as the "black drop."

The evening now being far advanced, the lecturer was obliged to curtail the remaining portion of his paper, and after some illustrations of the "black drop," and of the English and American photoheliographs, had been thrown on the screen, he concluded by giving a list of the various values which had been obtained for the Sun's distance, showing how closely they all clustered around $92\frac{1}{2}$ millions of miles, despite the very different methods by which they had been obtained.

TUESDAY, DECEMBER 5th.

A lecture on ' Portable Timekeepers," was delivered by Edward Rigg, Esq., M.A., Royal Mint.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

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Lambert, Carlton J., M.A., F.R.A.S., M.P.S., Professor of Mathematics, Royal Naval College, Greenwich, S.E.
Lambert, Rev. Brooke, M.A., B.C.L., Vicar of Greenwich; The Vicarage, Greenwich, S.E. (*President*).
Laughton, John Knox, R.N., M.A., F.R.A.S., F.R.G.S., Pres. Meteorological Society, Mathematical and Naval Instructor, Royal Naval College, Greenwich, S.E. (*Vice-President; President 1880*).
Lavers, T. H., 12, Belmont-hill, Lee, S.E.
Legge, Rev. Hon. Augustus, M.A., Vicar of Lewisham, Lewisham, S.E.
Leunig, F., 31, Belmont-hill, Lee, S.E.
Lockhart, William, F.R.C.S., 67, Granville-park, Lewisham, S.E.
Lotz, W. F., The Hollies, Avenue-road, Lewisham, S.E.
Low, Edwin, Aberdeen-house, Blackheath, S.E.
Lubbock, Sir John, Bart., M.P., F.R.S., High Elms, Farnborough, Kent.

Marten, Rev. R. H., B.A., 53, Blessington-road, S.E.
Midwinter, E. J. H., F.I.C., Woodlands, New Barnet.
Mc Craken, Robert, Fareham-lodge, Slaithwaite-road, Lewisham, S.E.
Morris, Henry, 4, Belmont-hill, Lee, S.E.

Newman, Arthur, 1, Carlton-road, Brockley, S.E.

Ord, C. Knox, M.D., F.L.S., The Limes, Lewisham, S.E.

Pearce, E. R., 76, London-street, Greenwich, S.E.
Penn, John, M.I.C.E., Greenwich, S.E. (*Council*).
Penn, T., Grove-house, Lewisham, S.E.
Phillips, Edward, Athena-house, Morley-road, Lewisham, S.E.
Pitter, Joseph, 5, Bonfield-road, Lewisham, S.E.
Potter, Edwin J., Courthill-villa, Courthill-road, Lewisham, S.E.
Potts, William, 34, Limes-grove, Lewisham, S.E.
Powell, Rev. Arthur H., B.A., 6, Park-place, Greenwich, S.E.
Price, John Edward, F.S.A., M.R.S.L., 60, Albion-road, Stoke Newington, N.
Purvis, Prior, M.D., Lansdowne-place, Blackheath, S.E.

Reed, Fred. H., 10, Belmont-hill, Lee, S.E.
Ritchie, J. H., Cedar-bank, Hyde-vale, Greenwich, S.E.
Robinson, Henry, Eliot-park, Blackheath, S.E.
Robinson, Rev. E. C., Thornleigh, Catford Bridge, S.E.
Rome, William, The Red-lodge, Putney, S.W.
Roper, Arthur, M.R.C.S., Lewisham-hill, S.E.
Rudd, Charles, R.N., 6, St. Thomas's-terrace, Charlton, Kent.
Rudd, Rev. Thomas, Congregational College, Lewisham, S.E.

Sampson, James, Phœnix-villa, Morley-road, Lewisham, S.E.
Saunders, H. S., 36, Lee-terrace, Lee, S.E.
Saunders, Martin L., 36, Lee-terrace, Lee, S.E.
Saundry, Dr., Royal Kent Dispensary, Greenwich, S.E.
Short, Frederick Hugh, 1, Marlborough-road, Lee, S.E.
Simpkinson, Rev. C. H., B.A., Holy Trinity Vicarage, Greenwich, S.E.
Smale, G., Ormond-house, Granville-park, Lewisham, S.E.
Smith, Henry Francis, Slaithwaite-road, Lewisham, S.E.
Smith, Niemann, 87, Granville-park, Lewisham, S.E.
Smith, W. Johnson, F.R.C.S., Surgeon to the Seamen's Hospital, Greenwich, S.E.
Spurrell, F. C. J., F.G.S., Belvedere, Lessness Heath, Kent.
Stanley, J. H., Napoleon-cottage, Rushey-green.

Tate, H. T., 1, Leicester-villas, Thornford-road, Lewisham, S.E.
Taylor, A. H. S., 9, Essex-villas, High-road, Lee, S.E.
Thomas, Rev. T. W. Embleton, M.A., Maze-hill-school, Greenwich-park, S.E.
Turner, Neville, 8, Ringstead-road, Catford.
Tustin, J. J., 9, Paragon, Blackheath, S.E.

Waghorn, J. W., B.Sc., F.R.S.N.A., Instructor in Physics, Royal Naval College, Greenwich, S.E.
Watchurst, Charles, 33, Blessington-road, Lee, S.E.
Webster, W., Jun., F.C.S., Wyberton-house, Lee-terrace, Lee, S.E. *(Council.)*
West, Rev. Thomas J., M.A., College-park, Lewisham, S.E.
Westrup, W. E., 20, Dartmouth-terrace, Lewisham-hill, S.E.
Whomes, Robert, Brook-house, Lewisham. S.E.
Wilson, Edward, 59, Lee-park, S.E.
Wiltshire, Rev. Thomas, M.A., F.G.S., F.R.A.S., F.L.S., &c., Professor of Geology and Mineralogy, King's College; 25, Granville-park, Lewisham, S.E.
Wire, Travers B., May's-buildings, Crooms-hill, Greenwich, S.E.
Wolffgang, Ernest, Greenbank, Queen's-road, Forest-hill, S.E.

Yeo, John, F.R.S.N.A., Lecturer on the Steam Engine, Royal Naval College Greenwich; Kingswood-lodge, Lewisham-road, S.E. *(Honorary Secretary)*

H S Richardson.
Greenwich.

FIFTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

Scientific Association.

PROCEEDINGS

1883,

AND

LIST OF MEMBERS.

Greenwich:
H. S. RICHARDSON, STEAM PRINTING WORKS,
CHURCH STREET.

FIFTH ANNUAL REPORT

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CHURCH STREET.

LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 7th January, 1884.

President:

LAUGHTON, J. K., R.N., M.A., F.R.A.S., F.R.G.S.,
President Royal Meteorological Society; Mathematical and Naval Instructor, Royal Naval College, Greenwich.

Vice-Presidents:

ARMSTRONG, Dr. HENRY E., F.R.S.,
Sec. Chemical Society.

LAMBERT, Rev. BROOKE, M.A., B.C.L.,
Vicar of Greenwich.

Council:

BUSHE, Colonel C. K.,
Member Royal Institution.

CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc.,
Astronomer Royal.

GOEDECKER, F.

HADDON, A., M. Phys. Soc.

HOLMES, T. VINCENT, F.G.S.

PENN, JOHN, M.I.C.E.

Honorary Treasurer:

BRABROOK, E. W., F.S.A., M.A.I.,
Barrister-at-Law, Assistant Registrar of Friendly Societies for England.

Honorary Secretaries:

JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., F.G.S., &c.,
159, High Street, Lewisham, S.E.

SAUNDERS, MARTIN L.,
36, Lee Terrace, Lee, S.E.

REPORT OF THE COUNCIL

FOR THE YEAR 1883.

In presenting their Report, the Council congratulate the Members on the continued prosperity of the Association.

Lectures of a high character have been delivered at the ordinary Evening Meetings held on the first Tuesday of the month, and the attendance of the Members has been good.

For the Summer Excursion a visit to the Royal Mint was arranged. Sixty Members and friends availed themselves of the permission to see the operations there; but as more than twice that number applied for tickets, some disappointment among those who were unable to go, was unavoidable.

The Sub-Committee which was formed for the purpose of organising a systematic search for evidence of Pre-historic Man in the Valley of the Ravensbourne, has to report that the cuttings and gravels in this district have been carefully examined by some of the Members, but as yet without result. As there is every prospect, however, that important excavations in the gravel-beds of the neighbourhood will be made during the ensuing year, the Council recommend that this Sub-Committee be re-appointed, and that the Members of the Association generally should bear the subject in mind, and assist the Committee with information of any projected disturbance of the soil, or of any discoveries independently made, that may come to their knowledge.

The question of whether and to what extent the British Association might be made a connecting link between the numerous Scientific Societies scattered over the country, has been much agitated for the past few years at the Meetings of the Association; and in 1882 a Select Committee was appointed to consider, in detail, the various suggestions which had been offered. At the invitation of that Committee, the Council requested Mr. Laughton, one of our Vice-Presidents, to represent this Society at the Meeting of the British Association at Southport. Mr. Laughton accordingly attended the Conference of Delegates held on the 21st September; and at our October Meeting reported that the Conference had unanimously accepted the rules and conditions of affiliation which were submitted to them by the Select Committee. These rules do not in any way interfere with the perfect freedom and independence of each Society; whilst they will, it is hoped, enable all to receive strength and support from each other and from the British Association itself. An interesting paper by Mr. Meldola, of the Essex Field Club, suggesting that the pre-historic remains of Britain should be systematically investigated by the several local Societies, appropriately closed the proceedings of the Conference.*

Though the Meetings of the Association continue to be well attended, it should be borne in mind that in a neighbourhood like this, removals of Members are frequent, and the Council would be glad to be supplied from time to time with the names of suitable candidates. They therefore suggest to their brother Members the desirability of pointing out to such of their friends as would be likely to appreciate them, the advantages which the Association offers.

* This paper is printed *in extenso* in "Nature," 1st Nov., 1883.

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the Year ending 31st December, 1883.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance brought forward from last year ...	8	7	11	Hire of Room	10	0	0
Subscriptions	64	1	0	Expenses of Lectures	15	16	4
				Printing and Stationery	18	8	8
				Postage	3	13	11
				Sundries		1	6
				Balance	24	8	6
Total	£72	8	11	Total ...	£72	8	11

Examined and found correct, January 4th, 1884,—THOS. H. LAVERS
ALBERT LEWIS GUY.

PROCEEDINGS, 1883.

LIST OF OFFICERS AND COUNCIL FOR 1883.

President:

LAMBERT, Rev. BROOKE, M.A., B.C.L., *Vicar of Greenwich.*

Vice-Presidents:

ARMSTRONG, Dr. HENRY E., F.R.S., Sec. C.S.
LAUGHTON, J. K., R.N., F.R.A.S., F.R.G.S., Pres. R. Met. Soc.

Council:

BUSHE, C. K., Colonel, M.R.I.
CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc., *Astronomer Royal.*
GOEDECKER, FRANZ.
HOLMES, T. VINCENT, F.G.S.
PENN, JOHN, M.I.C.E.
WEBSTER, WILLIAM, Jun., F.C.S.

Honorary Treasurer:

BRABROOK, E. W., F.S.A., M.A.I.,
Barrister-at-Law, Assistant Registrar of Friendly Societies for England.

Honorary Secretaries:

JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., F.G.S., &c.
YEO, JOHN, R.N., F.R.S.N.A.

TUESDAY, FEBRUARY 7th.

I.—An abstract of a paper entitled "Monthly Means of the Highest and Lowest Diurnal Temperatures of the Water of the Thames, and Comparison with the corresponding Temperatures of the Air at the Royal Observatory, Greenwich," by Sir GEORGE BIDDELL AIRY, K.C.B., F.R.S., late Astronomer Royal, was presented by the Author.

It consisted of a partial reduction of the thermometrical observations made in the water of the Thames during a period of thirty-five years. The self-recording instruments were attached to ships which were anchored in the Thames, nearly opposite Greenwich, and the thermometers were read every day at 9 a.m. The following appear to be the legitimate inferences:—

(1.) The Mean Temperature of the Thames water is higher than that of the Observatory thermometers by 1°·5. But the locality of the Observatory thermometers is about 160ft. above that of the Thames thermometers. It would seem probable, therefore, that the mean temperature of the water is higher than the climatic temperature by only a small fraction of a degree.

(2.) This difference is not uniform throughout the year. With some irregularities, the greatest excess of Thames temperature occurs in October and the least in February.

(3.) The mean range of temperature during the day is 2°·1.

(4.) The material water is very little changed at Greenwich by the tide. Although a vast body of water rushes up at every flow, running with great speed, and sometimes raising the surface by 20ft., yet nearly the same water runs down at ebb, and is again brought up, with all its contents, at the next flow. These expressions are to be taken as modified by the descent of fresh water from the land; but the amount of that water must be small in comparison with the mass which it joins in the Thames at London.

(5.) The author did not imagine that the tidal action had any beneficial effect on the climate of London, except that probably the agitation of the water produced mechanical agitation of the air, and thus destroyed injurious stagnation.

II.—A Lecture was then delivered on "The Sun, its Origin, History, and Future," by Henry Walker, Esq., F.G.S.

The Lecturer said that the topic seemed not only novel but audacious; but we live in the days of the new astronomy, and there is evolution in astronomy as certainly as there is in biology. The new astronomy had its origin in the Spectroscope, and Wollaston, Fraunhofer, and Kirchhoff paved the way for our present conception of the universe. By means of the Spectroscope, Dr. Huggins was enabled to state the true nature of the nebulæ. He rehabilitated the nebular hypothesis, which was first enunciated by Kant, and which had fallen into disfavour owing to the erroneous inferences of Lord Rosse from what he had seen in his great reflecting telescope.

A nebula is a shining mass of mist—the rudimentary stage in the formation of a star. At first it is shapeless, but it contains potentially the suns and planets of the future. When a nebula presents a spiral form an advance has been made. A still further advance is exhibited when the nebula exhibits a globular appearance. Some of the more rudimentary of the nebulæ show in the Spectroscope the lines of hydrogen and nitrogen.

The Sun's distance from the earth is about 93 millions of miles, and his bulk is so great that he is able to influence the distant stars; α Centauri is at a distance of 200,000 times that of the earth from the Sun, and yet, unless that star were moving in a direct line at the rate of 200 miles an hour, it would be drawn towards the Sun.

When the Sun is eclipsed, a bright halo is seen around it, and this is called the "Corona." This is composed of meteoric or nebular matter. Underlying the Corona, and closely covering the bright surface of the Sun, is the "Chromosphere," which consists of coloured glowing gas. The coloured projections from the Chromosphere are known as the "Prominences," they can readily be seen by means of a spectroscope of considerable power.

The general surface of the Sun is not of uniform brightness, it appears to be mottled and dotted here and there with bright portions which are called "Faculæ," and dark portions which are known as "Sun Spots." Sun spots are usually preceded by faculæ; they travel, not on the equator, but to the north and south of it, and they are not found near the poles. When a spot is examined in the spectroscope, it is seen that the lines of Fraunhofer broaden out, as if the dark centre of the spot were a cooler portion than the Sun's surface. Some spots exhibit a rapid movement of rotation; a solar cyclone with a velocity of 166 miles per second has been witnessed. Not only is the earth travelling round the Sun, but the Sun itself is moving, and carrying all his attendant planets and their satellites to a distant part of the heavens. The actual path of the earth in space is a "skew spiral."

It is now possible to classify the stars in the heavens according to their age. The white stars, such as Sirius and Vega, are those in vigorous youth, the yellow stars are of middle age, and the red stars are declining and cooling down.

Stars are liable to accidents. Of late years, two stars, one in Corona Borealis and one in Lyra, have suddenly blazed up and become much brighter and more conspicuous than they ordinarily were. The spectroscope shows that this catastrophe has been due to blazing hydrogen, with which the star has been enveloped.

There are some reasons for believing that the Sun is a variable star, the variability being due to sun spots.

TUESDAY, MARCH 6th.

A Lecture on the "Transmission of Power" was delivered by Robert M. Walmsley, Esq., B. Sc., F.C.S.

From remote antiquity the Transmission of Power has been looked upon as a matter of extreme importance. In very early times Energy was applied in the construction of immense buildings and monuments, and huge stones were frequently transported from considerable distances.

The power of doing work is known as "Energy." The energy of a moving body, as for example, a cannon-ball fired from a gun, is known as "kinetic" energy. Air in motion and water in motion are forms of this kind of energy, and both are traceable in their origin to the sun. Another form of energy is that of a raised weight, it is known as "potential" energy, or the energy due to position. When the raised weight is allowed to fall a certain amount of work is effected. The head of water of a water-fall, and a full tide are examples of this form of energy.

Energy is derived from the combustion of fuel, from chemical action, and from the oxidation of food in the body of animals. An experiment was shown in which chemical action produced a current of electricity; this current was made to raise a weight, and the same amount of electricity decomposed water into its two constituents, hydrogen and oxygen.

Energy is indestructible, although it may be transformed into various modes of action,—mechanical energy, radiant energy, electricity, chemical energy, &c. Coal, by the heat it evolves, is able to generate mechanical effect. The energy of coal again is derived from the sun, for in byegone ages the energy of the sun's rays was stored up in vegetables, and these subsequently became converted into coal. The "head of water" is clearly traceable to the same source—water is raised by the sun in a state of vapour, clouds are formed, and rain falls upon hills and high ground. Here is a raised weight. The energy of the tides is not from the same source.

The Lecturer mentioned five methods of transmitting power: (1) man, (2) ropes, (3) water, (4) air, and (5) electricity.

Man's work is usually directive. It is only when very large numbers of men are employed that their work is at all efficient. Most of the potential energy of man's food is converted into heat of low temperature.

Ropes which run on pulleys fixed on the ground are sometimes used in Germany. But there is much friction, and, as a source of power, the method is costly.

Water is an agent much more frequently employed. It is dammed up where it is required, and the fall of the water is the source of the energy. The chief advantage of water lies in its incompressibility, hence, any pressure can be transmitted, and there is no danger of an explosion. In mountainous districts it is cheap and largely used. In Hull there is a Water Company which supplies water at a pressure of 700lbs. to the square inch. The disadvantages of water are the friction which is set up where it has to be sent to long distances, and the strain to which pipes are subjected with every variation of pressure.

Air is used in the air-break by which a train is brought to a standstill, and as compressed air in excavating tunnels and in driving tramcars. Its disadvantage lies in its compressibility—

owing to this quality it becomes seriously heated during compression.

Electricity. The cheapness with which electricity can be generated will doubtless shortly render this an agent commercially suitable for transmitting energy; for owing to the invention of the dynamo, which is a machine which turns mechanical energy into electricity, and which, by reversion, converts electricity into mechanical energy, very little energy is wasted. The principle upon which this conversion depends, is a movement of coils of copper-wire in a magnetic field: when a coil is moved in a magnetic field a current is established, and this can be made available for the conveyance of electrical energy to a distance. The usual source of energy for driving a dynamo is coal or gas. The wires which pass from the dynamo are distributed on either the parallel or the continuous system. In the parallel system there are two wires connecting, and wires pass from one to the other through lamps or motors as may be required. In this case a large quantity of electricity with a low electro-motive force is wanted. In the continuous system a continuous wire is passed through a series of lamps and motors, and in this case a smaller quantity of electricity with a higher force is necessary. Electric currents can also be derived from a battery, from an accumulator which is a form of battery, and from heat. When a current passes along a wire, the wire becomes heated to an extent which depends upon the resistance to the passage of the electricity. In the case of large currents the heating becomes very serious indeed. This is diminished by driving the machine at a high speed. If we are to have a large quantity of work done we must use a high electro-motive force, as we thus get the greatest efficiency. But there is danger to life in these high electrical pressures, and it is here that the use of secondary batteries, or accumulators, comes in. An accumulator is a cell consisting of lead plates which have been coated with oxide of lead. A current of electricity is passed through the cell, the electrical energy in motion is converted into chemical energy at rest, and this remains until it is called forth when wanted to be transformed into electrical energy.

The chief cause of loss of power in the working of all machines is friction of the bearings or of other parts.

TUESDAY, APRIL 3rd.

A Lecture was delivered on "The Conservation of Energy in Organic Nature," by W. Lant Carpenter, Esq., B.A., B.Sc., F.C.S.

The doctrine of the Conservation of Energy is one of the grandest generalisations of modern physical science. The first treatise on the subject was by Sir W. Grove, and the first hint that the doctrine was applicable to the organic world came from Dr. Mayer.

The Lecturer first glanced at its applications in the physical world. Energy is the "power of doing work," and the various forms of energy, such as mechanical energy, electrical energy, and so on, are interchangeable; each can be converted into any other, either immediately or mediately. Energy is never diminished in amount, nor is it increased. The energy of a railway train, when brought suddenly to a standstill, is not lost; it is converted into heat.

Under the influence of the "radiant energy" of the Sun, the cells of plants decompose the carbonic acid of the air, appropriate the carbon for their own growth, and set free oxygen. At the same time the root-cells absorb water, as well as the mineral matters ammonia, phosphates, &c., dissolved therein. The energy thus appropriated is stored up, and when the wood and resin in the plant are burned, it is recovered in the shape of light and heat. Coal is the remains of huge forests of trees which grew many ages ago. It is even now forming in the "Great Dismal Swamp" in Virginia, U.S.A., and in other parts of the world.

A broad distinction between animals and plants is that animals cannot (as plants do) derive their food from carbonic acid, ammonia, and water; they require to have these substances decomposed for them, and elaborated into food-compounds, by plants. Heat is necessary to maintain the vital processes of a warm-blooded animal; death by starvation is really death from cold. Man's food consists essentially (1) of starch, sugar, &c.; (2) of fats and oils; and (3) of albuminoids, such as the gluten of bread, the fibrin of meat, and the casein of cheese. The first and second of these classes contain carbon, hydrogen, and oxygen only, the other contains nitrogen in addition. Very recent physiological researches have clearly shown that the amount of work done in the animal body, both in keeping up its own internal heat, and in exerting energy outside it, is entirely due to, and varies with, the complete combustion of the carbon and hydrogen only contained in its food, by means of the oxygen inhaled in breathing; and that it does not depend upon the oxidation of muscular tissue, or of the nitrogen in nitrogenous food. Nitrogenous food apparently simply increases the oxidative power of the tissues of the body.

Work is measured in what are called foot-pounds—a pound weight raised to the height of a foot is known as a foot-pound. A good day's work for an average man is about 1,085,000 foot-pounds, or 484 tons raised to the height of one foot. The average daily need of the adult body is 4,900 grains of carbon and 300 grains of nitrogen. By the respiration of each adult, about 8oz. of solid carbon, in the form of carbonic acid, is thrown off daily.

Animals then exhale the substances which are necessary for the food of plants, while plants prepare from these substances what is necessary for the respiration and food of animals; and thus the balance of Organic Nature is maintained.

In man, muscle is the instrument by which the transformation of energy is accomplished, not the material which is itself transformed; and although muscle acts under the direction of the will, it does not derive its power of acting from the will any more than a steamboat derives its power of motion from the steersman.

Reviewing the relations between the various forms of Energy in nature, we see:—(1) That where one is excited or exists, many others are also set in action; hence, probably, all are modes of motion; (2) That any one can be transformed either directly, or by intermediate steps, into any other; and (3) That none of them can be produced but by some other as an anterior. We also see that they act uniformly, *i.e.*, according to fixed laws. The term "Law of Nature," in its scientific sense, is simply the expression of the ordinary uniformity with which certain sets of phenomena occur, In all phenomena, the more closely they are investigated, the more are we convinced that neither matter nor energy can be created or annihilated.

TUESDAY, MAY 1st.

A Lecture on "Heating and Cooking by Gas," was delivered by Dr. H. E. Armstrong, F.R.S., Sec. Chem. Soc.

Gaseous fuel, such as ordinary coal gas, has both its advantages and disadvantages from a domestic point of view. Thus it may be burnt without the production of smoke or dust; a gas fire may be lit at any moment, whenever required; it entails no labour; it need not be kept burning any longer than is requisite; and it attains its full efficiency very soon after it is lit. But it is very costly in comparison with coal or coke, and its use undoubtedly involves the exercise of more intelligence than is commonly displayed in burning coal.

Coal gas chiefly consists of hydrogen and marsh gas mixed with carbonic oxide and small quantities of hydrocarbons (compounds of carbon with hydrogen), which are the main source of its illuminating power. When allowed to burn freely in the air, its constituent gases undergo complete combustion, water and carbon dioxide (carbonic acid) being formed; but if the air supply be insufficient, or even if an ample supply of air be provided and the gas be burnt under a cold surface, such as that of a metallic vessel containing water, the combustion is always more or less incomplete, and carbonic oxide and acetylene are formed. These two last-mentioned gases are highly poisonous; their production in this way has led to not a few fatal accidents and has involved illness probably in very many unsuspected cases. The so-called "Geysers" are specially dangerous, and the statements often made by vendors that in their stoves the combustion is complete should not be believed. Hence, gas should never be used for heating purposes unless efficient means be taken to carry away the products of combustion, and under no circumstances should a gas stove be used unless provided with a flue. In order to secure efficient ventilation of bath rooms, &c., it is not only necessary to provide an exit; an inlet for fresh air must also be provided, otherwise the supposed exit will rarely act but as an inlet.

Various forms of gas heating stoves were referred to, and it was pointed out that the chief defect in all arose from the difficulty of heating a sufficiently extensive surface to bright redness by a moderate amount of gas; hence the low efficiency of all gas stoves. Fletcher seeks to recover some portion of the heat carried away by the products of combustion by passing these through a chamber traversed by tubes open above and below; the air from the room in its passage through these tubes becomes heated, so that the heating is effected by this stove partly by means of hot air and partly by radiant heat; fresh air may be admitted from outside to the tubes.

Gas cooking stoves are economical because they need not be used a moment longer than is necessary. In the majority, the gas jets are so arranged as to bake the food; in a few, however, the cooking may be effected as in the case of an ordinary fire by radiated heat: in fact, a joint may be roasted, and there is reason to believe that this is the better method. In all cases, when gas is used for cooking, a regulator should be attached to the meter or stove; this is not only desirable on the score of economy, but mainly because it is then possible for the cook so to arrange that the stove is heated to practically the same temperature at various times of the day, and day after day, by merely turning on the supply tap to the same extent. Although it is essential when using a gas stove to be more watchful, as the temperature so much depends upon the rate at which the gas is burnt, a far better opportunity of obtaining even results is afforded by a gas stove as compared with a coal fire; and it is to be hoped that ladies will avail themselves of the opportunity and more fully investigate the subject of cooking, so that sooner or later we may know exactly the limits of temperature within which the various articles of food should be cooked.

THURSDAY, MAY 24th.

A party, consisting of sixty ladies and gentlemen, visited the Royal Mint.

TUESDAY, OCTOBER 2nd.

A Lecture on "Cremation in its Social and Sanitary Aspects," was delivered by the Rev. Brooke Lambert, M.A., B.C.L., Vicar of Greenwich, President of the Association.

Those who have amused themselves by observing the tide as it rises, will have noticed that there is no unbroken advance of waves. One wave gets a little beyond those which went before, but the next wave falls far behind; and it is only after watching carefully for some minutes that one can establish the fact of the rise. The same thing may be observed in the tide of public opinion: the advance, when there is advance, is very slow, and to the eager watcher is somewhat disheartening.

The subject on which I wish to arouse some little public opinion is one which bears witness to this fact. The plan of disposing of the bodies of our friends by cremation was brought into public notice by Sir Thomas Browne, author of the "Religio Medici," 225 years ago. And yet this method, which, however rash it may seem to make such a prophecy, is the method of the future, has made no way. Browne's "Hydriataphia or Urn Burial," is an interesting treatise on the various methods adopted in different nations for burying the dead out of sight. He wrote at a time when modern science was in its infancy, for he could say, "Some say that snow is black, *that the earth moves*, that the soul is air, fire, water—but this is mere philosophy."

But since Sir Thomas Browne's day little has been done to promote the reasonable reform he suggested. Cremation was for a time optional in France in the first French Republic, but the permission was afterwards rescinded. On the continent there is one country where it is permitted and performed, *i.e.*, Italy. In some other countries it is favoured, and has been actually performed. In America it is occasionally practised. But there are no signs that the tide has done more than begin to turn. And in England the wave has scarcely begun to rise. Looking down Mr. Eassie's list of publications on the subject, which is by no means perfect, I yet can trace no important work on the subject from the time of Sir T. Browne, till another physician of not less merit succeeded in awakening public attention.

Sir Henry Thompson, in 1874, ventilated the subject in the "Contemporary Review." He was answered by Dr. Holland, whom he demolished in a second paper. As a result of Sir H. Thompson's paper, a Cremation Society was established. The Cremation Society built a furnace, and burnt a horse in it, but then the wrath of the late Home Secretary was aroused, and he warned the members to be careful what they were doing, or he would run a Bill through Parliament which would make the practice on which there is no law, distinctly illegal. And so the subject slept again. Now there seem to be signs of a re-awakening of interest in the subject, and if I can do anything to kindle that interest, I shall feel that I am doing a good work.

I have headed my paper, "Cremation in its Social and Sanitary Aspects." I think that perhaps the sanitary should come before the social aspects, but I have been, perhaps, unduly afraid of the utilitarian point of view. For if Sir Henry Thompson made any mistake in his paper, it was in the terribly utilitarian tone he took. To suggest, as he did, that in place of importing bones for the purpose of enriching the soil, at a cost of some £1,000,000 per annum, we should save our money by using our friends for this purpose, was hardly the way to catch the ear of the British public. The British public is practical enough, but it is also very sentimental. It has no hesitation in turning the loveliest river into a common sewer, but you can get any amount of votes in Parliament to prevent a lake being turned into a reservoir. Any appeal to utilitarianism, though made, as Sir H. Thompson's was, from a purely scientific point of view (for his purpose was to show, that by adopting his plan we were doing at once what Nature did more slowly), any appeal to utilitarianism shocks people.

But there are social instincts which are worthy of consideration I take, first, the preservation of the remains of those dear to one. I have been a cremationist from my youth, and I was driven to think of it from sentimental reasons before I knew anything of the sanitary aspect of the question. I had the misfortune to lose four very near relations; two of whom lie in France, one at Portsmouth, and one at Lima. It was always to me a matter of regret that the old Roman practice of incinerating the body had gone out before my day. Then that deep craving which man by an instinct has to preserve his dead near him could have been gratified. Burial-grounds were well enough in days when people travelled little. A man would lie with the forefathers of the hamlet in the peaceful repose of the churchyard shadowed by the yews under which he had sat and talked with those now joined with him in silent converse. But when men began to travel, the instinct represented in the family vault could not so easily be gratified, and it is a loss to have one's friends lying all over the world, instead of gathered in a home sanctuary. But if this were all, it might be mere sentiment· I am, however, bound to suppose that it is no mere sentiment which makes people revolt from having the graveyards of their ancestors destroyed. But, despite this feeling, graveyards are always being destroyed. This has from the first been the case with unconsecrated burial-grounds. I have known a thickly-populated neighbourhood in Whitechapel occupy the site of a disused burial-ground. It was only by the strongest protest on the part of the public, that the historic cemetery of Bunhill Fields was saved from the grasp of the Ecclesiastical Commissioners, for whose proceedings in this matter I should not be inclined to apologise. But the rich who can attain an undisturbed freehold, made sure to them and their posterity for ever, as surely as Abraham's first possession, little reck of how entirely the poor are at the mercy of the owners of cemeteries and other burial-grounds. And even these can be disinherited of their possession by means of an Act of Parliament. So that for rich or poor, if they care to preserve the remains of their friends, there is no such certainty as would be involved in a return to the old practice of cremation. By this means the remains are made moveable like the title-deeds of their estates. And if the Moors carried the keys of their Spanish castles across the water, our emigrants might perpetuate in their new home a remembrance of their ancestors.

There is another reason which I should like to touch upon whilst dealing with the more sentimental side of the question.

I have myself always had a peculiar horror of the danger of being buried alive. That this is no mere idiosyncrasy is witnessed by curious provisions in wills, by which men have endeavoured to guard against this possibility. I will not make your hair stand on end by recitals of what has been discovered in opening up graves, of instances in which the unhappy victims of too speedy interment have been found to have lived again. Probably the possibility has given rise to the mischievous practice of the long delay between death and interment, which, in the families of the poor, is a really terrible evil. But I will note the fact that the daughter of Henry Laurens, President of the American Congress, was only by accident saved from the fate. She had, as it was supposed, died of small-pox, when the windows being opened to ventilate the room, the draught most happily revived her, and saved her from the fate of an unrighteous vestal virgin.

I shall have more to say of the way in which cremation would indirectly make the registration of death more exact, but the process would at least prevent the horrible after-consequences of a mistake, which has so dwelt on the minds of men that they have left orders that their bodies should be boiled, stabbed, or post-mortemed, in order to prevent such a mishap.

But perhaps I have said enough as regards the social aspect let me now proceed to the sanitary question, for I must deal with this at some length, and yet leave myself room to answer some of the stock objections to this resort to a practice so old that it has become forgotten, and is now looked on as an innovation. That the bodies of the dead are sources of ill-health to the living, was abundantly proved by the Report on Extramural Interment, signed by the late Lord Carlisle, the present Earl of Shaftesbury (then Lord Ashley), Edwin Chadwick, and Dr. Southwood Smith, in 1850. The evidence was so overwhelming that burials within towns were for the future forbidden, though with such tenderness for prejudice, that burials are still allowed even in such places as Greenwich. But two facts were then unknown, or little known; one of which has become of the first sanitary importance, and another is fast rising to equal importance. The fact that the virus of disease was chiefly communicable in water was unknown. That was absolutely established in 1866 by the cholera visitation in Whitechapel. It had been discovered by Dr. Snow and Rev. H. Whitehead, who exposed the tragedy of the Broad Street Pump in the cholera visitation of 1854. It had been conjectured that the fact there discovered must have been of wider application, because the districts which had a good water supply went almost harmless. But it was left for that visitation to show that persons drinking New River water escaped the disease, and persons drinking East London water on the opposite side of the street were attacked. An examination of the East London sources being made, a leak was discovered in a reservoir near the Lea, and it was conclusively established that, so far as cholera was concerned, water was the great distributor of that disease. Now if this fact had been known, the Extramural Interment Act would have shut up almost all churchyards in country places. As a rule, towns and villages have always crept towards the hill-tops, and the church being usually in the centre of the village, was at the top of the hill. Hence the drainage from the churchyard filtered into all the water-sources below. I have before my mind's eye at this moment a country-town of some 6,000 inhabitants; the church, as usual, set on a hill. At a little depth below the soil ran a stiff bed of clay, which of course cropped out lower down; and here was the most perfect provision for conveying the miasma by means of water and natural drainage all over the town.

I always myself wondered, during the long controversy as to he burial of nonconformists in churchyards, that no one turned the difficulty by proposing a Commission to shut up all graveyards which were overcrowded or insanitary. Where the former is not the case (for it is no uncommon thing to find a country churchyard in which every part but the brick graves has been used over and over again, till the earth shows on the least disturbance the fragments of bones)—where the churchyard is not overcrowded, it is almost always insanitary from the drainage. If this plan had been adopted, no religious difference need have arisen, for cemeteries would have been established all over the country. But, further, there should have been a provision that no dwellings should have been erected within a certain distance of cemeteries. For as the revelations of the Commission of 1850 showed, that as graveyards became saturated so they became dangerous from the gases evolved, there ought to have been a sanitary cordon, which would have prevented the evils in store for the present generation, in the large population collected around the metropolitan cemeteries.

It is an interesting subject for enquiry, why the instinct of men leads them always to build near a cemetery. Such is the fact. It was objected to a site which had been chosen for a cemetery at Tamworth that it was too far out of the town. I replied that, unfortunately, the existence of the cemetery would be sure to draw the population that way. I prophesied that within a short time after the opening of the cemetery, a public-house would be erected close to the gates, and other houses would creep up to keep it company. The prophecy has not been verified so far as the public-house is concerned but it has been verified, as I expected, as regards other houses. Now as cemeteries (this one among the number) are usually situated, like churches, on a hill, we have again this drainage difficulty to contend with. The cemeteries being, in fact, centres of infection, their position enables them to distribute that infection; and where there is not a water supply apart from wells, they must be sources of danger.

But a new danger has lately been discovered, and this is the second fact unknown at the time of the passing of the Extramural Interment Act. It has long been held that all disease arose from some kind of fungus germ. The theory of epidemics is that these germs, finding certain suitable soil, multiply rapidly. The process is somewhat like that of the distribution of thistle-down. Imagine a field of dandelions and thistles; if you could provide that these seeds should be distributed by the wind over an asphalt playground, the distribution would produce no crop of dandelions and thistles. Here and there erosion might have taken place, and one solitary specimen might from time to time take root. But imagine this field to be situate amidst ordinary pasture-land, it would be a centre for the propagation of thistles and dandelions. The gentleman who introduced, from patriotic motives, the Scotch thistle into Australia, has verified the truth of the latter hypothesis, if it needed verifying. Now disease spreads in the same way. There are constitutions, and conditions of the constitution, on which the seeds of disease fall innocuous. There are conditions, on the other hand, in which the seed falls into good soil and bears fruit, some thirty, some sixty, some a hundred-fold. The germs of epidemic disease seem usually to find a suitable pabulum in water and damp earth, and the cholera epidemic of which I have spoken above is an evidence of the spread of a plague when it has found a suitable breeding-ground. Hitherto the germs of disease have, to a great extent, eluded the research of the enquirers in this field. But the practice of vaccination and inoculation resting on this theory, enables us to pronounce it absolutely true.

I have been directed by our indefatigable Secretary to certain papers by Pasteur and others, in which the theory of these disease germs is carefully worked out. Many of you may have seen, however, a paragraph in the papers lately, as to the recent outbreak of yellow fever in Rio. "In reporting the disastrous outbreak of yellow fever in Rio this summer, Mr. Corbett, British Minister in Brazil, draws attention to the remarkable results of the researches into the causes of infection, made by Dr. Freire, one of the Medical Commission appointed by the Government with that object. Having gathered from a foot below the surface of the soil in the cemetery, some earth from the grave of a person who had died about a year previously from this terrible disease, Dr. Freire subjected it to an examination under a microscope, magnifying 740 diameters, and discovered myriads of living microbii, mostly identical with those found in the vomitings, the blood, and other organic liquids of persons who have died of the fever."

The observations, which are set forth in detail, together with other interesting experiments in the report which Mr. Corbett forwards, are verified by *three* other medical men. They show, according to Dr. Freire, that "the germs of yellow fever perpetuate themselves in cemeteries, which are like so many nurseries for the preparation of new generations destined to devastate the city. A significant fact to which Mr. Corbett refers is that few or no cases have occurred among the shipping in the port, and that this immunity is attributed to the effect of a police regulation by which vessels are obliged at this season to move to some distance from the shore."* If cemeteries are the nurseries of these germs of disease, if water be the vehicle by which they are most easily distributed, and if the situation of our churchyards and cemeteries favours their distribution, a clear case is made out for the resort to some other method for the disposal of the remains of those who, having done their work for good or ill, should not be permitted to illustrate in this way that "the evil that men do lives after them," the good being "oft forgotten with their bones."

When such facts as these to which I have called your attention are mentioned, at once the recollection goes back to curious outbursts of disease when the remains of those plague-stricken have been disturbed, and to the incidents of which these facts supply a natural explanation. That greater evils have not arisen from cemeteries is due to the fact that hitherto they have not reached that terrible condition of the graveyards in London and elsewhere, which caused the passing of the Extramural Interment Act. Till the sponge becomes absolutely saturated it holds all the water; saturate it thoroughly, and the slightest pressure causes the contents to exude. How thoroughly the sponge must be saturated in such cemeteries as the Tower Hamlets, and many other of the older metropolitan cemeteries, I leave you to judge. We may be on the verge of some terrible outbreak, of which the few dropping cases of epidemic are but the first evidence. The first rocket that went off at Woolwich the other day was followed by a volley of death-dealing missiles. It needed

* "Daily News," 2nd October, 1883.—Yellow-fever fungus. Doctor Domingo Freire, of Rio Janeiro, the discoverer of the yellow-fever fungus, cryptococcus xanthogenicus, has made the experiment of transferring this fungus into the system of animals by injection, and has obtained satisfactory confirmation of his theory. The inoculated animals, after a very short time, showed all the symptoms of yellow-fever, and, on dissection, their blood was found to be full of germs of cryptococcus xanthogenicus.

no prophet to tell that when one had exploded the rest would follow suit. We have the explosives amongst us, it is only a question of time; their discharge is not likely to be so harmless as that at Woolwich.

Now, these being the facts of the case, what are the objections to the remedy proposed, the return to the old practice of cremation. There is, first, the religious objection, which I can hardly discuss here, but which is an objection so utterly irrational and based on such a material conception, that it really demands no discussion. Granted that the early Christians found in the practice of burial a protest against the idea of annihilation, a protest in favour of a resurrection, it would seem that they were designed to give in their deaths an evidence of the fact that resurrection depended on no such material conception. The old martyrs, instead of preserving their bodies, gave them to be eaten by the beasts, or consumed by the fire. If any were certain of that future life to which we most confidently look, then were they. But if for the maintenance of the doctrine as an article of faith, if as a condition of their future existence, it were necessary that the empty shell should be preserved, then they who are most certain of life have least certainty of it. Incorporated into the bodies of the beasts which devoured them, or scattered as were their ashes over the earth, they have lost their title-deeds, if the poor remnants of mortality are the title-deeds of future existence. The argument is not worth pursuing. For if you carry out the thought of what becomes of men when they are burned, you would find that nature does in a slower way what the lions and the fire did more quickly. The earth decomposes the bodies, and they are taken up into grass and trees, which again are decomposed into other vegetable pabulum, and are incorporated into the bodies of other animals, and eventually into those of man. But even if the actual preservation of the carcase were necessary, in no case is such the general rule. The future world would be an aristocracy or plutocracy, for only those who have the privilege of vaults and brick graves, could be at all certain of a future The common grounds are allowed to be disturbed every fourteen years, and therefore in most churchyards the remains are hopelessly commingled.

Let us pass on to a far more specious objection. It is argued that if the bodies be burnt then no trace remains whereby in case of violent deaths, not suspected at the time, poison could be traced. But this is not an argument against a new method of disposal of the body after death, but of a new method of accurately registering death. Nothing can be more careless than the present system. Sir H. Thompson shows that in Wales, attention was called to the strange prevalence of phthisis in a particular district, ("Cremation, p. 51.") On enquiring, it was found that phthisis was considered a convenient word to describe slow wasting death. And if there was this carelessness on the part of these medical men, that was but a symptom of the careless way in which deaths were registered, or not registered. Sir H. Thompson (p. 50) says that a good many certificates of death are issued every year in London by non-medical persons; and he further mentions—"a parish in London where 40 deaths were registered in one year on the mere statement of neighbours of the deceased. No medical certificate was procurable, no inquest was held. The bodies were buried without inquiry. The practice is not illegal." In times of epidemic any amount of foul practice may pass unobserved. I remember a case in the Cholera Epidemic of 1866, where the person dying suddenly being well connected, and an inquest having been summoned before his connections knew of the death, the inquest was never held, in order to avoid publicity. How the matter was arranged I never knew, but I know that I buried the body with a duly signed certificate. There was no doubt in this case that the death was from Cholera, but it showed me what things might be done, where there was a motive for avoiding the usual formalities. There is but one method of absolute safety in these matters. That method is an independent examination such as is held in Paris, by some one not the regular medical attendant on the deceased, and if in any doubtful case the stomach and heart were preserved in some public hospital, there would be a guarantee such as does not at present exist against foul play.

There remains only one other objection worthy of consideration. It is the sentimental objection. We began with sentiment, and sentiment plays so large a part in human action that we must end with it. It is so horrible to think of the remains we loved being burnt. No one could endure it. To this we answer—1st, that men did endure it, and that it did not seem shocking to men of old to make "great burnings" for the deceased. It is a mere question of habit, and—2nd, that if men did not shut their eyes to what really happens to the bodies of their friends, cremation would seem a much more decent fate than that which consigns them to a putrefaction and destruction which I dare not describe. We are obliged within a few hours to hide our dead out of our sight, before we commit them to the unseen horrors of the grave. That the old house should be ruined and dilapidated might cause us a natural tear, but that it should be tenanted by such a crew is more than we dare think of. Says Southey in his common-place book, 4th Series, p. 195, "The nasty custom of interment makes the idea of a dead friend more unpleasant. We think of the grave, corruption, and worms. Burning would be much better." And Southey's opinion has been shared by some of the best men of our day, from the orthodox Lord Shaftesbury, and the learned and excellent Sir Spencer Wells, to all those modern lights of science, who naturally advocate a plea so rational.

I have brought this matter in all seriousness before this Association, somewhat briefly, because I hope for discussion; not so briefly, but that I have, I think, glanced at most of the great arguments for it, and all the objections alleged against it. I have not touched the mechanical question, because I am not competent to speak on that part of the question. Suffice it to say that this side has not been forgotten, and that furnaces are in existence, which in an hour could, without injury or offence to the neighbourhood, return us the remains of those whom we loved, to be kept in our homes in some receptacle which shall in beauty of design and material, form a fitting resting-place for them. On the one hand we have our present practice, which from beginning to end is hideous and noxious; we have the bodies of those who gave themselves to do good in the world made by our present evil arrangements the sources of distribution of disease and death. On the other hand you have a process sanctioned by the customs of all countries in old times, and only not perpetuated because of a foolish mistake as to the resurrection of the material body—a process which prevents injury, and restores the lost to the home which their presence brightened. What prevents the adoption of the plan which does away with so much harm, and makes you to keep ever near you that precious treasure? only a sentiment, only a prejudice. But prejudices and sentiments are not easily uprooted, and since I have attempted the task of uprooting them, I have to ask the indulgence of the Association, and whilst I apologize if I have in any way hurt their feelings, assure them that I have undertaken the task under a very solemn sense of responsibility.

TUESDAY, NOVEMBER 6th.

A Lecture on "Caves and Cave-Men" was delivered by F. W. Rudler, Esq., F.G.S., Director of the Anthropological Institute, and Curator of the Museum of Geology.

The Lecturer introduced his subject by referring to the manifold uses of Caves in historic times—giving illustrations of their occupation as temporary habitations, as places of refuge and concealment, as strongholds or rallying points, as natural prisons, and as sepulchres. Fortunately for the archæologist, caves had been similarly used in pre-historic times, and hence they have yielded relics which throw great light upon the early phases of human existence in this part of the world.

Attention was called to the various kinds of caverns known to geologists, and their mode of formation was discussed. The Lecturer referred to lava-caves, ice-caves, marine-caves, inland-caves, fissure-caves, and tunnel-caves. It was pointed out that these natural hollows are most abundant in limestone, and the cause of this was dwelt upon at some length. The formation of stalactites and stalagmites was explained, and specimens of the "dripstone" were exhibited, showing its varieties, especially those used as marbles, such as the so-called "onyx marble," the Gibraltar stone, and the "oriental alabaster." It was explained that the rate of growth of these stalagmitic deposits varied greatly under different conditions, and that consequently they formed a very imperfect natural chronometer for registering the flux of geological time.

After discussing the existing flora and fauna of caverns, the Lecturer referred to the remains of pleistocene mammalia which formed so conspicuous a feature in our bone-caves. Referring to the history of these ossiferous deposits, he dwelt on the labours of Buckland, and traced the development of our knowledge of the subject. By aid of a map he traced the distribution of bone-caves in Britain, distinguishing those which had yielded, in association with the extinct mammals, relics of human workmanship. The Caves of France were appealed to in order to complete the picture of the palæolithic cave-man.

Palæolithic cave-man was described as being a hunter, fowler, and fisher of rude type, ignorant alike of domesticated animals and of cultivated plants. He was probably clad in the skins of animals taken in the chase, these skins being dressed with stone scrapers, and sewn together by means of sinew-threads and bone-needles. Of textile and fictile industries he appears to have been ignorant, neither spindle-wheels nor potsherds having been found in well-authenticated association with palæolithic implements and pleistocene mammals. His weapons and tools must have been made of stone and bone, of wood and horn. Well-shaped harpoons of reindeer antler have been found both in this country and in France. As ornaments, he wore necklaces of perforated teeth and shells, and he probably used red oxide of iron as a pigment for personal decoration. His perception of art was remarkable for one so low in the scale of culture, and is abundantly attested by the incised outlines of animals executed on fragments of bone and antler which are found not only in French caves, but, to some extent, in our own: witness the engraving of a horse from the palæolithic deposits of one of the caves at Cresswell Crags.

Attention was drawn to the remarkable resemblance between the habits of the old cave-men and those of the Esquimaux of the present day. It was possible that a yet earlier race of cave-men had existed in this country, inasmuch as rudely-formed stone implements had been found, both at Kent's Cavern and at Cresswell Crags, under conditions which suggested an antiquity far more remote than that of the Esquimaux-like people. These earlier cave-men were probably akin to, if not identical with, the pleistocene men, whose flint implements have been found in the old gravels of many of our rivers, and notably in those of the Thames.

TUESDAY, DECEMBER 4th.

A Lecture on "The Geology and Scenery of the South-East of England" was given by T. V. Holmes, Esq., F.G.S.

By "Rocks" geologists mean all the mineral formations, whether hard or soft, that make up the crust of the earth. Rocks are divided into three great classes:—The Aqueous or Sedimentary, which have been deposited through the action of water, usually as sediment; the Igneous, or rocks which have been melted in the hot interior of the earth, and have become solid at its surface, like lavas, or at some distance beneath, like the granitic rocks; and lastly, the Metamorphic or altered rocks, which originally sedimentary, have been more or less changed through exposure to heat and pressure when deep below the surface. All the rocks within 80 miles of London belong to the Aqueous division. The oldest rocks of England and Wales are to be seen in the west and north-west, the newest in the south-east; the Chalk, the most recent of the great persistent formations, occupying, with beds overlying it, most of that part of England eastward of a line drawn from West Dorset to the eastern side of the Wash. The beds overlying the Chalk are sands, gravels, and clays of various ages. These have been deposited in narrow seas like the English Channel, in estuaries, or in river-valleys. But a great mass of nearly pure limestone, like the Chalk, must have been deposited in a broad, open sea at a considerable distance from any land.

The "Challenger" exploring expedition, a few years ago, showed that over a very large area at the bottom of the North Atlantic a deposit much resembling chalk is now being formed. This deposit is called the "Globigerina Ooze," from the fact that the white chalky-looking mud so named is found, when examined by the microscope, to consist mainly of the shells of a minute creature called a Globigerina, which abounds in many seas both at the surface and at various depths. It is one of the most widely distributed forms of Foraminifera. The flint bands so common in the Chalk, are made up of the sponges, foraminifera, and other organisms, which secrete a flinty or siliceous shell or skeleton. The hard parts of both the calcareous and flinty organisms have sunk together to the bottom, and at some later period the flinty particles have separated themselves from the calcareous ones by the influence of "concretionary action." Concretionary action is found to have taken place in many different kinds of rocks, and has been noticed in laboratory experiments.

It was once supposed that the ancient chalk sea was as deep as that in which Globigerina Ooze is now being deposited. But Mr. Alfred Russel Wallace and Mr. Gwyn Jeffreys have lately been calling attention to evidence which tends to show that the Chalk, though deposited in a broad open sea, is hardly to be considered a *deep*-sea formation, as the Globigerina Oozes from comparatively shallow water, much more resemble the Chalk than those from a depth of 1000 fathoms or more. And the fossils of the Chalk are all comparatively shallow water forms, many living at depths not exceeding 40 to 50 fathoms; while the genera specially characteristic of the deeper Atlantic are very rare or entirely wanting in the Chalk.

Chalk is found here and there from the north of Ireland to the Crimea, and from the south of Sweden to the south of Bordeaux. This implies the former existence across what is now Central Europe, of a sea rather larger than the Mediterranean. It may have been much larger, as chalk would only be formed at a considerable distance from land.

Besides the microscopic fossils of the Chalk there are plenty of larger size. Various kinds of sea-urchins are especially abundant. According to the present state of our knowledge, the Chalk is the latest formation containing Ammonites, and the remains of those great extinct reptiles, the Ichthyosaurus, Plesiosaurus, and Pterodactyle. The difference between the past and present condition of the flint is strikingly shown by the way in which the delicate shells of sea-urchins are found filled up with flint, and by the beautiful casts in flint of spines and other objects.

The thickness of the Chalk in the neighbourhood of London is between six hundred and seven hundred feet. But at Norwich it is found to be 1,150ft. thick.

The Eocene sands, gravels, and clays, overlying the Chalk, are seen to abound especially in the neighbourhoods of London and Southampton. They once stretched across the area now occupied by the Chalk of Salisbury Plain, and the beds below the Chalk of the Weald district. When, after the deposition of the Chalk and Eocene beds, the whole area was upheaved, the upheaval was greatest along a line ranging across the middle of Salisbury Plain to the neighbourhood of Winchelsea and Dungeness. Along this line the strata were bent up so as to form an anticlinal fold or ridge, while parallel to and on each side of this line, in the neighbourhoods of London and Southampton, they lie in trough-like hollows, or synclinal folds. Hence, the beds along the course of the anticlinal ridge were much more wasted by the sea, on emergence, than those in the synclinal hollows. The work of the sea, however, as a denuding agent, is to plane down rocks to a certain level, while the present contours of the ground are due to the subsequent action of rain and rivers. This becomes very plain on an examination of the Weald district.

The Weald district is the area bounded on the north by the North Downs, which range from Folkestone to Farnham; on the south by the South Downs, which stretch from Beachy Head to Petersfield; on the east by the sea, and on the west by the escarpment between Farnham and Petersfield, connecting the North and South Downs. The North and South Downs and the escarpment connecting them are the steep slopes made by the outcrop of the Chalk around and facing the Weald. Within the area bounded by the outcrop of the Chalk are the outcrops of the Upper Greensand, Gault, and Lower Greensand; all, roughly speaking, parallel to that of the Chalk. The centre of the district consists of the rolling hills of Hastings sand in the east, and, west of Horsham, of the plain of Weald clay. East of Horsham the Weald clay occupies a belt of country both north and south of the underlying Hastings sand, and between that formation and the Lower Greensand. North of a line drawn across the centre of this district (east and west) the beds have a northerly, south of it a southerly, dip. And wherever we stand on the edge of the Chalk escarpment and look towards the Weald, we always have a belt of much lower ground at our feet. Now we find the rivers of this district, instead of running out to sea along the plains of Gault or Weald clay, rise in the centre and run either north or south, crossing the lofty Chalk escarpment. Hence, as rivers can never have run up hill, it is obvious that the work of the sea must have been finished when it had planed away the Tertiary beds and much of the Chalk, leaving the centre of the district rather higher than the present height of the Chalk escarpment around it. And, consequently, to the varying effects of the action of rain and rivers on hard and soft rocks the present contours of the ground are due.

Our views southward from the neighbourhood of Greenwich are bounded by the edge of the escarpment of the North Downs. The well-known landmark, Knockholt Beeches, stands near the brow of the escarpment. Looking northward from Knockholt Beeches we see the Lower Tertiary escarpment rising above the dip-slope of the Chalk about Farnborough and Keston. Under London the Chalk bends downward in a synclinal fold, and is covered by Tertiary beds, again rising from beneath them in the neighbourhood of Watford. But a local upturn of the Chalk along the valley of the Thames causes its appearance at the base of the Tertiary plateau extending between Erith and Greenwich. At Greenwich a line of fault, ranging nearly east and west, and with a downthrow on its northern side, causes the top of the chalk to be about 125ft. below at the Royal Naval College, instead of close to the surface as might be anticipated from the position of the chalk-pits of Westcombe Park, Blackheath Hill, and Loampit Hill, Lewisham.

The highest of the Eocene beds in this neighbourhood is the London clay, which rises above the Blackheath pebble beds at Shooter's Hill, and is itself capped there by gravel of much later date. Of still more recent date is the gravel of the Thames valley, on which the town of Greenwich stands. Perhaps the most important variation in the Tertiary beds hereabouts is the reduction of the Blackheath pebble beds from a thickness of about 40ft. at Blackheath, to one of a few inches at Loampit Hill, Lewisham.

The three influences that have affected the scenery of south-eastern England (and elsewhere), apart from the nature of the rocks themselves, are, firstly, the movements of upheaval and depression that have determined what kind of rock should present itself at the surface at any given spot; secondly, the action of the sea on our coasts; and thirdly, that of rain and rivers inland. North of the Thames the cliffs are of soft clays, gravels, and sands, lying directly or indirectly above the Chalk. They tend consequently not only to recede rapidly, but to do so without producing those gulfs and promontories that characterize coasts with well-marked alternations of harder and softer strata. And as the shingle in the east of England travels southward, in consequence of the superior force of the flood-tide from the north as compared with that passing up the English Channel, the mouths of the rivers Yare and Alde have been deflected southward. The Broads of Norfolk are pools in the course of the estuary, the waters of which, less than a thousand years ago, covered the broad marshes now seen in the lower parts of the valleys of the Bure, Yare, and Waveney. The deposits of shingle and blown sand that have given a site for the town of Yarmouth, and deflected the Yare southward, have been the means of converting the former estuary into marshland.

South of the Thames the outline of the coast is bolder, the harder Chalk forming the promontories of the North and South Foreland, and Beachy Head; Culver Cliff and the Needles on the east and west sides of the Isle of Wight; and Ballard Down, north of Swanage Bay. At Dungeness Point and Pevensey Level, we have estuaries silted up, and the alluvium more or less protected from the action of the waves by the formation of shingle ridges on the side of the alluvial tract next the sea. At Selsea Bill the great destruction of the land by the waves has been to some degree counterbalanced by the silting-up of an estuary that has converted an island into a peninsula. The Isle of Wight owes its existence as an island to the destruction of the soft Tertiary strata of South

Hampshire at a much more rapid rate than the harder Chalk and subjacent beds. The Undercliff of the Isle of Wight is due to the slipping forward of the Chalk and Upper Greensand over the Gault clay, the dip being slightly seaward. The shingle of the English Channel travels eastward. Hence, the recent deflection eastward of the mouth of the Avon at Christchurch.

The inland scenery of Norfolk, Suffolk, and Essex, is monotonous from the surface features being almost invariably composed of the soft rocks overlying the Chalk. And the Chalk itself, in those counties, nowhere stands out in a bold and striking manner, as in the escarpment surrounding the Weald, or the high ridge crossing the Isles of Wight and Purbeck. A marked peculiarity of Chalk escarpments, as compared with those of the harder Carboniferous limestone, is that the former are never craggy, but always (though often steep) smooth and voluptuous in outline. And the valleys and combes scooped out of the chalk have the same smooth character, a peculiarity considered by White, of Selborne, to give chalk hills a superiority over "those of stone, which are rugged, broken, abrupt, and shapeless." Of the formations exposed within the Weald area, the Gault and Weald clays make flat ground, the Lower Greensand and Hastings Sand hilly ground. The finest scenery of the Lower Greensand is in the district between Dorking and Haslemere. The Hastings Sands form crags in the neighbourhood of Tunbridge Wells. The Devil's Dyke in the face of the chalk escarpment of the South Downs, near Brighton, and the Devil's Punch Bowl and Devil's Jumps in the Lower Greensand, near Haslemere, are all alike natural formations.

In 1858, Mr. Godwin Austen, after studying the arrangement of the rocks of Belgium in connection with those of the South of England, came to the conclusion that the anticlinal axis of the Ardennes was probably continuous with that of the Mendip Hills, though, owing to the unconformity between the rocks of the Mendip Hills and those east of them in England, no indications of this ancient ridge are visible at the surface. When the Sub-Wealden boring was begun at Netherfield, near Battle, in the lowest rocks of the district, it was thought not improbable that Palæozoic rocks might speedily be reached. But though begun in the highest beds of the Oolitic series (the Purbeck), the boring at a depth of 1907ft. was still in Oolitic rocks. Now supposing a line to be drawn from Netherfield to Meux's brewery, at Tottenham Court Road, London, and another boring made along its course in the neighbourhood of Knockholt Beeches, with the view of ascertaining the thickness of the Chalk and of the strata between the Chalk and the Purbeck beds, we should probably get a result like the following:—

Chalk	...	700ft.
Upper Greensand	...	30
Gault	...	160
Lower Greensand	...	400
Weald Clay and Hastings Sand	...	1,400
Depth to Purbeck Beds	...	2,690

And though the Weald Clay and Hastings Sand might be expected to be thin at London, a great thickness of Oolite beds would naturally be looked for there. But deep wells at Meux's brewery, and some other places in or near London, show that the Gault Clay is the lowest formation found there in its full thickness below the chalk. For the continuity of the beds below the Gault (which are known to exist both north and south of the environs of London) is there broken by the existence of a ridge consisting of rocks older than any elsewhere met with in South-East England, either at the surface or in the Sub-Wealden boring.*

At the invitation of the President, Mr. Laughton gave a short account of the remarkable Sunsets which had excited general attention. There seemed very strong grounds for believing that they are due to the presence, at a very great height, in the upper regions of the atmosphere, of a quantity of fine dust, thrown up by the eruption of Krakatoa on the 26th and 27th of August. They are not peculiar to this, or any one part of the world: they have been reported from all quarters—Europe, Asia, Africa, America, and Australia: it is therefore extremely unlikely that

* For details see "Guide to the Geology of London and the Neighbourhood," by W. Whitaker, B.A., F.G.S., of H.M. Geological Survey.—*Stanford and others. Price 1s.*

they are caused by any mere meteorological conditions of the air; conditions which, in the first place, are local, and in the second, are not uncommon. The sunsets, on the other hand, are not local, and they are in a most singular degree uncommon—as uncommon, it might almost be said, as the eruption of Krakatoa itself. The correspondence of time, too, is very well marked: the first phenomena of the kind were observed in India within a few days of the eruption: a green sun was reported from Madras on the 5th or 6th September; and such appearances have gradually spread to more distant regions. The shock of the eruption appears also to have been transmitted through the air, two or three times right round the globe; disturbances following each other at intervals of about thirty-six hours, were shown by every self-recording barometer in Europe; and though there is not as yet any direct evidence to connect these disturbances, or the extraordinary sky effects, with this tremendous explosion, the presumption that there is such a connection is very strong.*

* [A few days later (8th December) a long and detailed letter to the same effect, by Mr. Norman Lockyer, appeared in the "Times"; and since then, many very valuable communications have been published in "Nature." Two papers on the barometric disturbances, by Mr. R. H. Scott and General Strachey, are published in the Proceedings of the Royal Society for the 12th December.]

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

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Adkin, Robert, Lingard-road, Lewisham.

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Yeo, John, F.R.S.N.A., R.N., Royal Naval College, Greenwich.

H. S. Richardson. Greenwich

SIXTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1884,

AND

LIST OF MEMBERS.

Greenwich:

H. RICHARDSON, STEAM PRINTING WORKS,

CHURCH STREET.

SIXTH ANNUAL REPORT

Academies, &c. — OF THE

Lewisham and Blackheath

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LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 6th January, 1885.

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159, High Street, Lewisham, S.E.

SAUNDERS, MARTIN L.,
36, Lee Terrace, Lee, S.E.

REPORT OF THE COUNCIL FOR THE YEAR 1884.

It is with much pleasure that the Council, in presenting their Report, congratulate the Members on the satisfactory condition of the Association.

Lectures have been delivered at each of the ordinary Evening Meetings, and the attendance of Members and their friends has been fairly good.

The Sub-Committee which was formed for the purpose of organising a systematic search for evidence of Pre-historic Man in the Valley of the Ravensbourne, is still actively employed, but as yet nothing has been discovered to reward their exertions.

The Rev. Brooke Lambert, as a delegate from this Association, attended the Meeting of the British Association at Montreal.

The Essex Field Club having commenced their Exploration of the Deneholes at Hangman's Wood, near Grays, the £5 granted by the Association in aid of the work, has been paid to their account by the Treasurer.

The Members of the Council have also to report, with sincere regret, the loss that they, individually, and the Association at large, have sustained by the death of their colleague, Mr. Franz Goedecker. One of the earliest Members of the Association, he was also one of its most zealous supporters; and, by his influence and energy, he contributed greatly to its successful establishment. It will be within the recollection of the Members that he was a constant attendant at the Meetings, and more than once exhibited before them specimens of his remarkable artistic talent. His position as Secretary for Art to the German Athenæum indicates the estimation in which he was held by his fellow countrymen and fellow labourers. On a brief visit to the Continent, he succumbed to an attack of heart disease, which prematurely closed a career of high promise, to the great grief of those who best knew the amiable qualities he possessed.

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1884.

Receipts.	£.	s.	d.	Payments.	£.	s.	d.
Balance brought forward from last year ...	24	8	6	Grant to Essex Field Club	5	0	0
Subscriptions	29	8	0	Hire of Room	10	0	0
				Expenses of Lectures	17	6	2
				Year Book of Scientific Societies		6	0
				Printing	14	13	1
				Postage	4	2	2
				Balance	2	9	1
	£53	16	6		£53	16	6

Examined and found correct, 2nd January, 1885,—

EDWIN L. CROW.
ALBERT L. GUY

PROCEEDINGS, 1884.

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SAUNDERS, MARTIN L.

TUESDAY, FEBRUARY 11th.

A Lecture on "The Great Ice Age in Britain," with Lime-Light Illustrations, was delivered by HENRY WALKER, Esq., F.G.S.

When snow falls in mountainous regions, it neither melts nor evaporates to any considerable extent. From constant pressure of the overlying mass the lower portion becomes converted into ice, and this, accumulating in the valleys to the depth of some hundreds of feet, forms what looks like a river of ice. This is a Glacier. Though apparently quite motionless, a glacier moves downwards at the rate of from a few inches to a few feet in a day, and it carries with it, either on its surface or frozen in its substance, whatever fragments of rock have fallen upon it or have been broken off in its course. In this way a glacier conveys to considerable distances enormous blocks of rock, and by means of the fragments attached to its sides and bottom, it scours and polishes its bed, and finally at its termination deposits its burden of stones and mud in what is known as a "Moraine."

From observations of the phenomena, such as are to be seen in Switzerland to-day, where there are in the valleys large blocks of stone or "boulders," which have been transported in many instances from a distance of several miles, and where the sides are scored and scratched by the stones as they passed along, Dean Buckland thought he detected, in his wanderings among the Welsh mountains, the large perched blocks, the moraines, and other evidences of former glacial action. His announcement was at first received with derision, and it was not until Professor Ramsay published his book on "The Glaciers of North Wales," that the matter began to be looked upon as worthy of serious attention. There is now, however, thanks to the researches of a large number of competent geologists, abundant proof that ice action, such as is now going on in Switzerland, was at one time to be found going on in Wales. Then came further discoveries, and there was soon forthcoming evidence of wide-spread glaciation in Scotland and Wales, and in England as far South as the Thames. In the neighbourhood of London, glaciation has left its mark at Finchley, Epping, and Muswell Hill.

The condition of things which preceded the glacial epoch was shown by a map of North-Western Europe as it probably appeared when the "London Clay" was being deposited. The climate was then subtropical. Palms grew in abundance. There were turtles and serpents. The period was known as the "Eocene."

Then followed the "Miocene" period, during which the rhinoceros, hippopotamus, elephant, antelope, and bear abounded.

Britain was then continuous with the Continent of Europe, so that there was no impediment to the migration of animals and plants.

After the Miocene came the "Pliocene" period, during which the animals much resembled those of the present day.

Over the area which is now known as Great Britain and Ireland, the change wrought by the action of ice took place. In the course of centuries, the climate of Britain became colder and colder, and the severest stage of glaciation set in. With this decrease of temperature the polar ice-cap came down to lower and lower latitudes, and the conditions which are found in Greenland to-day, prevailed in the Britain of that day. Snow falling on several centres served to feed the glaciers, and the great glacier system of Scandinavia came down to the British glaciers, and determined their course northward and southward. Before the polar ice-cap descended there was rich vegetation in Britain—pine, oak, and beech forests abounded—but glaciers 2000 or 3000 feet thick ploughed up everything before them, and the forests of Pliocene Britain were utterly destroyed. All the animals were driven out and went southward.

A good example of the results of this glacial action is to be seen in the Pass of Llanberis, in North Wales. Here are found, perched high up on the valley, rocks which are of a different composition from those in the neighbourhood, and which must have been carried from a considerable distance. Some of them weigh as much as 2000 tons, and they remain behind as permanent memorials of a huge glacier which has long ago melted and evaporated.

At one time the land of Britain was at a considerable elevation above the sea level, and extended to some distance into the Atlantic. Next came a time when the land slowly sank, and only a few projecting portions remained above the water. Britain then presented the appearance of an archipelago. The greater portion of Eastern England was submerged. At this time glaciers passed among the islets, and each breaking off at its free extremity, formed "ice-bergs," which dropped their burden of clay and boulders on the sea-bed below. The ice at length slowly disappeared, and then the land was once more elevated above the sea level. This is how the surface soils came into existence.

Some time was then devoted to the consideration of the animals which existed in Britain during the cold periods: the mammoth, the woolly rhinoceros, the lemming, the musk ox, &c. In bone caves, where skeletons of animals are frequently found, they can often be obtained entire in places where the hyænas have not been able to get at them. But complete skeletons are usually not obtained where the animal has been washed down by a river.

There is evidence more than complete to show that man was contemporaneous with the mammoth, the mastodon, and the woolly rhinoceros. Man in those days taking advantage of caves and rock shelters, fed on those animals. Bones of the rhinoceros, split open and charred by fire on a primitive hearth, have been discovered.

Glacial periods recur from time to time. Geology furnishes evidence to show that there have been many such periods, although not all of them have been of the same intensity. The last glacial period was a severe one, the next will be a comparatively mild one.

The explanation of the cause of a glacial period is given by Astronomy. When from any reason there is continuously, for many thousands of years, a diminished supply of the sun's heat to the Northern hemisphere, a glacial condition arises in that portion of the earth. This condition depends mainly upon the configuration of the orbit of the earth at the time. At present the earth moves in an elliptical orbit, which is very nearly a circle, but which may vary to the extent of as much as 14,000,000 of miles; the earth being by that amount farther from the sun at one time than at another. It is easy to see that when, for many hundreds of years in succession, winters occur while the earth is at its greatest distance from the sun, they are likely to be exceptionally severe, and as the summers as short, the snow which has fallen does not melt away. Hence, the polar ice-cap, growing century by century larger and larger, descends to lower and lower latitudes, and what is known as a "Glacial Period" results.

TUESDAY, MARCH 4th.

A Lecture, with Pianoforte Illustrations, on "The Development of Pianoforte Music from Bach to Liszt," was delivered by C. ARMBRUSTER, Esq.

Of all the arts, Music is the only one, the high development of which belongs entirely to modern times, and its best and richest blossoms have been put forth on German soil. According to the means by which Music is produced, it is divided into three classes: Vocal Music, Instrumental Music, and the combination of the two. Vocal Music attained a certain high degree of development while Instrumental Music was still in its infancy. In Italy, in the 16th Century, Vocal Music was already far advanced, but the subsequent development of Music generally in Germany was of far greater extent. Down to the 17th Century, Music as an art was exclusively applied to the service of the Church; all the great composers of the 15th and 16th Centuries, and even most of those of the 17th Century, devoting their activity almost entirely to Sacred Music. This is not very remarkable, as very much the same thing might be said of the beginnings of all the other arts, the plastic art especially. It is true that instruments were then occasionally used to accompany the singing, but their accompaniments were anything but independent; and a combination of several instruments for any higher musical artwork was still unknown. It was not until Music began to emancipate itself from the Church, and stage and solo singing began to develop, that Instrumental Music showed those first blossoms which at this day have ripened into such wonderful fruits.

There is one instrument, however, which possesses a literature of older date. That instrument is the Organ, but it ought to be considered rather as a combination of many and various instruments than as a single one. It is natural that the organ should have received the greatest share of attention, since the art itself was devoted to the Service of the Church, and the Church was the only place in which such an instrument could be found. The organ had already been brought to a high state of perfection, before the Pianoforte was invented.

The ancestor of our present Pianoforte—the old clavier, or clavecin—gave only one loudness of sound, and the later instrument received its very name "piano" or soft, and "forte" or loud, from the fact that one could obtain from it various gradations of sound. The Organ and the Clavier (or Pianoforte) are the only instruments which suffice in themselves for the reproduction of a complete musical art-work. Their literature is artistically very complete and abundant; and consequently their study is the most important for a general knowledge of Music.

Bach, who was born in 1685, was such an amazing artist and genius, that his truly gigantic productions put everything else that had been composed before his time into the shade. It is true that his strong point does not exactly lie in his piano work, but rather in his cantatas, his great passion-music, motetts, and organ works; nevertheless, his clavier works are so numerous and so important that they certainly represent the essence and sum total of all the piano literature of his epoch. They will retain their immeasurable artistic value as long as musical art and the capacity to understand and appreciate it, shall exist.

Handel was contemporary with Bach. His great importance lies in another direction, viz., in the Oratorio; his clavier works undoubtedly equal some of Bach's, but their number is far smaller.

With regard to the form in which these two great masters wrote, we find it principally as the so-called "Suite," or series, which consists of a number of smaller pieces which had resulted from old dance forms. As all these pieces were in the same key, a certain monotony was produced. Bach's and Handel's successors transformed the suite into the "Sonata," which signifies a piece sounded or played on an instrument. This is the second great form of composition for instrumental music. The Sonata usually consists of four movements, or pieces, but these are far more elaborately worked out than the pieces constituting the Suite, and an essential rule is that they should not be in the same key. Even in the movements themselves modulation into other keys is far more largely employed than used to be the case in the old Suite. The word Sonata is usually employed only for compositions of this form for one or two instruments. If three instruments are employed we speak of a trio, if four of a quartett, and so on of quintetts, sextetts, octettes, and nonettes; then we arrive at the complete orchestra where we find the term "Symphony." According to their form, however, all these compositions are really Sonatas. The Concerto also belongs to the Sonata form, but it consists of three movements only instead of four. Neither the Concerto nor the Phantasia is a modern invention. Bach and Handel used these forms. In the phantasia, as the name indicates, the composer to a certain extent dispensed with the strict rules of composition; yet Bach in his celebrated "Chromatic Phantasia" gives in its second part a fugue of such strict and measured form, that the great master has never written a stricter one. The fugue has been applied to vocal as well as to instrumental music. It is in the fugue that Bach is unrivalled, just as Beethoven is in the symphony, Schubert in the song, Shakespeare in the drama, and Wagner in the musical drama.

Next in time comes Mozart. He was so universal a genius that he achieved triumphs on every side, and some of his pianoforte works, particularly his concertos, rank among the greatest productions of their kind. His greatness lies chiefly in his operas, masses, string-quartetts, and orchestral symphonies.

Beethoven's pianoforte works form the crown and summit of everything that has been written since Bach—they have not been approached, much less equalled, by any subsequent composer. Under Beethoven's hands the form of the sonata did not essentially change. A detail worth mentioning is that he transformed one of the four movements of the sonata, viz.—the third one. This with Mozart and his contemporaries had usually been a menuet, with its accompanying trio; Beethoven replaced it by a scherzo.

Schubert was born at the close of the last century. He died in 1828, having barely passed his 30th year. His great musical importance lies in his wonderful achievements in the domain of song. His pianoforte works are very numerous, and their artistic value very great.

Mendelssohn and Schumann were born at a time when the musical art appeared to be deteriorating. The former opposed this deterioration with all the energy of his nature; it was he who revived the memory of Bach, who seemed to have been completely forgotten. Schumann fought against the shallowness of the art-world of his period, not only by his compositions, but by founding a musical paper, which has done immense service, and exists to the present day. With Mendelssohn and Schumann must be mentioned a third master—Chopin—who was almost exclusively a pianoforte-composer.

In Mendelssohn's pianoforte works there is a nervous, passionate excitement, which forms a strong contract to the plastic repose and happy contentment which characterise the works of Haydn, of Mozart, and of Beethoven. A speciality of Mendelssohn's was the musical painting of nymphs and elfins; Shakespeare's Midsummer-Night's Dream was a subject which attracted him more than any other; he composed the magnificent overture to this drama when he was but sixteen years of age, and by this composition, these airy beings, born of human fancy, made their triumphal entry into the domain of music.

Chopin principally cultivated the smaller forms of music, such as nocturnes, valses, mazurkas, ballades, polonaises, &c. He was a pianist of the first order, and his works represent an immense amount of care and labour.

Liszt is a master who is yet living. He ranks supreme over all others as a pianoforte player, and is at the same time a most prolific composer for the instrument. He is so great a player that the concert tours he undertook through all European countries where music is appreciated, were so many triumphal processions. His works are admired by every true musician, and he holds an entirely unique position among the modern representatives of the pianoforte. His studies, fantasias, impromptus, rhapsodies, and numberless other pieces for the instrument, are one and all truly marvellous productions. Not least among them are his wonderful arrangements of orchestral and vocal pieces for the piano.

The following is the list of illustrations to the Lecture :—

BACH : Prelude and fugue, in E (from the "Wohltemperirte Clavier").

HANDEL : Air and variations (from Suite, in E) known as "The Harmonious Blacksmith."

MOZART : Rondo in D (from Sonata in the same key).

BEETHOVEN : Thirty-two Variations on a theme in C minor.

SCHUBERT : Impromptu, in G, op. 90, No. 3.

WEBER : Aufforderung zum Tanz, in D flat, op. 65.

MENDELSSOHN : Three Fantasias : op. 16 — Andante and Allegro, A minor. Cappricio, E minor. The Rivulet, E major.

SCHUMANN :— Intermezzo (E flat minor) and Scherzino (B flat major) from "A Carnival's Jest in Vienna," op. 26. Novelette in E major, op. 21, No. 7.

CHOPIN : Nocturne, in B, op. 32, No. 1. Valse, in A flat, op. 42.

LISZT : Study : Waldesrauschen (Forest Murmurs). March from Wagner's "Tannhäuser" arr.

The grand Pianoforte used on the occasion was kindly lent to the Association by Messrs. Broadwood.

TUESDAY, APRIL 1st.

Professor ARMSTRONG, Ph.D., F.R.S., Sec. C.S., read a paper on "Our Local Water Supply."

Water, as defined by the chemist, is a compound, in certain definite unalterable proportions, of the two elements oxygen and hydrogen. As thus defined, water is unknown in Nature: even the purest rain-water containing the gases of the air in solution, and that falling in or near to towns is more or less largely charged with products of combustion and decay, &c., not to mention mechanical impurities such as soot, dust, and even living organisms which it scrubs out of the atmosphere on its way to earth. River and well-waters also contain in solution various solid matters derived from the soil and rocks over or through which the water has passed on its way to river or spring, the character and amount of such dissolved matter being necessarily subject to considerable variation.

The foreign matters naturally present in waters, except in rare cases, as, for example, in the neighbourhood of copper and lead mines, are of a harmless kind. Whenever a water which is normally fit for use becomes contaminated with harmful impurities, it is by the introduction of sewage matter; and there is practically no room for doubt that the noxious matter in most, if not in all cases, consists of living micro-organisms—so-called *bacteria*. It cannot be too clearly understood that the chemist is unable in the great majority of cases, to say whether a water be or not pure and fit for use for dietetic purposes: he is rarely able to say more than that the evidence points to the water being contaminated with sewage-matter, and to recommend its disuse, since experience shows that the use of water thus contaminated is attended with danger. The evidence on which the chemist chiefly relies in proof of sewage contamination is the presence in unusual amount of substances such as ammonia, nitrates and chlorides, which, although normally present in all waters, are yet, as a rule, met with in only small quantities.

Judged of from the point of view of freedom from sewage contamination, the water supplied to our district from deep wells in the chalk by the Kent Company is on all hands admitted to be a water of great purity: the presence of a large quantity of lime salts is sometimes popularly supposed to favour the development of a certain class of disease, but there appears to be no satisfactory scientific evidence in support of this view; so that for dietetic purposes we may regard our water supply as entirely satisfactory, and if it could only be made compulsory upon the Company to supply (on fair and reasonable terms), and householders to accept, a constant service, all such abominations as tanks being of necessity abolished, the district might contemplate its lot with a fair sense of security.

But, unfortunately, the Kent water is not nearly so well suited for other domestic purposes—for cooking, for cleaning purposes, and in boilers. As the rain which has fallen upon the land penetrates into the earth it becomes saturated with carbonic acid; and as the water thus charged percolates through the chalk this acid acts upon the chalk or calcium carbonate, forming "*acid* calcium carbonate," a substance which is much more soluble than chalk itself. When the water is boiled, this acid carbonate decomposes into carbonic acid, which escapes, and chalk which separates in a more or less crystallized state, and chiefly on the surfaces of the vessel in which the water is heated: hence the "furring" of our boilers and kettles.

When ordinary soda soap is added to the water it forms an insoluble lime soap by its action upon the acid carbonate of lime, and it is owing to the production of this insoluble soap within the pores of the skin that washing in the Kent water is so difficult and unpleasant an operation.

In practice the water is rendered less hard, or "softened," either by boiling, or by the addition of "washing soda," which also causes the conversion of the acid carbonate in the water into the ordinary carbonate. On the large scale, hard water such as ours is successfully softened (at the Colne Valley Works, near Harrow, and at Canterbury, for example) by adding lime water, whereby again the acid carbonate is converted into the ordinary carbonate, which falls out as a crystalline deposit.

The amount of personal inconvenience resulting from the use of so hard a water in our district is undoubtedly very great. Soap and soda are used to waste in very large quantities in order to overcome the evil. Probably also if statistics could be obtained as to the life of our kitchen kettles and boilers, in comparison with a district in which soft water is used, the result would be startling, and would clearly show how costly an article we are provided with.

Reference was made to the ease with which rain-water might be collected in a fairly clean state by fitting an interceptor between the store tank and the delivery pipe.

The Lecturer said, with regard to filtration, that it was an insult to the Kent water to filter it through any of the ordinary filters, which were more likely to do harm than good, owing to the extreme difficulty of getting domestic servants to keep such filters clean; moreover that nothing was to be gained by filtering Kent water, provided it had been taken direct from the main, or from a *clean* tank. A filter was shown and explained, consisting of a series of paper discs through which the water was forced, the paper of these discs having incorporated with it a quantity of purified animal charcoal; the filter was so constructed that new discs could be put in with the greatest possible readiness at any time.

MAY 6th, 1884.

An Address on "Modern Studies on Climatology" was delivered by J. K. Laughton, Esq., M.A., R.N., President of the Association.

Of all the Meteorological elements which combine to make up what we call the climate of any country, by far the most important and most generally interesting, is temperature. It is not only that other climatic conditions—such as rain or moisture—largely depend on temperature, but that the degree of heat or cold is in itself, to a great extent, the measure of our comfort and discomfort. It is thus that in speaking of climate, we very commonly mean temperature only, or temperature affected by humidity. Now as far as we are concerned, all heat comes from the sun. If there were no sun, we should, practically, have no heat; we should have a temperature (if it may be called so) of something like 500° F. below the freezing point of water. It is difficult, if not impossible, to conceive such a state of things; but as it would be quite incompatible with the existence of organized beings, such as we know them, the exact conception of it is unnecessary.

Since then the sun is the source of all climate heat, it would seem at first sight as if all places on the same parallels of latitude ought to have the same temperature, as if the decrease from the equator towards the poles should be regular and everywhere the same. It is well known to every one that this is not the case; that the temperatures of different regions in the same latitude often differ enormously; that, in fact, temperature depends on a great many conditions, of which latitude is indeed one, but sometimes, to all appearance, not a very important one.

The Lecturer then referred to maps on which were drawn the isotherms, or lines of equal temperature; calling attention to their irregularity, and to their almost total want of agreement with the parallels of latitude; and showing, as an instance of this, that, in the winter months, the isotherm of 35° passes through the Hebrides and the North of Scotland, takes a sudden dive to the Southward through the East of France, and then turns to the East across the plains of Lombardy; or that the isotherm of 32° runs nearly due North and South, skirting the seaboard of Norway, through Germany to Venice, where it turns East across what used to be Turkey, and the Black Sea.*

This extreme irregularity calls for some explanation. Why is it, we may ask, that places so differently affected by the sun should have the same temperature? The answer depends very much on the special conditions of each place. One, the most familiar to every one, is the aspect. A place fronting towards the noon-day sun, on the side of a slope, sheltered from cold winds by a line of hills or high land, or even a clump of trees, is often found to be very much warmer than other places in the same neighbourhood. Most of the health resorts along our South Coast—Ventnor for instance—are so situated; so are the favourite sites along the Riviera. The giving out of heat by freezing water, or the absorption of heat by melting ice, when these processes of nature go on a large scale, as within the Arctic circle, have a very remarkable effect in ameliorating or embittering the climate of special localities, where ice is formed and drifted away, or where ice is continually pushed in and stored up to be melted. More generally important are differences of soil or geological conformation. Everyone knows that on a hot July day, a green field may be pleasant enough to walk in, whilst a dusty white road is almost unendurable. It is that the heat, as it strikes the arid road, is at once given off to the air; when it strikes on grass, it remains there to do work, and is absorbed in the life it nourishes. And so on a large scale, a tract of country such as the Great Sahara, or the Stony Desert of Australia, is as a dry dusty road of great magnitude; the unpleasantnesses of it are magnified, and the temperature of the superincumbent air is often very great: in each of the above-named localities, a temperature of about 130° F. in the shade has been observed.

But all these purely local causes, however important, are trifling in their effects in comparison with those of the wind, and its great ally, the ocean. The air is the receiver and transmitter of all the heat which makes the earth habitable; without the air

* The Isothermal Maps exhibited were, in the main, reproduced from Mr. Scott's *Elementary Meteorology*.

and the clouds of vapour in it, the heat, as soon as it came to the earth, would be absorbed or would be radiated back into space; it is by the air that it is confined and rendered available for the support of life. Necessary as the air is for us to breathe, it is equally necessary to warm us. We all know how winds carry heat and cold, and can fancy, if we have not practical experience of the effects of wind blowing from off a burning soil or snow-clad plains. Nevertheless, the effect of wind would be little, were it not backed up by the ocean. It is the ocean which is the real storehouse of climatic heat; and by means of currents it distributes it to different localities. The power of dry air to carry heat, great as we are apt to think it, is trifling as compared with that of the same volume of water: in scientific phrase, water has a much greater capacity for heat than air has. The quantity of heat which will raise the temperature of any given volume of water by 1° F. will raise the temperature of more than 3000 times that volume of air by 1°. The water absorbs the heat, carries it about with it wherever it goes, and gives it off economically: air, on the other hand, throws it about with reckless profusion, lavishes it at once, regardless of what becomes of it. It is this difference between the two that gives the great climatic importance to the currents of the ocean. In this country we are especially dependent on the Gulf Stream. Some of you have, probably, been tempted now and then, to vote the Gulf Stream a nuisance; its absence would be a very much greater nuisance. It has been calculated by Mr. Croll, that if the North Atlantic, in temperate latitudes, were deprived of the heat it receives from the Gulf Stream, its average temperature would fall to something like 35° F. below the freezing point of fresh water. If this calculation errs, it is in its moderation. It is at least probable that instead of 35° we ought to say 100° F. It may be left to you to imagine what a South-west wind in this country would be like if it came to us from over such a frozen sea. As things are, the average temperature of the extra tropical North Atlantic is about 56° F., or 24° above the freezing point of water; and this heat, continually renewed by the Gulf Stream, is continually given off into the air and carried over this country by the south-west winds, which fortunately for us largely prevail over all others. If the prevailing winds of these latitudes were south-easterly instead, very little of this genial warmth would come to us: Labrador and the coasts adjoining would get it, and the remarkable differences of climate between this country and Labrador (places in the same latitudes) would be reversed; we should be hard bound in ice and snow, whilst there, they would have mild, soft open winters: this would be the chosen home of tobogganing; and the mud pies, dear to childhood, would be relegated to North America.

A current of exactly the same nature as the Gulf Stream produces an exactly similar effect in the Pacific, and through the intermediate agency of south-west winds carries to Vancouver's Island and the Oregon Coast soft humid warmth during the winter months, while the opposite shores of Kamtchatka are hard frozen and buried in snow.

Some of you may perhaps think that this estimate of the climatic importance of ocean currents is exaggerated; that hot winds off the land also produce very marked effects. That hot winds do blow off heated lands is certain enough; but in point of fact, their heat is very soon dispersed, and their climatic effect is inconsiderable. The best known of all hot winds is the Mediterranean Sirocco, which blows every now and then from the Great Sahara. It is excessively disagreeable: whilst it lasts, it makes life a burden in places exposed to its influences, but it very soon loses its characteristics. In Malta and in Sicily, it is very offensive; but by the time it reaches the coast of France, it is harmless enough. It has indeed been accredited with improving the climate of Switzerland and of reducing the Glaciers, once so enormous, to their present relatively "pigmy" proportions. This, however, is a mistake. The pre-historic glaciers, whose giant size is attested by their existing moraines, belonged to the general epoch, and were not an isolated phenomenon, depending on a Medi-African sea; and the recession of the glaciers has absolutely nothing to do with the Sirocco. The wind that does sometimes act on the mountain snow is the extension of the south-west wind, which comes to Switzerland moist and warm with the moisture and warmth of the Gulf Stream, throws down its moisture on the western slopes of the hills, retaining the heat which is given out by the condensation; and so passes into the Eastern valleys as a wind dry and exceedingly hot. The same phenomenon is experienced in many mountain countries; in New Zealand, in Norway, in Greenland, and on the Eastern side of the Rocky Mountains, where the peculiar heat and dryness of the air permits and encourages frequent devastating fires, and has rendered large tracts of country absolutely treeless.

The Lecturer concluded with a hasty survey of the climatic conditions of different countries where the mean temperature throughout the year is the same, but very different at different seasons, more especially instancing Tierra del Fuego and Astrakan; in the first of which the temperature is rarely much above or much below the freezing point, whilst in the other warm summers are followed by cold winters. The average is the same, but the flora and fauna of the two places are extremely different.

The following Notes on "The recent Earthquake in Essex," by T. V. Holmes, Esq., F.G.S., were then read by the Secretary.

Having just returned (May 5th) from a visit to Colchester and its neighbourhood, it occurs to me that a few brief notes on the results of the recent earthquake there may be acceptable to the Lewisham and Blackheath Scientific Association. The Essex Field Club has naturally felt specially interested in an event which has been attended with startling effects in that county alone, and three of its members, Mr. R. Meldola, Mr. W. Cole, and myself, went down with a view of obtaining evidence at first hand. In our inquiry we received much valuable assistance from Mr. H. Laver, surgeon, of Colchester.

The area in which many buildings have been seriously damaged is but a small one. I mean, that the district in which from one-third to two-thirds of the buildings have been damaged is but small. In the town of Colchester itself ninety-five buildings out of a hundred are probably not perceptibly the worse for the shock, though some important falls occurred, notably that of the spire of the Congregational Chapel. This spire was of stone: that of the Church in the High Street, which is constructed of timber, is unhurt. At Lexden, west of Colchester, and in the country a mile or two north, the damage done has been trifling. The area of serious damage is from Colchester southward. A line drawn from Colchester Railway Station, or thereabouts, and passing a mile westward of Mersea Island to the estuary of the Blackwater, and another drawn from the same point on the north, and ranging thence to a spot about a mile eastward of Mersea Island, and on to the sea, would comprise the whole of the grievously afflicted district.

At Colchester we saw that the Congregational Church spire had been thrown down towards the N.E. At Wivenhoe, between three or four miles lower down the River Colne, we found the battlements of the Church tower thrown down to the north side. Inside the Church the first glance disclosed but little damage, but more careful examination showed that one of the pillars on the south side of the nave had been twisted more than an inch out of its place, and the whole of the arcade had thereby been seriously weakened. And Wivenhoe Hall, though the exterior suggested that the damage done had been but slight, appeared, on examining its interior, to be so fundamentally shaken and cracked as to require entire re-building. In the village the chimneys of a whole row of cottages had been thrown down to the north-west, and various chimneys had been twisted either to the north-east or to the north-west. At Abberton, Peldon, and Langenhoe, the damage done has been very great, the churches at the two latter places being very seriously injured. The vestry chimney at Peldon Church had fallen northward, and three cottage chimneys in that village had all fallen in the same direction. As a general rule we found the northern ends of buildings had suffered most. Where wooden cottages had brickwork chimneys, one at the north end the other at the south, the northern chimney had fallen northward, while the southern chimney had frequently fallen southward. Few buildings in Peldon escaped injury except barns or sheds made of wood and covered by thatch, and they, though often extremely old and shaky in appearance, were invariably none the worse for the shock.

On Mersea Island the damage done was by no means so great as at Peldon and Langenhoe; the building which had sustained the most serious damage being the school at West Mersea. The children were in the building when the shock took place, but fortunately none of them were injured. The clock at the school stopped at 9.20 on the day of the earthquake; the range of its pendulum, when going, was about north-west and south-east.

We were told that the water of the wells on Mersea Island had been thick and turbid on the day of the shock. We went to a spot on the shore at West Mersea where a fissure was said to have been caused by the earthquake. At the foot of a gravel bank about twenty feet high, which bounded the higher ground, and overlooked the mud flats, we saw a spring of clear water, and along the side of this bank we found the fissure which could be traced perhaps sixty or seventy yards. The earthquake shock had evidently produced the fissure, but of course a very slight shock or vibration of any kind might cause a fissure in such a position. For a few yards the fissure was large enough to admit a man's arm, further on it became a mere crack.

Mr. Larman, of the coast-guard at West Mersea, told us that at the time of the shock he happened to be looking at the "White Hart" Inn. It seemed to him that the roof of the building was raised some inches, and then lowered again. Knowing that the landlord kept a considerable stock of gunpowder, he supposed at first that an explosion had taken place. The clock at the "White Hart" stopped about 9.19, its pendulum swinging from north-west to south-east, a direction the same as that of the clock at West Mersea School.

In conclusion, I would state that Mr. R. Meldola, Vice-President of the Essex Field Club, is collecting evidence for a report upon the above calamity, and that he will be very glad to receive information from any locality with respect to time of shock, stoppage of clocks, &c. His address is 21, John Street, Bedford Row, London, W.C.

THURSDAY, JUNE 5th.

A small party of members and friends went to Box Hill.

TUESDAY, OCTOBER 7th.

A Lecture "On the addition to our knowledge of Old London, obtained by observation of the Line of Railway for the Extension of the Metropolitan Inner Circle, and on Recent Discoveries at Bevis Marks," was given by J. E. PRICE, Esq., F.S.A.

The paper was illustrated by a large series of Maps, Plans, Sections, and Diagrams, together with Sketches of many of the Antiquities discovered. The Lecturer remarked that, in the preparation of his observations, he had been much indebted to the authorities connected with the line, and especially to Mr. E. P. SEATON, the Resident Engineer, for the facilities for investigation which had been afforded from the commencement of the works to their completion. The excavations necessary had been made in portions of the City of London which were of the highest interest to the historical antiquary. Commencing at the Mansion House Station the line proceeds down St. Thomas Apostle, across Cloak Lane to Dowgate, cutting in its course directly through the now dried up channel of the old Walbrook. Then beneath Cannon Street it passes to Fish Street Hill, through Pudding Lane, Eastcheap, and Tower Street to Trinity Square, thence through the ancient City Wall under the Minories, and so on past St. Botolph's, Aldgate, joining the Metropolitan Railway at Aldgate Station. At most of these different sites, as likewise at many others, relics of the more ancient city had previously been profusely met with. At Queen Street, Roman remains with indications of the site of the late cemetery or burial ground belonging to the old church of St. Thomas Apostle, were disclosed. Near to the churchyard of St. John the Baptist, a depth of 35 feet had to be attained for the requisite foundations; here the ancient watercourse was well defined, the soil abounding with pottery, cinders, oyster shells, &c., and a fine Roman amphora three feet in height was brought to light. Under the site of Tallow Chandlers' Hall was observed a curious subway, which, passing beneath the Hall of the Skinners' Company, crossed College Street, and joined the old sewers in Lower Thames Street.

By the side of the brook near to the foundations of the church of St. John the Baptist, the remains of an old landing stage were well defined, together with a large piece of Roman pavement formed of small red bricks, and laid in what is technically known as the "herring-bone" pattern. The greater part of this had to be destroyed, but a small piece by way of illustration was preserved, and is now in the City Museum at Guildhall. Near to St. Swithin's Church a large block of Roman masonry had to be cut through as it crossed Cannon Street. This wall was again met with in Bush Lane, a circumstance which leads to the opinion that it was once a boundary wall of the early city, and erected for such purpose on the eastern bank of the stream, afterwards known as Walbrook.

Near to the wall in Bush Lane the remains of another tesselated pavement were discovered; it was of a superior kind and formed of small cubes of light-coloured stones. Not far from this, quantities of pottery and other objects were met with. At Fish Street Hill the Weigh House Chapel had to be pulled down in order to make way for the "Monument Station;" here some human remains were discovered, but nothing besides of antiquarian interest. At Seething Lane, at the bottom of what had apparently been a well, the arm of a fine bronze statue was recovered; the greater part of the arm together with the wrist and fingers was perfect, and the relic had evidently formed portion of the statue of a male figure of heroic size. As a work of art it is extremely good, and affords a proof that the city of "Londinium Augusta" was then, as now, adorned with statues, doubtless erected to those whom the citizens of that far-off time deemed worthy of honour.

Under the gardens of Trinity Square the soil was light in colour, and numerous remains of reeds, water-plants, &c., were disclosed. At one part of Tower Hill the roots of many ancient trees came into view, an indication of the ancient vegetation which had been cleared away when the site came into the occupation of the early colonists. Near to the west end of the gardens, on the place so marked on the ordnance map, the remains of the old scaffold were unearthed, and the Trustees of the gardens have recently placed a paved square to mark the situation of so historical and memorable a spot. Not far from Trinity Mews the ancient city wall was again met with, and some fine sections were exposed to view. A piece no less than 55 feet in length was removed, and so strong was the masonry that the work was accomplished only by a great expenditure of time and labour. The foundations of the wall appeared to be of the same character as that which has been observed on the occasions when other sections have been open to examination—a layer of flint stones on a bed of puddled clay, and above this a plinth of dark-brown sandstone, hand-dressed, and laid with considerable care. The wall itself was composed of small, irregularly cut stones, principally of Kentish rag, with bonding courses of bright red tiles, laid at regular intervals, and the whole was faced with well-squared stones, dressed and laid in regular bond.

Near to Church Street, Minories, the line entered on the site of the Abbey of the Nuns of St. Clare, founded in 1293 by Edmund Earl of Lancaster, and lasting up to 1539, when it was suppressed by Henry VIII. Many remnants of the old building were removed; the work observed was mostly of chalk, and of a Norman character. The remains of what had been a fine leaden coffin was discovered in this locality. It was of Roman date, ornamented with lines of a beaded pattern enclosing scallop-shells—a familiar mode of ornamentation with the Romans. The coffin, which was unfortunately broken up by the workmen owing to the value of the metal, showed that the place was used by the Romans as an extra-mural cemetery.

On reaching Aldgate the circle was complete. At this place it was interesting to note the successive layers of the soil. No fewer than eight were counted. As the made ground was 12 feet deep, it seemed probable that this portion of Old London had been, on the average, raised something like 9 inches in every 100 years. In the course of the works two City Halls had to be removed, viz., that of the Cutlers in Cloak Lane, and that of the Butchers' in Eastcheap. Such of the antiquities as could be saved by the Directors of the line were presented to the Corporation of London, and what could be collected of the leaden coffin referred to was sent to the British Museum.

The Lecturer then proceeded to give a brief description of some relics of the Roman period then being unearthed at Castle Street, in Bevis Marks. There the old wall was again met with—fine fragments with the facing perfect in every respect, and the treble course of bright red tiles well defined. It appeared 8 feet from the surface line, and, as usual, was about 8 feet 6 inches thick. At the corner of Castle Street one of the old bastions attached to the wall for increasing its strength appeared *in situ*; the foundations of the massive structure were perfect, and large quantities of ancient masonry had to be removed. These were found to include massive coping-stones, semi-circular in section, caps of columns, pilasters, and other architectural fragments. Portions of a frieze, upon which were sculptured groups illustrative of a funeral feast, were discovered. The seated figures and the figure of a table supported by legs in the form of winged lions, were well preserved. Another relic showed a panel, having upon it a well-modelled figure of a cupid, or genius, in bas-relief, the body holding in one hand a festoon or wreath of fruit-leaves on which a bird was perched. A small statue of a male figure clothed and in singular dress was also discovered—the head was missing, but there were certain resemblances in the figure to the statue of Atys, which was discovered in this locality many years ago, and which is now in the British Museum. Some remains of inscriptions were also met with, and of these sufficient remained legible to prove that the whole of these important sculptures had belonged to sepulchral memorials erected by the Romans. These had been broken up and used as building materials, when the line of bastions, which are known to have existed in connection with this portion of the city wall, was constructed. The remains were of like character to those which had been discovered in the bastion found at Camomile Street some years ago, and which are now carefully preserved at Guildhall. Of these an exhaustive description had been published by the London and Middlesex Archæological Society. Since these discoveries other bastions have been examined; they were constructed in like manner, and their situations had been shown to harmonise with those marked on Aggas's map, published in the reign of Queen Elizabeth, at which time the bastions were all standing.

The Lecturer, in conclusion, observed that he had in his possession a large number of drawings, plans, sections, &c., illustrative of the series. The work, cost of labour, &c., to say nothing of the time to be devoted to the proper investigation of such important discoveries as those to which he had had the pleasure of referring, was beyond the scope and power of a small local society—it needed some more important organisation, and one even of a national character. Steps were being taken to bring this about, and an influential committee had been formed with Sir JOHN LUBBOCK, M.P., as its Treasurer, and it was to be hoped that, under such an organisation, the movement would meet with general and adequate support.

TUESDAY, NOVEMBER 4th, 1884.

A Lecture on "The Chemical and Physical Changes effected by Cookery" was delivered by W. MATTIEU WILLIAMS, Esq., F.R.A.S., F.C.S.

The Science of Cookery is very little understood, having been but little studied by modern chemists. A book was written about 100 years ago by Benjamin Thompson, Count of Rumford, who, when he began life, was only a poor school-master, but in turn became a soldier, a diplomatist, and a statesman. The Count came to England to publish essays he had written on scientific and practical subjects; and in his writings he tells how he provided dinners for a large number of the poor in Munich at a cost not exceeding one-third of a penny per head, shewing how much cheaper we could all live if we paid more attention to science in the cooking of food. The Count of Rumford was the founder of the Royal Institution, but it was originated for a different purpose from that to which it is now devoted.

The Lecturer then showed two experiments:—The first was, the application of heat to gelatine, which reduced the solid to a liquid; and the second, application of heat to albumen, with the result that the liquid was turned to a solid. The cook has to apply heat, and ought to know something about what is being done. Heat may be communicated by contact or by radiation: the former method is used when food is plunged into boiling water, and the latter when it is roasted.

Albumen, and its great nutritious properties were next spoken of, and the various forms it took under different treatment. Albumen heated to 120° showed filaments, at 160° it became a tender jellied solid, but with a gradual increase to 212° it became a firm solid, and if kept at this temperature hardened and became horny and cement-like in substance. The usual way of cooking an egg is to place it in boiling water for three-and-a-half minutes, but this is not the scientific method; plunge the egg into boiling water, take it off the fire and leave it for about ten to fifteen minutes, and then you will have a properly cooked egg.

The boiling of a leg of mutton should be carried out in a similar manner. Albumen exists in the meat between the fibres, and the primary thought should be:—How can the albumen on the outside be hardened so as to keep the juices in while that inside shall be kept tender? This is effected by placing the meat in boiling water, and then keeping it at the reduced temperature of 180°. Gelatine is hydrated when heated under the temperature of boiling water, but at a dry heat above 212° de-hydration takes place; for an illustration of this, it is only necessary to go to the carpenter's glue-pot and see the effect of over-heating or continual heating on the glue, which gradually loses its adhesive properties.

Stewing of steaks and meats should be conducted in the same manner. It is, however, better to place a vessel containing the meat in boiling water, one vessel inside the other, like the glue-pot. Frying, when properly conducted, is only boiling in an oil bath. In ordinary boiling, the temperature cannot be raised above 212°; but in boiling fat you can raise it to 400° or 500°. In cooking fish it is important to have a fat-bath of about 2in. to 3in. deep, so as to cover the fish entirely; the frizzling heard when the fat is put on the fire is not from the oil boiling but the water contained in it. Fish contains a large amount of water, which, as it boils, drives the fat away from the article cooking, thus causing it to be less greasy than if it had been cooked in our ordinary fryingpans.

After having spoken of cooking by convection, the Lecturer next called attention to roasting, or cookery by radiation. Rumford put his meat in a closed vessel, and then cooked it by radiation. If flesh is to be roasted, a circular fire, with the meat in the centre, would be the proper thing; but undoubtedly, the best way of so cooking meat is in an oven. There has been, and up to the present is, great prejudice against baked meat: two reasons could be given for this antipathy; the first is that in the time of our forefathers, the joints used to be sent to a bakery, where all sorts and conditions of meat mingled their various odours so that individual flavour was entirely lost in the eating; and secondly, the ovens were constructed for the baking of bread, not for the roasting of meat.

Cheese is a slighted article of food. It is very nutritious; but should not be eaten raw. 20lbs. of it is equal to 60lbs. or more of sheep-flesh. Mutton contains 70 per cent. of water, whereas Cheshire cheese has only 30 per cent., and no bones. But it is found to be very indigestible owing to the casein, the principal constituent of cheese, being insoluble. There are two forms of casein: soluble, as in milk, which is easy of digestion, all the young of the mammalia living and thriving on it; and insoluble as, in cheese. It is this latter form of casein which is the cause of cheese not being easy of digestion. A method was given of bringing the casein back to its soluble state, viz., by grating the cheese and putting it into water or milk, adding bi-carbonate of potash in the proportion of about one-sixth of an ounce of potash to 1lb. of cheese. In cheese we have a good portable food, specially adapted for the poor; no ice is required to keep it, as in animal food, below a certain temperature. In Italy the people never take soup without having grated cheese served with it. There are a number of ways in which cheese might be more used in this country; it could be used in puddings, and would be both digestible and economical.

In conclusion, the Lecturer dwelt on the fact that the subject, one of the greatest practical importance, was really one capable of scientific treatment, and well worthy the study of everybody.

TUESDAY, DECEMBER 2nd.

A Lecture on "Canada, its Aspects and Prospects," was delivered by the Rev. Brooke Lambert, M.A., B.C.L., Vice-President of the Association.

The Lecturer, in touching on the Canadian Dominion, its aspects and prospects, dwelt on the enormous space represented in a country where the map of Europe might lie over the dominion and only just cover it. If on the other hand one remembered that the population of this whole dominion was but that of London, only some 4,500,000, one could judge how vast the space looked divided amongst such few people. The next point on which he dwelt, was the phases of history called out by the various parts of the country. Lower or Eastern Canada represented the old French kingdom, with its grand contest with heathen superstition. The centre of Canada, represented by Montreal, the focus of present activity, has still its lien on the old French inhabitants. Toronto, farther west, represented the future of Canada, touched by American fashions but not surrendering to their powerful influence. Lastly, there was the capital of the *paulo-post* future —Winnipeg—situated on the border of the prairies—the capital of that district which would owe its prosperity to emigrants, and would to a certain extent, develop the education of the Indians who still linger in the "*reservations*" far afield. The Lecturer next proceeded to describe the general aspects of the country. He dwelt at some length on the method of travel, and of life in this country in which, as he said, those who got on in England would get on much faster—but in which any one who failed here was sure to find his lowest level very much sooner.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

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SEVENTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

Scientific Association.

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Greenwich:
H. RICHARDSON, STEAM PRINTING WORKS,
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REPORT OF THE COUNCIL
FOR THE YEAR 1885.

The Council have much pleasure in presenting the Report for the seventh year of the Association's existence.

The success of the Association has been continuous since its establishment in 1879, and the Council are able to append a satisfactory financial statement.

The Lectures delivered before the Association by Mr. J. G. Goodchild, F.G.S., F.Z.S., Mr. C. E. Peek, M.A., F.R.A.S., F.R.G.S., F.R.Met.Soc., Mr. Henry Walker, F.G.S., Mr. G. G. Chisholm, M.A., B.Sc., F.R.G.S., Mr. P. W. Ames, F.R.G.S., F.R.S.L., Mr. Carl Ambruster, and Mr. W. Mattieu Williams, F.R.A.S., were well attended, and it is believed that the members and their friends appreciated their highly-interesting and instructive character.

No discovery has rewarded the researches of the Sub-Committee on Pre-historic Man during the year, though a watch has been kept upon all excavations in the neighbourhood.

Professor Armstrong, F.R.S., attended as Delegate at the Aberdeen Meeting of the British Association, of which the Lewisham and Blackheath Association is a duly recognised corresponding Society.

Mr. T. V. Holmes, the President, having suggested to the Metropolitan Board of Works that plates should be placed to mark the site of the two subsidences which occurred on Blackheath in the years 1878 and 1880, and which are marked "A" and "B" on the plan attached to the Report on the subsidences issued in July, 1881, the Council have to announce that the suggestion has been carried out, and that metal plates have been fixed at the points referred to. They bear an inscription similar in appearance to that which, at the request of Sir G. B. Airy, was placed on the Heath at "C" in July, 1882.

It may be remembered that a sum of £5 was granted by this Association to the Essex Field Club, in aid of their proposed Denehole Exploration. It may therefore be of some interest to the Association to learn what has been done, so far, towards the investigation of the Essex Deneholes.

The Exploration Committee having decided that Hangman's Wood, near Grays, should be the scene of their first labours (the open pits of that group having already been descended and figured), work was begun there in October, 1884, and carried on for a month under the superintendence of Mr. W. Cole, Hon. Sec. E.F.C., and of our President, Mr. Holmes. On the surface two trenches were dug, each from 20 to 30 yards long, and from two to three feet deep, in spots surrounded by Denehole shafts. Below, tunnels were driven in three different directions from the most favourably situated of the open-shafted pits, and twelve distinct deneholes were by their means placed in communication with each other. Lastly, the huge mounds of rubbish at the base of the shaft in two of the open pits were carefully removed, and their contents examined, and a similar examination of the contents of two chambers of two of the closed pits was also made.

As regards the surface trenches, it was found that when the shafts were begun the gravel occupying the surface had, on removal, been carefully and evenly spread over the ground. Then as the shafts grew deeper, the underlying Thanet Sand was also evenly distributed. But the immense quantity of chalk taken from the chambers beneath seems to have been entirely deposited elsewhere, not a single fragment being visible in either of the trenches. Chalk is, as compared with gravel and sand, a soluble material, and if carefully distributed in small quantities over a large area, would entirely disappear in course of time. But had heaps of chalk been anywhere allowed to accumulate to a height of but three or four feet, they would not have utterly vanished and left no traces of their former presence. Of course this singular care for the preservation of the original contours of the ground by an even distribution of the sand and gravel, together with the careful removal of the much more conspicuous chalk, points to a strong desire for the preservation of secrecy on the part of the designers of the deneholes.

The careful removal of the conical heaps of *débris* at the base of the open shafts disclosed a precisely similar state of things in each case. The heap was found to consist of a low cone of gravel surmounted by a steeper cone of Thanet Sand. Of course there was a little sand in the gravel, and a slight admixture of gravel with the sand, but in the main, the sand lay above the gravel. In the gravel, and usually not far above the smooth chalk floor, were considerable numbers of large flints that had been more or less squared. They had evidently been used for steining the uppermost seven or eight feet of the shaft, which is in the surface gravel. The history of the formation of the heap had, in the opinion of our President, been this: On the pits becoming disused and neglected, the steining flints had fallen down the shaft, accompanied by more or less of the gravel. The gravel had then been worn back by the action of rain and frost till a broad funnel-shaped opening was produced, on the sides of which grass subsequently grew, and thereby checked the denudation. The Thanet Sand forming the upper part of the mound appeared to have been the slow and gradual deposit of centuries, the weathering of the sand part of the shaft having been very even and regular. Here and there were found lumps of chalk, which had evidently fallen down from the immediate neighbourhood of the shaft. Bones of various animals—those of the ox, horse, and dog predominating—were found here and there in the mounds, and in one of the pits the femur and some other bones of a man were discovered; the skull, however, was wanting.

In tunnelling from the open deneholes into adjacent closed ones, passages were directed towards the shaft of the pit it was desired to enter. Experience showed that the denehole excavators had no scientific means of ascertaining the direction towards which they were working, but that they trusted to prevent intercommunication partly by the preservation of a certain (though in itself insufficient) distance between the several shafts, and partly by a keen perception of the relation between the intensity of sounds and the thickness of the chalk partition walls. In some instances the partition between the adjacent chambers of different pits had been broken, enabling the explorers to get from one pit to another without tunnelling. But it was always found that on each side of the broken partition the chambers were rounded off, showing a recognition of the danger of inter-communication, and a desire to avoid it. Indeed, it usually seemed probable that the fracture had been made many years after the pits had fallen into disuse.

The bones of animals of various kinds, and the pottery of different ages found in the mounds and in the two chambers examined, though of very considerable interest and importance, are not sufficient to settle conclusively the age of the deneholes. Hitherto, indeed, the tunnelling has been much in excess of the sifting, partly because it was felt that to obtain the ground plan of a compact group of pits was a matter of the highest importance in itself, and partly because the deneholes hitherto entered have been so choked with *débris* that it seemed desirable to enter, if possible, a pit less blocked up than usual before the explorers devoted themselves mainly or wholly to sifting. It is obvious that articles throwing light on the probable antiquity of the Deneholes can only be expected to lie on or close to the floor.

It had been hoped to continue the exploration this year (1885), but various circumstances have obliged the explorers to postpone operations until next Spring, when they trust to be able to bring the investigations at Hangman's Wood to a satisfactory conclusion.

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1885.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance brought forward from last year ...	2	9	1	Hire of Room	10	0	0
Subscriptions	63	10	6	Expenses of Lectures	21	4	5
				Printing	13	19	10
				Diagram Frame, Tongs, &c.	2	2	6
				Postage	3	10	0
				Sundry Expenses		6	4
				Balance in hand	14	16	6
	£65	19	7		£65	19	7

Examined and found correct, 29th December, 1885,—EDWIN L. CROW.
THOMAS BRAMLEY.

PROCEEDINGS, 1885.

LIST OF OFFICERS AND COUNCIL FOR 1885.

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Vice-Presidents:

LAUGHTON, J. K., R.N., M.A., F.R.G.S., V.P.R. Met. Soc.,
Mathematical and Naval Instructor, Royal Naval College, Greenwich.

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CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc.,
Astronomer Royal.

ELLIS, WM., F.R.A.S., F.R. Met. Soc.

FISHER, T. CARSON, M.D.

HADDON, A., M. Phys. S.

PENN, JOHN, M.I.C.E.

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Barrister-at-Law, Assistant Registrar of Friendly Societies for England.

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JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., F.G.S., &c.,
159, High Street, Lewisham, S.E.

SAUNDERS, MARTIN L., A.R.I.B.A.,
36, Lee Terrace, Lee, S.E.

TUESDAY, FEBRUARY 3rd.

A Lecture on "Birds of Prey" was delivered by J. G. Goodchild, Esq., of H.M. Geological Survey, F.G.S., F.Z.S., Member of the British Ornithologists' Union.

The lecturer began by some observations upon the zoological position of Birds of Prey or Aetomorphæ, based upon the researches of Huxley, Parker, Garrod, Forbes, Nitzsch, and others, and illustrated his remarks by reference to various tables and diagrams upon the screen. Contrary to the view generally held, the lecturer maintained the opinion that the Aetomorphæ, although undoubtedly presenting many points of agreement amongst themselves in regard both to their external characteristics and to their mode of life, do not form a really natural group like the Passeres, or the Psittaci, but that the group really comprises several assemblages of raptorial forms evolved independently, and at various times in the past, from widely-separated Sauropsidan ancestors. He regarded their present outward similarity of form as due to morphological convergence accompanying progressive adaptation to a common mode of life. The earlier stages of changes of habit likely eventually to lead to such outward changes of form as those referred to may be observed in many widely-separated forms of birds at the present day. It is quite conceivable, for example, that under particular conditions of environment, one of the Passeres, such as a Shrike, might take to living entirely on small mammals and birds. In such a case, if the competition with other birds leading a similar mode of life were severe, any slight modification of form amongst the offspring of such shrikes, as would enable the younger generation to compete successfully with their fellow-birds in the struggle for existence, would be a manifest advantage to the possessor, and would enable that bird to hold its own while others around it would be driven out of the field. Such beneficial modification of form would, of necessity, lead by slow degrees to the assumption of the external characteristics of the birds of prey, for the simple reason that those external characteristics are just such as best suit the mode of life of the possessor. Taking the case of the Game birds, again, we find many of them, the common Barn-door Fowl for example, and the

Curassows especially, feeding occasionally upon small mammals or birds. The Curassows at the Zoological Gardens will catch and kill and eat a mouse in almost as systematic a manner as the Kestrel does, and the same may be said of many allied forms. It is quite conceivable that, under changed conditions of their normal surroundings, the Curassows might be compelled to subsist entirely on small mammals or on birds of their own catching; and in this case such of their descendants as developed characteristics better fitting them for their raptorial mode of life would be more likely to survive and to leave numerous descendants than the birds that did not vary in that direction from the parental form.

The case of the Curassows is especially interesting because in many of their structural characteristics they closely approach some of the aberrant Actomorphs—the Polyborines and the allied forms, for example. Then again, there is the case of the well-known Carnivorous Parrot, which has made quite a new start in life within the last fifty years, and given up a diet of fern-roots for a more substantial one of mutton. No one can for a moment doubt that if its former diet failed, this particular form of Parrot could soon pick up a living by preying upon other denizens of that part of the world; and even if deprived of sheep-flesh it could supply its needs just as adroitly by attacking other animals as it does now with the colonists' sheep. In course of time, unless external circumstances intervened to prevent it, natural selection would develope a bird thàt might still retain some of the internal structural characteristics of the parrots, and yet be, externally, and in all essential points in its habits, a veritable Bird of Prey. No one, again, who will study the appearance and the habits of the remarkable Cuvier's Podargus, now (1885) living in the Zoological Gardens, can doubt that this very owl-like bird represents either one of two things: it is either a comparatively-unmodified descendant of the common ancestors of the Owls and the Goat-suckers, or else it is a raptorial type developed from a Goat-sucker stock. Similar observations apply also to birds like the Skuas, Albatrosses, Storks, and other birds that stand close upon one part or another of the Aetomorphæ as at present recognized.

Bearing these facts in mind, and taking into account the sum total of the facts revealed by a careful study of all the structural features presented by the Aetomorphæ, the lecturer considered that we are justified in recognizing the representatives of five such stock, or parent-sources whence the birds under consideration have been derived. These are—

1. The Accipitres, represented by the Old-World Vultures, the Eagles, Buzzards, Kites, Hawks, and Falcons.
2. The Striges, represented by the Owls.
3. The Pandiones, represented solely by the Osprey.
4. The Serpentarii, now only represented by the Secretary Bird.
5. The Cathartæ, embracing the Vultures of the New-World.

If our schemes of Zoological classification were complete and perfectly consistent, the Aetomorphæ as a whole should take no higher than a family rank, and the foregoing five sub-divisions should rank merely as sub-families. But it is more in accordance with the practice of Ornithologists to regard the Aetomorphæ as an Order, and to rank the five sub-divisions just referred to as Sub-Orders. Of the 11,000 species of birds recognized by Ornithologists the Aetomorphæ count as 510; which are distributed through the above-mentioned Sub-Orders as follows: Accipitres 300—320 species; Striges 400—410; Pandiones 1; Serpentarii 1; Cathartæ 9 or 10.

In regard to their geographical distribution, it may be said in general terms that the Accipitres have a world-wide distribution, except that no true Vultures are found in America or in Australia. The Striges also are represented over almost all the known parts of the earth's surface. The Osprey, again, is very widely distributed. The Secretary Bird is at present limited to the Southern part of Africa. And, lastly, the Cathartæ are mainly confined to the Southern States of North America and to South America.

Regarding the external characteristics of the Aetomorphæ as related to their habitat, the lecturer drew attention to the fact that nearly all the Birds of Prey that are decorated with occipital or other crests (not including under this term the frontal tufts of certain owls), are restricted to the Southern regions of the globe.

He then proceeded to describe in general terms the habits and mode of life of some of the leading forms of Birds of Prey, paying special attention to the Natural History of the Hawks and Falcons, and illustrating his remarks by reference to a large series of drawings from living birds. After appealing to his hearers to obtain more protection for these interesting birds, the lecturer went on to describe the methods adopted in capturing or otherwise procuring Hawks and Falcons for the purpose of Falconry, and then concluded by giving an outline of some of the processes adopted in training Falcons, and in afterwards making use of them in the field for Hawking and Falconry.

TUESDAY, MARCH 3rd.

There was a Lecture on "The Hot Springs of Iceland and New Zealand, with Notes on some Customs and Traditions among the Maories," by Cuthbert Edgar Peek, Esq., M.A., F.R.A.S., F.R.G.S., F.R. Met. Soc.

TUESDAY, APRIL 7th.

A Lecture on "Evolution," was given by Henry Walker, Esq., F.G.S.

The lecturer remarked that happily this question was no longer a burning question, it can be discussed without prejudice. Evolution is a topic which is brought into our general reading and general culture.

Evolution has made great progress in the Astronomical world —no one doubts the nebular origin of things. The terminology of Evolution has been adopted in Theology, and it may be taken as a fact that some approximation is being made between these two sciences.

The lowest known organisms, the bacteria, monads, and other forms, were shown to illustrate the physiological unity of animals and plants, and a common mode of nourishment was traced in the animal series as high as the sub-kingdom Vermes. Passing to vertebrate life, the question of intermediate forms, once of such polemical interest, was illustrated, and a series of views was thrown on the screen by the limelight to show the links between the lancelet and the true fishes, the fishes and the amphibia, and the amphibia and the reptiles. Perhaps the most striking part of the lecture, and the most effectively illustrated by views, was that which dealt with the transition from reptiles to birds—from scales to feathers—the great Belgian iguanodons being shown as walking on their hind legs. The lecturer went into considerable detail with regard to avian and reptilian affinities, as also into the structure of the old flying reptiles (pterodactyls, &c.). Mr. Caldwell's recent discovery with regard to the Australian duck-billed mole was recounted, and its bearing on the evolution of man was explained. Apologising for becoming somewhat personal, the lecturer showed in one picture, in their zoological order, the four species of anthropoid apes, with man, the first member of the anthropoidea, at their head. Another view showed the adult skull and the infant skull of the gorilla in startling contrast, the much larger brain-case of the infant, which diminishes as the creature grows, seeming to imply that the gorilla is a degenerate form, and, therefore, that man and the anthropoids come from a common stock, but that the latter have degenerated whilst man has advanced. In conclusion, the lecturer said that, looking at the reception of Evolution in the world of thought, it was evident we were in the midst of the greatest mental revolution the world had ever seen, and one not to be entered upon with a light heart. Looking back through all the ages of mental activity, it was startling to think that the disclosure of so tremendous a secret of Nature had been delayed till our time. All other discoveries of the human mind paled before this of Evolution.

A series of lantern transparencies illustrated the lecture.

TUESDAY, MAY 5th.

A Lecture on "Insectivorous Plants" was delivered by George G. Chisholm, Esq., M.A., B. Sc., F.R.G.S.

Attention was directed to this subject as far back as 1768, when Mr. Ellis sent a short account of one of these plants to the Swedish Natural History Society. In 1857 Livingstone mentioned that he had observed a plant in South Africa which frequently caught insects. It was a Drosera. But it was not until 1875, when Darwin published his book on "Insectivorous Plants," that any great interest was taken in the subject.

Plants feed partly upon mineral substances, which they draw up by their roots, and partly upon air, which they take in by their leaves. The wood of plants, or "cellulose," which is approximately composed of seven parts by weight of carbon, one of hydrogen, and eight of oxygen, is almost entirely taken up from the air. Plants also have some nitrogen in their composition. This is required for the production of protoplasm the active part of the plant, and is, as a rule, obtained from the soil. Now if plants could obtain their nitrogen directly from animals, in the tissues of which compounds containing nitrogen preponderate, they would not require large roots, and they might therefore flourish where large-rooted plants could not grow. Insectivorous plants have small roots. One of the results of Mr. Darwin's investigations was the discovery that many of the insect-eating plants belonged to the same natural family, and it is particularly interesting to notice, for instance, that several of the best-known examples of this class belong to a family so well characterised on purely structural grounds as that of the "bladderworts," or the Lentibulariaceæ.

In the *Pinguicula* the leaves are found slightly turned in, and studded with a number of glands, some of which are stalked and some unstalked. These glands constantly exude a viscid secretion, which besmears the whole surface of the leaf. The object of this sticky secretion is to catch insects. Insects alight on the leaves and cannot get away, owing to the adhesiveness of the secretion. The edge of the leaf then turns in, and grasps the victim so that it is perfectly entrapped. The insect finally becomes quite enveloped, a large number of glands is brought into contact with it, and the creature becomes slowly digested. The plant, however, only selects food which contains nitrogen. It can digest very refractory substances, so long as they contain nitrogen—cartilage for example. As in animals, these plants carry on digestion by means of an acid and a ferment. Two ferments have been discovered in insectivorous plants, "Droserin," which is analagous to the pepsine of the stomach, and "Azerin," which is analagous to the ptyalin of the saliva.

In the "Bladderwort," or *Utricularia*, which is an aquatic plant, a number of little cells or bladders are attached to the leaves. Each cell has an opening, which is closed by a tiny valve, which is transparent and colourless, and very flexible and elastic. When a small animal, such as an Entomostracous Crustacean, enters the bladder, the valve closes the cell at the orifice, and entraps the animal. Larvæ, worms, and even newly-hatched fishes are found in the Utricularia. The captured animals die from loss of oxygen, and the plants absorb the products of decay.

The *Droseraceæ* are a family composed of only six genera, all of which agree in being insectivorous, though they differ greatly among themselves in the mode of capturing and utilising animal food. The Drosera, or Sundew, is a genus containing a large number of species, which are spread all over the world. The leaves are covered with tentacles, and at the tip of each tentacle is a gland which secretes the viscid matter. When an insect alights on the tentacles, these begin to curve in towards the centre of the leaf. The animal is firmly grasped, and escape is hopeless. An extremely minute stimulus is able to bring about this motion—a piece of human hair one millionth of a grain in weight is sufficient. Darwin found that of a large number of fluids containing Nitrogen a very minute quantity indeed is sufficient to produce the effect—as, for example, the one-twenty millionth of a grain of phosphate of ammonia.

The Dionæa, or Venus's Fly-trap, is found in North Carolina. The leaf is in two halves, which are capable of being folded like the leaves of a book, and it is supplied with filaments, which are endowed with irritability. When an insect alights upon and comes in contact with the filaments, the leaf closes upon it like a rat-trap. By an experiment of Dr. Sanderson's, it was shown that an electric current passes through the leaf of the

Dionæa in both the active and passive state, but that, just as in animal muscle, the strength of the current is weaker in the former condition.

A highly interesting group of Insectivorous Plants is composed of those whose leaves take the form of pitchers containing copious secretions at their bottom. Such are the Sarraceniaceæ, in which, however, the secretion is not digestive, but unlike digestive juices, accelerates rather than retards putrefaction. These merely absorb the products of decay, like the bladders of the Utricularia. The pitcher plant proper, the Nepenthes, on the other hand, is a true digesting insect-feeder. In all these forms the insects are attracted to the pitcher by the presence of honey glands, and it has recently been shown that these honey glands are much more abundantly distributed over the pitcher and the neighbouring parts than was at one time supposed.

SATURDAY, JUNE 20th.

The Association visited the Natural History Museum, South Kensington, where the members were received by Professor Flower, LL.D., F.R.S., and under his guidance went over some of the departments. He described the recent additions to the Museum, including the fine series of groups illustrating the habits of wild birds, and gave at some length an account of the collection of skeletons of various species of whale. The newly-erected statue to Darwin was much admired.

TUESDAY, OCTOBER 6th.

A Paper on "Thought-Reading," was read by Percy W. Ames, Esq., F.R.G.S., F.R.S.L.

Indications may be observed, at the present time, that the uncompromising attitude maintained by men of science towards psychical phenomena is undergoing a change. That intolerance of questions beyond the frontier of their own activity often laid to the charge of Theologians, has, in this direction, been no less marked in scientific circles; and, by those who consider that the evidence is abundant and conclusive, the dogmatism of science is inveighed against quite as much as has ever been the bigotry of Religion. The half-contemptuous indifference manifested, even by those who admit the "vast wilderness of unexplored truth," and who readily pursue new tracks of inquiry, can only be attributed to a disbelief in the reality of the phenomena. Let it be shown that, underlying the accumulated explanations and impudent impostures, are to be found veritable facts, and the subject must be at once admitted into the realm of positive science and the processes of Nature therein traced and examined.

Some of the difficulties in the way of this demonstration and admission appear to arise from certain unscientific conceptions commonly held—such as, that matter is more real than mind. "Matter," according to Mr. Huxley, "is merely a name for the unknown and hypothetical cause of states of our own consciousness." It cannot be too forcibly urged that it is knowledge of things not in their reality, but in their ideality, that we possess, and this kind of knowledge man cannot transcend. Another conception is that the presence of all matter can be easily demonstrated. In the most established sciences it is admitted that matter may exist in so attenuated a condition that it can be known only by the effects of its motion. Visibility and tangibility are not essential qualities of material substances, and energy and activity do not depend on density.

A further error is to suppose that the evidence of the sensory organs is strictly trustworthy and complete. An examination of the method of excitation of the senses and of the sciences connected therewith, soon reveals the indirect nature of their evidence and the extreme limitation of their range of operation.

Thought-Reading, a purely elementary form of psychical phenomena, has been attributed to imposture, to muscular indications, to exalted states of the Nervous System, and to the Devil. The first is disposed of immediately the *modus operandi* is observed. Nor can any one who has witnessed all the manifestations of this power, possibly retain the second hypothesis: since when the surrounding conditions are favourable, the experiments are successfully conducted during contact through slack wire, fern-leaf, &c., and even without any physical contact whatever. An exalted state of the nervous system may mean merely that the characteristic property of nerve tissue is especially active, or it may imply that some rarely exercised power is called into operation, whereby something is detected more ethereal and subtle than is ordinarily perceptible. Finally, when we reflect upon the vast importance of those discoveries that have successively been attributed to demoniacal instigation, the subject of this paper, seems hardly worthy of that significant distinction.

Thought-Reading is not concerned solely with outside action or dependent on mere dexterity. It is best displayed between persons of similar temperaments, preferably the nervous sympathetic. The mind of the reader must be passive and receptive, that of the so-called medium, concentrated and determined. Ordinarily, feelings of various kinds, and wishes, intentions, reflections, and other ideas, pass unchecked through our minds, and, with the uncultivated, this stream of consciousness does duty for the exercise of thought. True thinking implies the power of marshalling ideas in order, giving them form and direction, and exercising [illegible] them complete control. It is necessary in these tests for the medium to analyse those actions which are usually antomatically performed, and to bring the supreme consciousness to bear upon every detail. By way of example may be mentioned such a test as the following: A particular passage is chosen from a certain book which is then placed with a number of others. This is done in the absence of the operator who now enters blindfolded, and, in contact with a sensitive medium, has no difficulty in immediately discovering the book, opening it at the right page, and placing his finger on the passage. It is not sufficient for the medium in this case to think exclusively of the words read; every movement that will have to be made in approaching the books, selecting the one used and finding the place, must be clearly and systematically thought out. When this is accurately done the medium is often the most astonished at the rapidity of the performance, many of the movements being apparently ahead of the train of ideas passing through his mind. It is not necessary that the operator should have any clue as to the nature of the experiment he is required to conduct. When the medium's part is well performed, other conditions being also favourable, striking notes of music thought of, writing down the number of a bank-note, and other tests of like character can be unerringly carried out with equal speed and precision.

It will not be supposed that by the term Thought-Reading, the suitability of which may quite reasonably be questioned, is meant a power of penetrating another's thoughts. It implies on the part of the reader nothing more than a peculiar degree of sensitiveness to external impressions together with the ability of correctly interpreting them, and on the part of the one whose mind is to be revealed, the power of concentrating thoughts and of projecting such impressions.

At the conclusion of the paper, Mr. Ames successfully performed a number of experiments on several of the audience.

TUESDAY, NOVEMBER 3rd.

There was a Lecture on the "Musical Dramas of Richard Wagner," by Carl Ambruster, Esq.

The Lecture was illustrated by a series of extracts from "Rienzi," "The Flying Dutchman," and "Tannhaüser," which was performed by Miss Pauline Cramer, of the Royal Opera, Munich, and of the Bayreuth Festivals, and by the Lecturer.

TUESDAY, DECEMBER 1st.

A Lecture on "The Fuel of the Sun" was delivered by W. Mattieu Williams, Esq., F.R.A.S.

About fifteen years ago the Lecturer published a work on this subject, and he is of opinion that discoveries since made have gone to confirm the views then advanced. He believes that the matter of our atmosphere is expanded throughout space, and accumulated around every orb proportionately to its gravitation. The sun does not rotate precisely like a planet; for the equator travels more rapidly than the regions nearer the poles, and this shows that the surface is gaseous, or something between liquid and gaseous. If the sun has a nucleus, the action of the planets is to produce an eccentric rotation of the sun itself, and to form a very complex series of tides which would account for the appearance of a constant movement on the solar surface. The Lecturer believes that the instirring, ejection, dissociation, and recombination of the enveloping solar gases are sufficient to originate and maintain the heat and light of the sun, the instirring agent being the eccentric rotation of the solar nucleus, and the fresh fuel being supplied by the cosmic matter exchanged for that ejected by the prominences, and which the sun meets with in the course of its translation through space.

*** Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

MEMBERS, 1885-6.

Adkin, Robert, Lingard-road, Lewisham.

Airy, Sir George B., K.C.B., M.A., LL.D., D.C.L., F.R.S., F.R.A.S., &c., late Astronomer Royal, White House, Greenwich.

Ames, Percy W., F.R.S.L., F.R.G.S., Park-house, Lewisham-park (*Council*).

Armstrong, Professor H. E., F.R.S., Sec. C.S., 55, Granville-park, Lewisham (*Vice-President; President* 1881).

Arnold, William, 3, Marlborough-road, Lee.

Baillie, C. W., Lieut. R.N., 56, South Street, Greenwich.

Brabrook, Edward W., F.S.A., M.A.I., Barrister-at-Law, Assistant Registrar of Friendly Societies for England, 177, High-street, Lewisham (*Hon. Treasurer; President* 1879).

Bradley, William, 39, Limes-grove, Lewisham.

Bramley, Rev. Thomas, M.A., Colfe's Grammar School, Lewisham-hill,

Bramly, J. R. Jennings, The Firs, Lee.

Bristow, Rev. R. Rhodes, M.A., St. Stephen's Vicarage, Lewisham.

Brown, Alfred J., 55, Trafalgar-road, Greenwich.

Burroughs, J. E. B., M.R.C.S.E., Manor-villa, High-road, Lee.

Carpenter, James, F.R.A.S., Chester-villa, South-street, Greenwich (*Council*)

Carline, John, Merivale, Catford-bridge.

Chandler, W. A., 1, Pagoda-villas, Brandram-road, Lee.

Christie, W. H. M., M.A., F.R.S., V.P.R.A.S., Astronomer Royal, Royal Observatory, Greenwich (*Council*).

Clarke, Major C. G., 19, Blessington-road, Lee.

Clarke, Reginald, M.R.C.S.E., South Lodge, Lee-park, Lee.

Corcoran, Bryan, 5, Douglas-road North, Canonbury, N.

Cotterill, J. H., M.A., F.R.S., Professor of Applied Mechanics, Royal Naval College, Greenwich.

Creed, Thomas, M.D., Croom's-hill, Greenwich.

Crow, E. L.. Lee-bridge, Lewisham.

Deverell, F. H., 6, College Park-villas, Lewisham.

Dewick, Alfred, 10, Granville-park, Lewisham.

Dickson, A., Sunfield-villa, Tyrwhitt-road, New Cross.

Domeier Albert, Tudor House, Blackheath Park.

Erskine, Lieut.-General G., 53, Lee-park.

Ellis, William, F.R.A.S., Pres.R.Met.Soc., 1, Hyde Vale-villas, Greenwich (*Council*).

Fisher, T. Carson, M.D., St. Clare, College-park, Lewisham.
Forsyth, Alexander, M.D., 12, Park-place, Greenwich.
Frean, G. H., The Orchards, Blackheath.

Garnett, Thomas, Highlands, Clarendon-road, Lewisham.
Geveke, George, Brunswick-house, Camden-road, Lewisham-hill.
Giessen, Andreas, 1, Dunbar-villas, High-road, Lee.
Greenhill, A. G., M.A., Professor of Mathematics, Moti Bagh, Lingard-road, Lewisham.
Guy, Albert L., A.R.I.B.A., 78, High-street, Lewisham.

Haddon, A., M. Phys. S., Demonstrator in Physics, Royal Naval College, Greenwich (*Council*).
Hagger, George, 23, St. Germain's-road, Forest Hill.
Hall, H. P., Park-villa, Blythe-hill, Catford.
Hammersley, Joseph, M.R.C.S. Eng, 2, Norfolk-villas, Rushey-green, Catford.
Hart, Harry, M.A., F. Math. Soc. Lond., Mathematical Instructor, Royal Military Academy, Woolwich ; Cromer-house, Lee-terrace.
Hartt, C. H., 5, Romney-terrace, Greenwich.
Haynes, J. A., M.D., High-street, Lewisham.
Hearson, T. A., R.N., F.R.S.N.A., Instructor in Applied Mechanics, Royal Naval College, 5, Westcombe Park-road, Blackheath.
Hesse, F., 23, Manor-park, Lewisham.
Holmes, T. Vincent, F.G.S., M.A.I., 28, Croom's-hill, Greenwich (*President*).
Hoskings, A. B., Ventnor-cottage, Bonfield-road, Lewisham.

Jackson, H. W., M.R.C.S., F.R.A.S., Membre de la Société d'Anthropologie, Paris ; 159, High-street, Lewisham (*Hon. Sec.*).
Jerrard, S. J., 72, High-street, Lewisham.
Jones, Rev. J. Morlais, College-park, Lewisham.
Johnson, W. Claude, M. Inst. C.E., 8, Vanbrugh-park, Blackheath.

Karlowa, Otto, The Hollies, Avenue-road, Lewisham.
Keen, Percy, 34, Manor-park, Lee.

Laker, Abbott G., 4, Endwell-road, Brockley-rise, Brockley.
Lambert, Carlton J., M.A., F.R.A.S., M.Phys.S., Professor of Mathematics, Royal Naval College, Greenwich.
Lambert, Rev. Brooke, M.A., B.C.L., Vicar of Greenwich, The Vicarage, Greenwich (*Vice-President ; President* 1882-83).
Laughton, John Knox, R.N., M.A., F.R.A.S., F.R.G.S., F.R.Met.Soc., Professor of Modern History, King's College, London (*President* 1881 *and* 1884).
Lavers, T. H., 12, Belmont-hill, Lee.
Legge, Hon. Rev. Canon, M.A., Vicar of Lewisham, Lewisham.
Leunig, F., 31, Belmont-hill, Lee.
Lockhart, William, F.R.C.S., 67, Granville-park, Lewisham.
Low, Edwin, Aberdeen-house, Blackheath.
Lubbock, Sir John, Bart., M.P., F.R.S., High Elms, Down, Kent.

Morris, Henry, 4, Belmont-hill, Lee.

Ord, C. Knox, M.D., F.L.S., The Limes, Lewisham.

Pearce, E. R., 76, London-street, Greenwich.
Penn, John, M.I.C.E., Greenwich.
Penn, T., Grove-house, Lewisham.
Phillips, Edward, Athena-house, Morley-road, Lewisham.
Pitter, Joseph, 5, Bonfield-road, Lewisham.
Potts, William, 34, Limes-grove, Lewisham.
Purvis, Prior, M.D., Lansdowne-place, Blackheath.
Purvis, John Prior, M.R.C.S. Eng., Royal Hill, Greenwich.

Reed, Fred. H., 10, Belmont-hill, Lee.
Ritchie, J. H., Cedar-bank, Hyde-vale, Greenwich.
Robinson, Henry, Cayuga-house, Eliot-park, Blackheath.
Robinson, Rev. E. C., Thornleigh, Catford-bridge.
Rome, William, The Red-lodge, Putney, s.w.
Roper, Arthur, M.R.C.S., Lewisham-hill.
Ruck, George Thomas, F.S.S., The Hawthorns, Dorville-road, Lee.

Saunders, H. S., 36, Lee-terrace, Lee.
Saunders, Martin L., A.R.I.B.A., 36, Lee-terrace, Lee (*Hon. Sec.*).
Saundry, Dr., Royal Kent Dispensary, Greenwich.
Short, Frederick Hugh, 1, Marlborough-road, Lee.
Smale, G. F. W., Ormond-house, Granville-park, Lewisham.
Smith, Henry Francis, Slaithwaite-road, Lewisham.
Smith, W. Johnson, F.R.C.S., Surgeon to the Seamen's Hospital, Greenwich.
Smith, William H., Camp's Hill-house, Lewisham.
Soper, Henry Coles, Trafford-bank, The Glebe, Lee.
Stanley, J. H., Napoleon-cottage, Rushey Green.

Thomas, Rev. T. W. Embleton, M.A., Maze Hill-school, Greenwich-park.
Tindall, George, Court Hill-house, Lewisham.
Towse, John Wrench, Hillside, Ravensbourne-park, Catford-bridge.

Waghorn, J. W., R.N., D.Sc., F.R.S.N.A., Instructor in Physics, Royal Naval College, Greenwich.
Watchurst, Charles, 33, Blessington-road, Lee.
Webster, W., Jun., F.C.S., Wyburton-house, Lee-terrace, Lee.
Whomes, Robert, Brook-house, Lewisham.
Wilson, Edward, 59, Lee-park.
Wiltshire, Rev. Thomas, M.A., F.G.S., F.R.A.S., F.L.S., &c., Professor of Geology and Mineralogy, King's College ; 25, Granville-park, Lewisham.
White, Rev. James, M.A., Royal Naval School, New Cross.

Yeo, John, R.N., F.R.S.N.A., Royal Naval College, Greenwich.

EIGHTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS, 1886,

PRESIDENT'S ADDRESS, 1887,

AND

LIST OF MEMBERS.

Greenwich:

H. RICHARDSON, STEAM PRINTING WORKS,

CHURCH STREET.

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LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual General Meeting, 11th January, 1887.

President:

ARMSTRONG, Professor H. E., F.R.S., Sec. C.S.

Vice-Presidents:

HOLMES, T. VINCENT, F.G.S., M.A.I.

LAMBERT, Rev. BROOKE, M.A., B.C.L.,
Vicar of Greenwich.

Council:

AMES, P. W., F.R.S.L., F.R.G.S.

CARPENTER, JAMES, F.R.A.S.

CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc.,
Astronomer Royal.

DOMEIER, A.

HADDON, A., M. Phys. S.

LAUGHTON, Professor J. K., R.N., M.A., F.R.G S., F.R. Met. Soc.

Honorary Treasurer:

BRABROOK, E. W., F.S.A., M.A.I.,
Barrister-at-Law; Assistant Registrar of Friendly Societies for England.

Honorary Secretaries:

JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., &c.,
159, High Street, Lewisham, S.E.

SAUNDERS, MARTIN L., A.R.I.B.A
36, Lee Terrace, Lee, S.E.

REPORT OF THE COUNCIL

FOR THE YEAR 1886.

The Council have the pleasure to present a brief Report of the Proceedings of the Association during the past year.

Lectures have been delivered at all the ordinary Meetings, and on each occasion the attendance has been satisfactory. Ladies usually avail themselves of their privilege as Visitors by coming in considerable numbers.

The Treasurer's Accounts have been examined by two Auditors, and the Balance at the close of the year was found to be £9. 1s. 6d.

There is also a balance of £25 due from Members as subscriptions in arrear, which, though somewhat larger than usual, will no doubt be received in due course.

The number of Members having been slightly reduced during the year by removals from the neighbourhood, and other causes, it is desirable that Members should at once invite such of their friends, as take interest in Scientific pursuits, to join the Association, and fill up the vacancies.

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1886.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
Balance brought forward from last year ...	14	16	6	Hire of Room	8	15	0
Subscriptions	33	12	0	Expenses of Lectures	15	17	5
				Printing	12	9	7
				Postage and Telegram	2	5	0
				Balance in hand	9	1	6
	£48	8	6		£48	8	6

Examined and found correct, 5th January, 1887,—THOMAS BRAMLEY, H. G. MORRIS, } *Auditors.*

PROCEEDINGS, 1886.

LIST OF OFFICERS AND COUNCIL FOR 1886.

President:

HOLMES, T. VINCENT, F.G.S., M.A.I.

Vice-Presidents:

ARMSTRONG, Professor H. E., F.R.S., Sec. C.S.

LAMBERT, Rev. BROOKE, M.A., B.C.L.,
Vicar of Greenwich.

Council:

AMES, P. W., F.R.S.L.

CARPENTER, JAMES, F.R.A.S.

CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc.,
Astronomer Royal.

ELLIS, WM., F.R.A.S., Pres. R. Met. Soc.

HADDON, A., M. Phys. S.

LAUGHTON, Professor J. K., R.N., M.A., F.R.G.S., F.R. Met. Soc.

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36, *Lee Terrace, Lee,* S.E.

TUESDAY, FEBRUARY 2nd.

A Lecture entitled "An Autumn Holiday Tour" was delivered by the Rev. Brooke Lambert, M.A., B.C.L., Vicar of Greenwich, Vice-President of the Association.

The Lecturer began by stating that he doesn't believe in two things—sunrises and waterfalls,—and that he never puts himself out of the way to see them. Last year he spent his holiday in Dalmatia and other parts on the Coast of the Adriatic. He went by the St. Gothard route (one of the most picturesque railways in the world), passed through Venice in the dark, spent a day in Trieste, and then went direct to Cattaro. The scenery on the Dalmatian coast is very remarkable; the coast dips abruptly into the sea, and is sheltered by a long line of islands, reminding one of a lake voyage. This part is interesting from the fact that to the inhabitants of this district we owe the rolling back of the Turkish irruption into Europe. Traces of the former glories of Venice are found everywhere—in all the towns the Venetian Lion is found, rampant, jubilant, quiescent, expectant. Passing down the coast of Dalmatia we come to the curious Bay of Cattaro, remarkable for the contests that have there taken place, and for the singular appearance of the entrance to Montenegro. Antivari, pitched on a little hill, is a ruined town which belongs no longer to the Turks, but to the Montenegrins. St. Giovanni di Medua is on Turkish soil, and here the Lecturer got into trouble about a pair of boot-trees. The Scutari roads in this neighbourhood had been newly metalled, and were very wretched. Itself it is one of the loveliest places in the world: it lies at the end of a lake about thirty-six miles long, and is embosomed in mountains. The dress of the Albanians is very picturesque, every man has petticoats of white cotton plaited into numerous folds. Like all Eastern towns, Scutari abounds in open places and wretched streets. The bazaars are quaint, the mosques picturesque.

Passing on to Montenegro the Lecturer went in a kind of flat-bottomed punt rowed by four men. Nature has denied to Montenegro most of the good things which go to make the riches of a country. The Lecturer thought it the stoniest territory he ever saw, and the least provided with water: it has no streams. What cultivation there is exists in small patches, and these look as if they had been lake-bottoms. There is plenty of wood, but there are no coals and no minerals. In Montenegro nearly every third man one met was a soldier, and the hill-tops were dotted over with forts.

On his return the Lecturer went by the coast from Cattaro, stopping first of all at Ragusa, off which place, at the Isle of Lacroma, Richard Cœur-de-Lion landed.

Civilisation breaks over barriers, and the most picturesque costumes are now giving way to the horrible caricatures of the modern tailor. Each village at one time had its distinctive dress, but this is now passing away, and, before long, all will be reduced to one common level of millinery, derived probably from France.

TUESDAY, MARCH 2nd.

A Lecture on "The Lion and its Kindred" was delivered by J. G. Goodchild, Esq., F.G.S., F.Z.S.

The Lecturer chose this subject because we know more of its history than we do of that of most other animals. The Lion is a vertebrate and a mammal. It is a carnivore. It is an animal with nails more or less pointed, and with never fewer than four toes on each foot. It has milk teeth which are shed, and permanent teeth of three kinds. We find that the muscle which works the lower jaw is very massive and powerful. In Cats the true molars are reduced to one above and one below. Throughout the whole of the Cats there is a strong family likeness, both internally and externally. Cats are found at the sea level, and as far upwards as 18,000 feet above it. There is a rusty spotted Cat in the northern part of India. The Leopard has a very wide distribution. Closely allied to the Leopard is the Jaguar. The Ounce is a large cat, it is found in high mountain regions about the snow line. Other Cats are those with tufted ears. Cats hunt as a rule singly, and not in packs as dogs do. The Lynx is an animal with strongly tufted ears; in former times it was a British animal. A close ally of the Lynx is the Egyptian Cat, which is probably the ancestor of our domestic

Cat. The tiger has a more limited range; its size is usually exaggerated. It seizes its prey by the neck, breaks the neck, and so kills it.

LION.—The young cubs of the Lion are commonly spotted and striped, but the markings disappear after a time. Lions vary to some extent in their colouring. The Lion is rapidly disappearing from the face of the earth; at one time it extended to the British Islands and to North America. The climate in those days was colder in Britain than it is now; the animal then had probably a thick fur, and was perhaps a spotted beast. The mane is now supposed to be all that is left of the thick fur. There are in England remains of the Lynx, Leopard, a cat allied to the Kaffir Cat, and the ordinary Wild Cat. In passing to the older formations we find there is less divergence from each other than is the case in the later formations.

TUESDAY, APRIL 6th.

Professor ARMSTRONG, F.R.S., Sec. C.S., Vice-President of the Association, delivered a Lecture on "Liquid Air."

TUESDAY, MAY 4th.

There was a Lecture on "Mineral Illuminating Oils and Lamps," by EDWARD PHILLIPS, Esq.

The Lecture was illustrated by diagrams relating to oil production, and a very large number of Lamps, specimens of oils and wicks, varieties of burners, &c., were exhibited on the tables. The Lecturer entered into details respecting the oil industries of Russia, and described the methods of distillation and purification. With regard to the safe use of Lamps he gave the following instructions:—1. Take care that the vessels to be filled with the oil are clean, and contain neither water nor dirt. 2. Dry the wick before using, so as to remove all moisture. 3. See that the wick fits the wick-tube, not too tightly nor yet too loosely. 4. The wick should not be longer than will reach the bottom of the oil-container; and as the wick acts the part of strainer, it should be changed not less frequently than every two months. 5. Before lighting the lamp, the charred pieces of wick must be removed by rubbing with the fingers. Do not, if you can avoid it, cut with scissors. 6 Turn up the wick slightly, light it, let the flame remain thus for two or three minutes, then turn up to the full power. The flame should be white; if it be orange-coloured the wick is too high, and must be turned down. 7. If a lamp has been used for three or four hours, it must be filled again before re-lighting. It is well to keep the lamp filled. Do not burn the lamp when the oil is nearly exhausted. 8. Take care to well wipe the lamp after filling. The unpleasant smell generally noticed when a lamp is first lighted chiefly comes either from the fragments of burnt wick inside the burner, or from oil spilt on the outside in filling. 9. To extinguish the light, turn down the wick gently, and leave the small flickering blue flame: this will soon die out. Do not blow down or across the chimney. 10. If the oil takes fire at the burner, a sharp puff of breath will frequently put out the flame. If it does not, smother it out with a mat or other woollen material.

In conclusion, the Lecturer showed some experiments with respect to the inflammability of the various products of petroleum, and demonstrated that the refined petroleum of commerce does not explode. Mr. Phillips stated that he was engaged in perfecting a safety lamp, which would be self-extinguishing if it fell on the floor.

TUESDAY, NOVEMBER 2nd.

A second Lecture on "Richard Wagner" was given by Carl Armbruster, Esq.

The Lecture was illustrated by a selection of extracts from "Lohengrin" and "The Master Singers of Nuremberg," which were performed by Miss Pauline Cramer and by the Lecturer.

The pianoforte was kindly lent for the occasion by Messrs. Broadwood.

TUESDAY, DECEMBER 7th.

A Lecture on "Apes and their Allies" was delivered by J. G. Goodchild, Esq., F.G.S., F.Z.S.

It is not easy to mark off all the Monkeys into one group. Monkeys are principally distinguished in the Eutheria by the possession of a hand-thumb, and foot-thumb. The object of the Lecturer was mainly to discuss the higher Apes, and the lower forms of animals immediately below them. There are 250 to 270 species of Monkeys, of which 240 are very distinct in character. Monkeys are more limited in space than they used to be in former times. There are none in Australia, New Guinea, and the neighbouring islands. It is difficult to define the Lemur from the Monkey, but the former has hair on the face, the latter has none. The Lemur is confined to Madagascar, while allied forms are met with in South Africa and Southern Asia. The lowest form of Lemur is the Aye-aye of Madagascar; a peculiar elongation of the toes enables the animal to hook out from holes in the wood the caterpillars upon which it feeds. There are no woodpeckers in Madagascar, and the Aye-aye does duty for them. The Lemur has no prehensile tail, no opposable thumb, no cheek pouches.

The nearest allies to the Lemurs in other parts of the world are found in South America—the Marmosets. American Monkeys have the nostrils widely separated, and thus differ from those of the Old World. The hand-thumb and foot-thumb of Marmosets are not well-marked. Certain other South American Monkeys have a prehensile tail, hairless at the tip, and with this tail they are able to pick up small things. All Monkeys of the New World, except Marmosets, have three premolar teeth; those of the Old World having only two premolars. Fossil Monkeys of miocene times have been found in America.

Among Monkeys of the Old World the tail is practically useless. Baboons are of the most brutal and repulsive type, but they are structurally higher than the Monkeys that have been referred to. Baboons seem to cultivate manners—such as they are; they appear to be governed by laws, and have a certain code of morality. Punishment is swift when these laws are transgressed.

The Anthropoid Apes, which more or less resemble man, may be roughly grouped, on the one hand into the Gibbons; and on the other into the Chimpanzee, the Orang, and the Gorilla. The Gibbons inhabit Southern Asia and the Indian Archipelago. The first feature in them that strikes one is the disproportionate length of the arms to the legs. This great length of arms is related to their mode of life in trees, for by their arms they are enabled to swing to a distance of thirty feet from one tree to another. They walk upon their legs, and balance themselves with their arms. In early geological times Gibbons extended into Europe as far as France.

The Orang is one of the largest Apes, inhabiting Borneo and Sumatra. Its movements are slow and lethargic, very different from those of the Gibbon. In a state of nature the Orang is a vegetable feeder. With regard to its intelligence, it seems to be on a very much lower level than the human idiot.

The Chimpanzee has a well-marked opposable thumb on the foot; that on the hand is less distinct. It has a high degree of intelligence, and in this respect is above the Orang. It is intellectually on the level of the idiot. It rarely walks on its legs.

The Gorilla leads nearly the same kind of existence as the Chimpanzee. In the young Gorilla the proportions of the skull appear more like those of the human skull than in the adult. The Gorilla almost as often goes upon its hind legs alone as it does upon all-fours. It uses its arms in self-defence.

The fact that the thumb of the Anthropoid Apes is becoming smaller, suggests that their ancestors had opposable thumbs. The organs of voice are the same in the Anthropoid Apes as in man; they appear to be perfect, but are not used in speech; and one would be inclined to conclude that these Apes had degenerated from a higher form of ancestor who had made some advance towards vocalisation.

THE PAST AND THE POSSIBLE FUTURE OF OUR ASSOCIATION.

Address delivered on January 11th, 1887, by the President, Henry E. Armstrong, Ph. D., F.R.S., Sec. C.S., Professor of Chemistry in the City and Guilds of London Institute Central Institution.

Our Association was formally constituted at a meeting held at the Clarendon Rooms, Lee Bridge, on February 4th, 1879, so that we are in the ninth year of our existence. Those fully acquainted with the inner working of the machine, know that Mr. Jackson is to be regarded as our "pious founder"; and in reviewing the past of the Association, it is my first duty—it is almost superfluous to say, my pleasing duty—to direct attention to the enthusiasm with which, as Hon. Secretary, he has during all these years devoted himself to its service, and to assure him on behalf of the Association that we highly appreciate and value his labours.

The objects of the Association are most clearly defined in the second of its rules:—

2. The object of the Association shall be the diffusion of Scientific Knowledge among its Members,

(a) By the Reading and Discussion of Papers, and by Lectures, on Scientific Subjects generally.
(b) By Reports on the Progress of Science.
(c) By the Exhibition of Objects of Interest, New Inventions, &c.
(d) By Excursions, Field Meetings, and Visits to Museums, Workshops, &c.

The following addendum to the rules indicates what, in the eyes of its promoters, was to be the function of the Association, and the mode of effecting its objects:—

Original papers will always be welcomed, but it is scarcely to be expected that they will be forthcoming, except on rare occasions, in a district so near to London with its numerous Scientific Societies; indeed, it is not proposed that the Association shall perform the work of, and be conducted as, an ordinary local Scientific Society. The intention is that those among its members having Scientific knowledge shall, to the best of their power, enlighten their fellow members as to the aims, principles and methods of the particular Sciences with which they are specially acquainted.

It is also contemplated occasionally to invite the co-operation of non-members in carrying on the work of the Association, although it is hoped that it will be chiefly supported by internal effort.

It is a special feature in the programme of the Association, that the presence of ladies at the meetings is desired.

Although the Association is termed the "Lewisham and Blackheath Scientific Association," it is not intended that it shall be confined in its operations to Lewisham and Blackheath, but that it shall include the neighbourhood generally.

Clearly our object was to found a mutual improvement society, and of set purpose we termed ourselves an Association—not a Society—in order that it might not be thought that our proceedings were to be modelled on the lines of a Scientific Society. In a neighbourhood like ours, so near to the head-quarters of all the great incorporated learned bodies of the kingdom, a Scientific Society must of necessity be a pretence, and its proper existence impossible.

To the continued useful existence of a mutual improvement association two things are essential: improvers and those willing to be improved. No rigid division of the two classes of members is possible, however, as frequently an interchange of relative positions must ensue in these days of extended knowledge. Our "Proceedings" contain the record of the doings of the one class, and a list of subjects brought under the notice of the members will be interesting at this stage of my address, Let me give such a list:—

1879.

March 5th.—The Electric Light: Mr. J. W. Waghorn, Royal Naval College, Greenwich. *Member.*

April 1st.—Starch: its formation and functions in plant life: Dr. Armstrong. *Member.*

May 6th.—Weather Forecasting: Mr. J. Knox Laughton, Mathematical and Naval Instructor, R.N.C., Greenwich. *Member.*

October 7th.—Various forms of telephone: Mr. A. Haddon, R.N.C., Greenwich. *Member.*

November 4th.—Prehistoric man: Mr. F. W. Rudler, Curator of the Museum of Practical Geology. *Non-member.*

December 2nd. The Steam Engine: Mr. Yeo, R.N.C., Greenwich. *Member.*

Two Excursions took place, one to Keston Common and the Source of the Ravensbourne on June 21st; the second to the British Museum, on October 18th, when Professor Owen delivered an address on some of the Fossil Animals in the Museum.

The first president of the Association, Mr. E. W. Brabrook, delivered an address at the close of his year of office on January 2nd, 1880.

1880.

February 3rd.—Our Sports and Pastimes: their origin and survival: Mr. J. E. Price, F.S.A. *Member.*

March 2nd.—Photography: its origin, progress, and practice: Mr G. Werge. *Non-member.*

April 6th.—Old and new views concerning the earth: Prof. P. M. Duncan, F.R.S. *Non-member.*

May 4th.—The progress of Ocean Steam Navigation: Mr. W. H. White, Assistant Constructor R.N. *Non-member.*

October 5th.—Glaciers and Glaciation: Mr. F. Bond, F.G.S. *Non-member.*

November 2nd.—Coal Gas: Dr. Armstrong. *Member.*

December 7th.—Dyeing: Mr. W. Webster, Jun. *Member.*

There were two excursions: the first to Chatham Dockyard on June 10th; the second on July 10th to Mr. Charles Darwin's house at Down: those members who were present at the latter, I am sure, will always remember the occasion, and will regard it as the greatest privilege ever conferred upon them as members of our Association.

The retiring president, Mr. J. K. Laughton, delivered an address at the meeting on January 4th.

1881.

February 1st.—The evolution of life with special reference to Darwin's theory of Natural Selection: Mr. J. Jenner Weir. *Non-member.*

March 1st.—Discoveries of Roman Remains made at Morton Farm, near Brading, Isle of Wight: Mr. J. E. Price. *Member.*

April 5th.—The lowest forms of animal life: Rev. H. H. Higgins. *Non-member.*

May 3rd.—The eye as an optical instrument: Mr. J. W. Waghorn. *Member.*

November 1st.—Dene-holes with special reference to the subsidences which have recently taken place on Blackheath: Mr. F. C. J. Spurrell. *Non-member.*

December 6th.—Diamonds, natural and artificial: Mr. F. W. Rudler. *Non-member.*

Two excursions took place, one to Kew Gardens on June 10th; another to the Zoological Gardens on October 22nd.

1882.

Jan. 3rd.—The Domestic Fireplace: Mr. C. H. Hutchinson. *Member.*

Feb. 7th.—The Recent Progress of Anthropology at Home and Abroad: Mr. E. W. Brabrook. *Member.*

March 7th.—Communicable Diseases: Dr. Armstrong. *Member.*

April 4th.—Wind Force and the way it is Measured: Mr. J. K. Laughton. *Member.*

May 2nd.—Aerial Navigation: F. W. Brearey. *Non-member.*

Oct. 3rd.—Early Man, or our Rude Forefathers: Rev. Brooke Lambert. *Member.*

Nov. 7th.—The Great Comet of 1882: Mr. W. H. M. Christie, Astronomer Royal. *Member.* Also the Transit of Venus: Mr. E. W. Maunder. *Non-member.*

Dec. 5th.—Portable Timekeepers: Mr. E. Rigg. *Non-member.*

On May 20th, an Excursion took place to the Deneholes in Jordan's Wood, Dartford; On June 7th, a large party visited the Royal Arsenal, Woolwich.

1883.

Feb 7th.– Monthly means of the highest and lowest diurnal temperatures of the water of the Thames, and comparison with the corresponding temperature of the air at the Royal Observatory, Greenwich: Sir G. B. Airey. *Member.* The Sun, its origin, history, and future. Mr. H. Walker. *Non-member.*

March 6th.—The Transmission of Power: Mr. R. M. Walmsley. *Non-member.*

April 3rd.—The Conservatism of Energy in Organic Nature: Mr. W. Lant Carpenter. *Non-member.*

May 1st.—Heating and Cooking by Gas: Dr. Armstrong. *Member.*

Oct 2nd.—Cremation in its Social and Sanitary Aspects: Rev. Brooke Lambert. *Member.*

Nov. 6th.—Caves and Cave-men: Mr. F. W. Rudler. *Non-member.*

Dec. 4th.—The Geology and Scenery of the South-East of England: Mr. T. V. Holmes. *Member.*

On Thursday, May 24th, a large party of Members visited the Royal Mint.

1884.

Feb. 11th.—The Great Ice Age in Britain. Mr. H. Walker. *Non-member.*

March 4th.—The Development of Pianoforte Music from Bach to Liszt: Mr. Armbruster. *Non-member.*

April 1st.—Our Local Water Supply: Dr. Armstrong. *Member.*

May 6th.—Modern Studies on Climatology: Mr. J. K. Laughton. *Member.* Notes on the Recent Earthquake in Essex: Mr. T. V. Holmes. *Member.*

Oct. 7th.—Recent additions to our knowledge of Old London: Mr. J. E. Price. *Non-member.*

Nov. 4th.—The Chemical and Physical Changes effected by Cookery: Mr. Mattieu Williams. *Non-member.*

Dec. 2nd.—Canada, its Aspects and Prospects: Rev. Brooke Lambert. *Member.*

On June 5th, there was an Excursion to Box Hill.

1885.

Feb 3rd.—Birds of Prey: Mr. J. G. Goodchild. *Non-member.*

March 3rd.—The Hot Springs of Iceland and New Zealand: Mr. C. E. Peek. *Non-member.*

April 7th.—Evolution: Mr. Henry Walker. *Non-member.*

May 7th.—Insectivorous Plants: Mr. E. C. Chisholm. *Non-member.*

Oct. 6th.—Thought Reading: Mr. P. W. Ames. *Member.*

Nov. 3rd.—The Musical Dramas of Richard Wagner. Mr. C. Armbruster. *Non-member.*

Dec. 1st.—The Fuel of the Sun: Mr. W. Mattieu Williams. *Non-member.*

On June 20th, a party of the Members visited the Natural History Museum.

1886.

Feb 2nd.—An Autumn Holiday Tour : Rev. Brooke Lambert. *Member.*
March 2nd.—The Lion and its Kindred : Mr. Goodchild. *Non-member.*
April 6th.—Liquid Air : Dr. Armstrong. *Member.*
May 4th.—Mineral Illuminating Oils and Lamps : Mr. G. Phillips. *Member.*
Nov. 2nd.—The Musical Dramas of Wagner : Mr. C. Armbruster. *Non-member.*
Dec. 7th.—Apes and their Allies : Mr. Goodchild. *Non-member.*

It will be admitted, I believe, by those who have been present at the meetings that the lectures, papers, &c., have, as a rule, been successes in point of subject-matter and style ; and that some, and I may especially instance the Rev. Brooke Lambert's most valuable Essay on Cremation, deserve to be more widely distributed than among the narrow circle of readers of our Reports.

Of the 57 papers, &c, of which I have given the titles, 28 have been read by Members and 29 by Non-members ; the disproportion will appear still greater if it be remembered that some of us have come forward on more than one occasion—too often, perhaps. This is not as it should be. I cannot believe that local talent does not exist in amount sufficient more nearly to supply the needs of the Association : either it is too modest, or it has not yet risen to that high sense of duty which the occasion demands ; probably, however, this is our fault, and is attributable to our not yet having made known clearly and widely enough our aims and objects.

Having said so much regarding the one class of our members —the improvers, let me now turn to the other class—those willing to be improved. Have they done their duty—in what does their duty consist? Obviously their duty is to attend the meetings regularly and thus encourage those who are doing their best to contribute to their information. I need scarcely point out that nothing is more discouraging to a lecturer than to see a small audience ; and that the failure of Members to attend places the Executive in a very difficult position, greatly militating against their efforts to induce competent men to come forward and address the Association. Of late the attendance has more often than not been far fron satisfactory, and not only in point of numbers: those who have looked around the room will have noticed that the majority of those present have been elderly Members and ladies.

"Of course these are all heartily welcome; but my chief complaint is that the young men of the neighbourhood evince no proper interest in our proceedings: we count but a very small number among our Members and it is not often that they appear as visitors. If our Association is to render any real service in the neighbourhood and is not to exist merely for the benefit of a very select few, it is essential that it become known to, and popular with, the young people: it is they who are most in need of, and can derive most benefit from, the information that it is possible for an Association like ours to provide and dispense.

On the occasion of the very admirable musical disquisitions by Mr. Armbruster, the attendance has been exceedingly good—in point of numbers; but the majority of those present have been ladies. Now why is this? Admitting—which I am not prepared to do—that the ladies whose presence graced these meetings came merely for the purpose of being amused, how is it that they were led to attend while their brothers remained away; how is it that entertainments which attracted them had no charms for young men? I believe the answer to be—Because young women are more or less successfully taught at school to understand and appreciate music, so much so that very frequently they continue their studies on leaving school; whereas young men are for the most part taught at school to understand and appreciate—nothing! and consequently more often than not display complete mental apathy in regard to any rational form of entertainment such as our Association can offer. Some no doubt belong to local debating societies, and thereby indicate a desire for self-improvement; but of such societies I am inclined to take Kingsley's view, who said: "I have nothing to say against debating societies: perhaps it was my own fault that whenever I belonged to one as a young man I found them inclined to make me conceited, dictatorial, hasty in my judgments, trying to state a case before I had investigated it, to teach others before I had taught myself, to make a fine speech, not to find out the truth."

I confess that I do not anticipate that any large number of young men of the type I allude to will be induced to join our ranks whatever may be the advantages we offer; but among their young friends our members must surely number many who, having their own establishments, are beginning to take a serious view of life, and will require but little persuasion to join us. Numbers give power, and there is no reason why our Association should not in the future be a centre of usefulness and intellectual activity. I also think that the time has come when the term "member" should apply to both sexes; there are no questions, I imagine, which concern an Association like ours that cannot be discussed in the presence of ladies, and I hope before resigning my office to gain the consent of the Association to this proposal. As a matter of fact, our Rules do not limit Membership to males, and our present treatment of persons of the opposite sex is to be traced to a statement made by Mr. Brabrook at the inaugural meeting to the following effect: "It will be suggested that you should resolve 'That the meetings should usually be open to ladies as visitors on the introduction of a Member.'" I am not aware that any such resolution was put.

One hopeful sign of educational progress in our neighbourhood, I think, is the fact that the attendance at the University Extension Lectures has increased in a very satisfactory manner since the establishment of an independent Lewisham Centre. As having relation to these Lectures, I may now read a letter from the Rev. Brooke Lambert, whose unavoidable absence this evening I much regret. He says:—

"The Vicarage, Greenwich,

"*25th January, 1887.*

"I am sorry that the Annual Meeting of the Provident Dispensary is fixed for 1st February. It is the first meeting since the project was set on foot, and I cannot therefore be present as I should have wished to support you at Lewisham.

"In connection with the subject on which I see you are to address us, may I make a suggestion: There are several courses of University Society Extension Lectures in the neighbourhood. Many of the courses have been on Scientific Subjects, Astronomy, Chemistry, Physiography, Botany, Geology. To those Students our Lectures would be very useful.

"It is the aim of our Society for the Extension of University Teaching to be more than a lecturing body. We always required Classes in connection with the Lectures, and offered Certificates on Examination. We want to go a step further, and weld the students of the various courses in each centre into one body, whose bond of union shall be study.

"We propose to form Students' Associations, out of which I hope may grow a good deal of Scientific earnestness.

"But as of old, 'crustula dabant doctores,' so it is necessary to throw out ground bait to catch one's fish, would your Association extend a friendly hand to our Society and admit students (certified to be Members of a University Extension Students' Association) at a nominal fee to your Lectures—*not* to your Excursions—leaving the bait to work for you as for us—ensuring as I trust it might, a larger audience for the Lectures, and attracting, as I believe it would, more Members to your Association: for many who came out of curiosity of the best sort, would become paying members. But I name the nominal fee because many of the students might be those who could not pay the 10s. 6d., and of those who could pay many will not take the trouble to get elected, yet in the room, might by a judicious canvass be caught as permanent members.

"Believe me, to be,

"Yours truly,

"BROOKE LAMBERT.

"Professor ARMSTRONG,

"*President Lewisham & Blackheath Scientific Association.*"

It appears to me that this is a most admirable proposal, but I trust that I may be favoured with your opinion of it. As yet I have had no opportunity of discussing it with my colleagues; I think, however, that during the present session, at all events, we might well try the experiment by giving notice at the University Extension Classes of the subjects to be considered at our meetings, coupling with this the intimation that admission tickets would be granted on application. I confess, however, that I look forward to an even more intimate connection between this Association and the Lewisham University Extension Centre: for I see no reason against, and many for, the work now carried on nominally under the auspices of the Society mentioned being conducted under our guidance. I have failed to discover that the Central Committee render any particular service to the Local Committees beyond that of easing them of a portion of the surplus receipts on the rare occasions when these are at disposal; they offer no advice in particular; they are not in the least acquainted with local requirements; and they fail to sufficiently encourage continuity of study. One of the chief difficulties in making the lectures successful arises from the largeness and character of the Local Committees, but it appears to be essential to have a large Committee in order to interest as many as possible in the work. Now if these lectures were given under the auspices of an Association like ours, all the advantages of a large town would be gained, as our Members might be kept constantly informed on the subject, and led to take an interest in the Courses; at the same time, the management might be vested in the hands of a small body, for the most part experts, whose action would not be hampered by the expression of opinion on the part of those who are little qualified to advise in such matters.

But now, Ladies and Gentlemen, let me address myself to the difficult task of pointing out to you in all seriousness why I regard the prosperity and success of our Association as of such importance to the district; let me indicate the nature of the work which I think it should be called upon to perform. Of late years complaints have been rife of depression in trade, and we all know that it is becoming increasingly difficult to keep head above water, and fairly to launch sons and daughters in the difficultly navigable ship of life. Many anticipate the return of the good old times; but not a few others are of opinion that this will never be, and that altered conditions must be met by a complete change of tactics. Said Professor Huxley a few days ago, in a letter to the *Times:* "I do not think I am far wrong in assuming that we are entering, indeed, have already entered, upon the most serious struggle for existence to which this country has ever been committed, and the latter years of the century promise to see us embarked in an industrial war of far more serious import than the military wars of its opening years. On the East, the most systematically instructed and best informed people in Europe are our competitors; on the West, an energetic offshoot of our own stock, grown bigger than its parent, enters upon the struggle, possessed of natural resources to which we can make no pretension, and with every prospect of soon possessing that cheap labour by which they may be effectually utilised."

How many are able to realise the truth of Professor Huxley's words? How many are able to appreciate the causes which are leading up to, indeed, have led up to, this industrial war which threatens us with destruction? How many will fathom Professor Huxley's meaning when he says "Many circumstances tend to justify the hope that we may hold our own if we are careful to 'organise victory?'"

Why is it that we are threatened with defeat? How are we to organise victory? We are threatened with defeat because we almost entirely fail to recognise the true character of our enemy; because an immense majority of us are ignorant of the weapons unceasingly wielded by our enemy, and are blindly satisfied to oppose against them all but absolutely untutored and unarmoured warriors. To organise victory we must be prepared to meet our enemy on at least equal terms:—we must understand his tactics; we must arm ourselves defensively and offensively with the most powerful of weapons.

In other words:—It is not yet recognised by any but the enlightened very few that the times are changed mainly because scientific discovery and the application of science to industry have revolutionised the civilised world. It is as though the language of a nation had been suddenly displaced by another of an altogether different type, strange to all but an extraordinarily small proportion of the population—consisting of those who either have had the good fortune, through some lucky accident, to receive systematic instruction in its character and use; or being possessed of genius, if not intuitively, have by their own effort and determination learnt to appreciate its meaning, and are able to express their deeds in its forms; although at times these latter find themselves at fault when called upon to interpret the more difficult passages.

This new language has powers and beauties inconceivably great:—we are assured that in times to come all intercourse with Nature will be carried on by means of it alone, and that those who are not practised in its use must of necessity fall absolutely behind in the race of life; and it is only in this language that the laws of health can be properly studied, no translation existing or being possible.

Why, then, is this not generally recognised—why is this new language not universally taught? Enquiry into the habits of the nation affected by this change of language, I think, would bring to light many peculiarities. We should find, probably, that they are too confident, owing to past success, due to the possession of great natural stores of wealth and to their having had amongst them many great men—whose genius, in fact, has brought into existence the new language; but for the most part they are not aware, or will not recognise, that their leaders have invented this new language: indeed, they have a most peculiar habit, almost every-one believing that he is able to give an opinion, and that his opinion is worth having, upon any subject whatsoever, and hence they pay little attention to what is said by their wise men, which perhaps is not surprising, as they fail to grasp the full meaning of the words used. Then—most serious of all—they entrust the education of their youth to men who, with very few exceptions, are absolutely ignorant of the new language: some few, indeed, thinking that it is likely to become fashionable, ostensibly make provision for teaching it, but, as a rule, place the assistant-masters they have chosen for the purpose in the most unfavourable position possible as compared with that of those teaching other subjects—especially languages of which no single word is ever used in ordinary daily intercourse; moreover, being themselves ignorant, they are unable to judge if those to whom they commit the teaching are doing their duty. The system prevailing at the chief schools may almost be termed the cattle-show system, the object being to compete for prizes at the Universities and elsewhere, very very few of these prizes, be it remembered, being offered for proficiency in the new language. Their Universities, in fact, are too much under the control of men who are without knowledge of, and therefore of necessity destitute of sympathy with, the new language: consequently they do not require that the students who come to them shall know a word of it, and all but a very small proportion quit them in an equally blissful state of ignorance, and entering schools and various professions exert a leavening influence which is better imagined than described. In this nation whose peculiarities we are considering, no effort is made to include among the responsible members of their Government a single person who is versed in the use of the new language, and among several hundred members in their House of Representatives those who really understand it may probably be counted on the fingers. As regards the daily newspapers, which exercise a potent influence on the people, their editors and regular staff of writers also know nothing of the new language; occasionally a paragraph appears in their columns, but usually it is of trivial import and weak in style, if not full of serious grammatical blunders.

Pardon this long indictment, but I hold it to be the duty of every one who is acquainted with the beauty and power of the new language, to lose no opportunity of proclaiming these and of advocating its study. At our meetings much can be done in making clear the meaning of the characters in which it is written, and in expounding the beauty of some of the passages in the great book of Nature, only decipherable after a knowledge of its character has been gained. But you all know very well that a useful knowledge of a language, with power to make use of it, cannot be gained by attendance at a few lectures; and that to this end prolonged and careful study under qualified teachers is necessary; also that it is of great advantage to commence this study early. And this brings me to my main point:—What I hope of this Association is that its members will rise up in revolt, and will induce their friends to rise up in revolt, against our school system: that they will insist upon proper attention being given to the teaching of this new language in our local schools: that, in short, they will be led to take a real interest in the school education of their children, and by example and precept at home will encourage them to strain every nerve to gain knowledge likely to be of such enormous value in the coming struggle. Probably I shall excite the anger of many parents by this suggestion, but I care little if

I lead some of you to enquire into the character of the work done by your children at school: I wish I could feel sure that such enquiry would not end in your becoming intensely dissatisfied. The fact is that in this, as in many other matters, we shirk and shift responsibility. If parents send their children to school say at 6 to 8 years of age and leave them there until 16, 17, or 18 years old, without making the slightest endeavour to ascertain if they are being properly trained, whose fault is it if at the end of their school life it be discovered that they have learnt nothing of real value to them in years to come? But how often is this discovery made? How frequently do we hear the outcry, "What am I to do with my sons?" And does not the difficulty in too many cases arise from the fact that the said sons have had no proper training at school? The fact is that our middle-class schoolmasters are, in too many cases, perfectly irresponsible persons. Parents, as a rule, have not the knowledge which would enable them to be judges; moreover, no school could be successfully carried on if subject to constant interference. But whereas in the Board Schools provision is made for testing the efficiency of the teachers, we, the middle-class public, have absolutely no guarantee that the teachers in the schools available to our children are competent to perform the work they undertake; and those who become teachers in our schools, as a rule, enter upon their duties without the slightest previous training, and have gradually to find out for themselves how to teach. The result is that, having themselves learnt more or less *about* events and things, but rarely, if ever, the art of *doing* things—they merely teach our children about events and things, and do their best to stunt what little intellect they possess by causing them to commit to memory a vast amount of useless verbiage, failing to realise that it is their main duty to develop faculties and not to exact positive knowledge. This is why we have such difficulty in placing our sons. No doubt changes are taking place; things are improving: but all too slowly if we are to retain that position of vantage in the world which Englishmen have so long enjoyed. I have spoken strongly in the hope of drawing your attention to this subject, as at the present day it is the most important one on which it is necessary to form public opinion.

And you will now also fully realise why we strongly urge that it is before all things important to introduce the study of the new language into our schools: it is because directly we begin life on our own account we are all continually called upon to *do* things, not merely to exhibit knowledge of things and of events—especially such as happened in classical and mythical times; and it is because we believe that no amount of classical or mathematical training will serve to develop and cultivate the power of doing, and that the faculties involved *in doing things* acquire their highest development through the study of natural science—the exact study, that is to say, of Nature's methods and workings. But it is right to caution you that your sons and daughters cannot gain this knowledge merely from books: as children they must learn to do things—that is, to make experiments, and to do things with a definite object in view; and they must learn to grasp the meaning of all they have done, to apply the knowledge gained, and to draw logical conclusions. It is no easy matter thus to teach young people: a more highly trained teacher than is ordinarily met with in schools is required; and the making of experiments—which, let me repeat, is indispensable—will involve some expense. But if it is once made clear to us that our children do stand to gain much from the study of the new language of which I have said so much, I am sure there will be few who will grudge the extra cost.

Time does not permit of my pointing out in detail all the manifold advantages arising from a proper training in the use of the new language. Let me then refer you to Herbert Spencer's Essay on Education, a cheap edition of which, costing 2s. 6d., is published by Williams & Norgate; it is the most valuable contribution to the subject ever written. Also let me refer you to Kingsley's Scientific Lectures and Essays (Macmillan), and to Huxley's collected writings. If you will but read, mark, learn, and inwardly digest these, you will not fail to do your duty as Members of this Association, and—those of you who enjoy the responsibility—as parents.

Coming from a clergyman, much that Kingsley says is of peculiar value, and I would specially urge you to read his preface to the book I have mentioned: from beginning to end it is full of wisdom, and a very mine of information and practical advice.

And now, Ladies and Gentlemen, you will have gathered what are my views with regard to the possible future of our Association—if our Members will bestir themselves; if our numbers increase largely; if, above all, we learn to know each other; if we take care to exert an influence at times other than those when we formally meet once a month: there is a possibility of a great work being accomplished. Some day I trust it may be possible to have erected in our parish a building devoted to educational purposes—to the study of the new language—in which we may find a home. But if my hopes are to be realised, it can only be because they are re-echoed by the Members generally, and by the manifestation of much greater activity than has hitherto prevailed among us. Sometimes but a spark is necessary to start the fire: I only hope that I may have struck that spark this evening.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

MEMBERS, 1886-7.

Adkin, Robert, Lingard-road, Lewisham.

Airy, Sir George B., K.C.B., M.A., LL.D., D.C.L., F.R.S., F.R.A.S., &c., late Astronomer Royal, White House, Greenwich.

Ames, Percy W., F.R.S.L., F.R.G.S., Park-house, Lewisham-park (*Council*).

Armstrong, Professor H. E., F.R.S., Sec. C.S., 55, Granville-park, Lewisham (*Vice-President; President* 1881), *President.*

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Bramly, J. R. Jennings, The Firs, Lee.

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Carpenter, James, F.R.A.S., Chester-villa, South-street, Greenwich (*Council*).

Carline, John, Merivale, Catford-bridge.

Christie, W. H. M., M.A., F.R.S., V.P.R.A.S., Astronomer Royal, Royal Observatory, Greenwich (*Council*).

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Dewick, Joseph, 4, Eastdown-park, Lewisham.

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Domeier, Albert, Tudor-house, Blackheath-park (*Council*).

Erskine, Lieut.-General G., 53, Lee-park.

Ellis, William, F.R.A.S., Pres. R. Met. Soc., 1, Hyde Vale-villas, Greenwich.

Forsyth, Alexander, M.D., 12, Park-place, Greenwich.

Frean, G. H., The Orchard, Blackheath.

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Harding, Alfred B., M.P.S., F.S.Sc., 1, Albion-villas, Catford.

Hart, Harry, M.A., F. Math. Soc. Lond., Mathematical Instructor, Royal Military Academy, Woolwich; Cromer-house, Lee-terrace.

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Lambert, Rev. Brooke, M.A., B.C.L., Vicar of Greenwich, The Vicarage, Greenwich (*Vice-President; President* 1882-83).

Laughton, John Knox, R.N., M.A., F.R.A.S., F.R.G.S., F. R. Met. Soc., Professor of Modern History, King's College, London (*President* 1881 *and* 1884), (*Council*), 130, Sinclair-road, West Kensington-park, W.

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Legge, Hon. Rev. Canon, M.A., Vicar of Lewisham, Lewisham.

Leunig, F., 31, Belmont-hill, Lee.

Low, Edwin, Aberdeen-house, Blackheath.

Lubbock, Sir John, Bart., M.P., High Elms, Down, Kent.

May, W. Page, B.Sc., University College, Gower-street, W.C.

Morris, Henry, 4, Belmont-hill, Lee.

·Ord, C. Knox, M.D., F.L.S., The Limes, Lewisham.

·Oxenham, Edward Horswill, Keston-villa, Catford.

Pearce, E. R., 76, London-street, Greenwich.
Penn, John, M.I.C.E., Greenwich.
Phillips, Samuel E., C.E., M. Phys. S., Castle-house, Shooters' Hill, Kent.
Potts, William, 34, Limes-grove, Lewisham.
Purvis, John Prior, M.R.C.S. Eng., Royal-hill, Greenwich.

Ratcliff, Rev. Walter Henry, 24, Kidbrook-grove, Blackheath.
Reed, Fred. H., 10, Belmont-hill, Lee.
Ritchie, J. H., Cedar-bank, Hyde-vale, Greenwich.
Robinson, Henry, Cayuga-house, Eliot-park, Blackheath.
Robinson, Rev. E. C., Thornleigh, Catford-bridge.
Rome, William, The Red Lodge, Putney, s.w.
Roper, Arthur, M.R.C.S., Lewisham-hill.
Ruck, George Thomas, F.S.S., The Hawthorns, Dorville-road, Lee.

Saunders, H. S., 36, Lee-terrace.
Saunders, Martin L., A.R.I.B.A., 36, Lee-terrace, Lee (*Hon. Sec.*).
Saunders, Sydney S., Woollahra, Lee-road, Blackheath.
Saundry, Dr., Greenwich-road, Greenwich.
Smale, G. F. W., Ormond-house, Granville-park, Lewisham.
Smith, W. Johnson, F.R.C.S., Surgeon to the Seamen's Hospital, Greenwich.
Smith, William H., Camp's Hill-house, Lewisham.
Soper, Henry Coles, Trafford-bank, The Glebe, Lee.
Stanley, J. H., Napoleon-cottage, Rushey Green.

Tindall, George, Court Hill-house, Lewisham.
Towse, John Wrench, Hillside, Ravensbourne-park, Catford-bridge.

Waghorn, J. W., R.N., D. Sc., F.R.S.N.A., Instructor in Physics, Royal Naval College, Greenwich; Penlee, Coleraine-road, Westcombe-park, Blackheath.
Webster, W., Jun., F.C.S., Wyberton-house, Lee-terrace, Lee.
White, Rev. James, M.A., Royal Naval School, New Cross.
Whomes, Robert, Brook-house, Lewisham.
Wilson, Edward, 59, Lee-park.
Wilson, Edward, L.D.S.R.C.S., 98, High-street, Lewisham.
Wiltshire, Rev. Thomas, M.A., F.G.S., F.R.A.S., F.L.S., &c., Professor of Geology and Mineralogy, King's College; 25, Granville-park, Lewisham.

Yeo, John, R.N., F.R.S.N.A., Royal Naval College, Greenwich; St. Fillans Villa, Vanbrugh-hill, Blackheath.

NINTH ANNUAL REPORT

OF THE

Lewisham and Blackheath

SCIENTIFIC ASSOCIATION.

PROCEEDINGS

1887,

AND

LIST OF MEMBERS.

Greenwich:

H. RICHARDSON, STEAM PRINTING WORKS,

CHURCH STREET.

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LIST OF OFFICERS

OF THE

Lewisham and Blackheath Scientific Association,

Elected at the Annual Meeting, 16th January, 1888.

President:

ARMSTRONG, Professor H. E., F.R.S., Sec. C.S.

Vice-Presidents:

HOLMES, T. VINCENT, F.G.S., M.A.I.

LAMBERT, Rev. BROOKE, M.A., B.C.L.,

Vicar of Greenwich.

Council:

AMES, P. W., F.R.S.L., F.R.G.S.

CARPENTER, JAMES, F.R.A.S.

DOMEIER, A.

HADDON, A., M. Phys. S.

LAUGHTON, Professor J. K., R.N., M.A., F.R.G S., F.R. Met. Soc.

SINKLER, EDWARD C.

Honorary Treasurer:

BRABROOK, E. W., F.S.A., M.A.I.,

Barrister-at-Law; Assistant Registrar of Friendly Societies for England.

Honorary Secretaries:

JACKSON, HENRY WILLIAM, M.R.C.S. Eng., F.R.A.S., &c.,

159, High Street, Lewisham, S.E.

SAUNDERS, MARTIN L., A.R.I.B.A.,

36 Lee Terrace, Lee, S.E.

REPORT OF THE COUNCIL

FOR THE YEAR 1887.

THE Council beg leave to present a Report of the Proceedings of the Association during its Ninth year.

The financial condition of the Association is satisfactory, as shown by the Treasurer's Account, which has been duly audited.

Lectures have been delivered by Mr. Alfred Harding, on "Sound Waves;" Dr. Percy Frankland, on "Micro-organisms;" Professor Howes, on "Eyes,—Ancient, Modern, and Indifferent;" Mr. F. W. Rudler, on "Earthquakes and Volcanoes;" Mr. Carl Ambruster, on "The Musical Dramas of Richard Wagner;" Professor J. Millar Thomson, on "Photography;" and Mr. E. W. Brabrook, on "Human Measurement." Though the Lectures have in themselves been certainly equal to those delivered in previous years, the attendance has been far from satisfactory, and, in consequence, the earnest attention of the President and Council has been given to the measures that should be taken to increase the interest shown by the Members in the proceedings of the Association.

The President, in an Address delivered on February 1st, referred to this matter, and pointed out at some length the important services the Association might render by acting as the focus from which scientific knowledge of value to the community at large could be spread in our district: this is so obvious that the failure of the Members to duly support the efforts of the Executive can only have arisen from the circumstance that they have not yet realised how much the success of the Association depends on their regular attendance. The Council would also direct the attention of Members to the importance of securing new Members, and especially of interesting young people in the work of the Association, and of leading them to see that their active co-operation would soon secure for it a position of influence and authority which could not fail to enable the Association to do most valuable work in the Lewisham District.

On the recommendation of the Council, the Rules have been altered to allow of the admission of ladies as Members. It is hoped that this alteration will not prevent any ladies who have hitherto attended as visitors, and who do not desire to become Members, from continuing to favour the Association with their company at the Lectures.

This Association, in common with other local Literary and Scientific bodies, has presented a memorial to the Trustees of the Lewisham Parochial Charities, asking for a grant of funds towards the foundation and maintenance of an Institute for the benefit of the inhabitants of Lewisham generally, and to serve as a centre for all movements having for their object the spread of information and culture among the people. The memorial has been favourably entertained, and the approval of the Charity Commissioners has been given to it. The Council are, therefore, in confident hope of shortly seeing the proposal put into practical form.

The Council regret that illness has deprived the Association, at some of its recent meetings, of the very efficient services of Mr. Thomas Mansfield, who has from the foundation of the Association generously and zealously given his assistance in the arrangements for the evening meetings, and to whom, in consequence, the Association is very much indebted.

It is gratifying to find in the recently-published book, "The Life and Letters of Charles Darwin," edited by his son Francis Darwin, the following reference to the visit of the Association to Mr. Darwin at Down:—"1880. He also received in the same year a visit from some of the Members of the Lewisham and Blackheath Scientific Association,—a visit which was, I think, enjoyed by both guests and host."—*Vol.* iii, *page 227*

LEWISHAM AND BLACKHEATH SCIENTIFIC ASSOCIATION.

Treasurer's Report for the year ending 31st December, 1887.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance brought forward from last year ...	9	1	6	Hire of Room	10	0	0
Subscriptions	49	7	0	Expenses of Lectures	17	11	0
				Printing	13	6	5
				Postage	2	16	7
				Sundries		1	3
				Balance in hand	14	13	3
	£58	8	6		£58	8	6

Examined and found correct, 8th January, 1888,—H. G. MORRIS, } *Auditors.*
F. LEUNIG,

PROCEEDINGS, 1887.

LIST OF OFFICERS AND COUNCIL FOR 1887.

President:

ARMSTRONG, Professor H. E., F.R.S., Sec. C.S.

Vice-Presidents:

HOLMES, T. VINCENT, F.G.S., M.A.I.

LAMBERT, Rev. BROOKE, M.A., B.C.L.,
Vicar of Greenwich.

Council:

AMES, P. W., F.R.S.L.

CARPENTER, JAMES, F.R.A.S.

CHRISTIE, W. H. M., M.A., F.R.S., V.P.R.A.S., F.R. Met. Soc.,
Astronomer Royal.

DOMEIER, A.

HADDON, A., M. Phys. S.

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36, *Lee Terrace, Lee,* S.E.

TUESDAY, JANUARY 11th,

There was a Lecture on "Sound Waves," by ALFRED B. HARDING, Esq., F.P.S., F.S.Sc.

The Lecturer gave a brief account of Wave Motion, as explaining the phenomena of light and heat, and probably of electricity and magnetism, and explained that sound was also due to the impact, in this case, upon the organs of hearing, of undulations set up in the atmosphere by the vibrations of sonorous bodies. The physical difference between a musical note and what we call noise is merely this:—a musical note is caused by a succession of sounds, however produced, following each other at regular intervals, and so rapidly as to blend together into one effect; a succession of irregular, confused sounds, is called noise. He showed that musical notes may be produced by very various and often unexpected means. For instance, by holding a card against the teeth of a rotating wheel he obtained a series of taps, linking themselves into a note, whose pitch rose as the wheel increased in speed. The vibrations of tuning-forks were explained and illustrated, and it was shown that in all cases the pitch of the resultant note was dependent on the number of vibrations in a given time, while the loudness or intensity was regulated by the amplitude of the movement. A gas flame was made to produce notes of varying character by placing tubes of different lengths over it, thus causing a rapid series of explosions.

The ear fails to pick out separate sounds which follow each other at the rate of sixteen or more per second, while beyond 30,000 per second most ears are unable to perceive any effect. The practical range of *musical* vibrations lies between forty and 4,000 per second, embracing about seven octaves.

The most perfect musical instrument in the world is the human voice, which is caused by the vibration of the "vocal cords" due to the outrush of air from the lungs through the glottis. Sweetness and smoothness of voice mainly depend upon the perfect closure at regular intervals of the opening in the glottis.

When vibrations are set up in an elastic medium there is always a tendency to the production of *harmonic* vibrations. If movable particles of matter come within the range of such vibrations, they will collect around the nodes or points of comparative rest. This the Lecturer exemplified by a series of beautiful experiments with Chladni's plates. On drawing various notes from these plates (which were of brass), sand which had previously been strewed over the plates was found to rapidly arrange itself in most perfect and symmetrical figures, every note having its own definite sand-pattern.

Sound-waves move through the air from a centre of disturbance spherically in all directions, just as ripples spread in concentric circles when a stone is thrown into calm water. The existence of such waves was illustrated in two ways: first, by causing the waves to impinge upon a gas flame in the so-called "sensitive" condition, which flame was thereby affected in a very remarkable manner; and secondly, by causing the air itself to take up and reinforce the vibrations of a sounding body—an effect known as resonance. The length of a column of air which has a maximum resonance for a given note is just one-fourth of the length of the sound-wave. Thus, a tube which resounds to a fork giving the note *C* with 512 vibrations per second, would be $6\frac{1}{2}$ inches in length, because the sound-waves produced by the sounding-fork are four times $6\frac{1}{2}$ inches, or 2 feet 2 inches long. The impact of sound-waves upon the ear causes the tympanic membrane, which is situated in front of the drum, to vibrate, and the vibrations are ultimately communicated, through the auditory nerve, to the brain, and there interpreted as sound. Hence sound, as such, has no existence outside of ourselves, it merely consists of an aërial disturbance, which is only differentiated as sound when affecting our organs of hearing.

Any other tense membrane will vibrate when struck by sound-waves, and if a conductor, such as a rod or string, be attached to two such membranes, sounds uttered near one may be conveyed to, and heard in the vicinity of, the other. This is the principle of the mechanical telephone, which, in its simplest form, has been known for very many years. The use, however, of a thin metal plate for a diaphragm, which, vibrated by sound-waves in front of a magnet, gives rise to rapidly undulating pulses of electricity in a coil of wire wound around the magnet, has converted a simple toy into a most valuable means of inter-communication.

The Lecturer illustrated this part of the subject by a complete set of Gower-Bell telephones, by means of which conversation was carried on between the Hall and a neighbouring house, through a resistance equivalent to 100 miles of wire. Hughes's microphone was also explained and illustrated, while the lecture concluded with the beautiful phonoscope, by means of which the impact of sound-waves upon a diaphragm was caused to control the passage of discharges from an induction coil to a rotating vacuum tube, thus producing a surprising variety of luminous patterns, dependent upon the pitch of the notes uttered.

TUESDAY, FEBRUARY 1st.

Professor Armstrong, F. R. S., delivered an Address on the past Work and possible Future of the Association. The Address was published in the Report of the Association, 1886.

TUESDAY, MARCH 1st.

A Lecture on "Micro-Organisms" was delivered by Dr. Percy Frankland, F. C. S.

These Organisms are very widely spread, and constitute one of the most important factors in life. They are both destroyers and producers. They are found as parasites on higher organisms, and are recognised as the causes of several diseases. They exist in water, air, and soil. They appear in the character of both friends and foes.

Micro-Organisms are classed in three groups:—1, Moulds; 2, Bacilli, forming chains, some being possessed of powers of locomotion, others not; 3, Micrococci. They are the most widely distributed of any living things on earth. Through the elaborate researches of Pasteur, the idea that animate matter can be produced from inanimate was exposed. There is no possibility of generating life from dead matter. Micro-organisms are found most abundantly in crowded dwelling-houses, and in towns; in the country they are rarer; and they are difficult to discover in air which has come from the ocean. It is by means of micro-organisms that sugar is converted into alcohol, and alcohol into vinegar; through them cheese becomes altered and improved in quality and flavour; bread "rises" from the gases they produce, and the dough is prepared for baking.

Germ Theory of Disease.—In the early stages of research there appeared to be a belief that living germs were at the bottom of many diseases. Certain skin diseases, such as ringworm, were shown to depend upon a mould, and *bacilli* were discovered in the blood of animals which had died from anthrax. Some of the more conspicuous of these diseases are as follows:—Anthrax, from *bacillus anthracis,* chicken cholera from another bacillus, erysipelas from a *micrococcus*, pneumonia from a small bacillus, and tubercle from Koch's bacillus. Micro-organisms can be cultivated in water, solution of extract of meat, &c., but best of all on solids such as potato and gelatine. They can be rendered visible by staining with aniline colours.

TUESDAY, APRIL 5th,

There was a Lecture by Professor Howes, Assistant Professor of Biology, Normal School of Science, South Kensington, on "Eyes—Ancient, Modern, and Indifferent."

TUESDAY, MAY 3rd.

A Lecture on "Earthquakes and Volcanoes" was delivered by F. W. Rudler, Esq., F.G.S.

Attention was first called to the frequent recurrence of seismic and volcanic disturbances in recent years. The earthquake, which shook a large part of Southern Europe, on Ash-Wednesday, Feb. 23, 1887, and the great Charleston earthquakes of Aug. 31, 1886, were described as illustrative of seismic phenomena in general. The connection between seismic disturbances and volcanic outbursts was brought prominently forward, and illustrated by the phenomena witnessed in New Zealand on June 10, 1886, which destroyed the Sinter Terraces on Lake Rotomahana. A full description was then given of the sequence of events during the great eruption of Krakatoa in August, 1883.

Having thus referred to recent illustrations of terrestrial activity, the Lecturer turned to the detailed study of volcanic phenomena. He showed that the essential function of a volcano was to establish a communication between the exterior of the earth and its interior, and through the channel thus opened up, heated matter was brought to the surface. A volcano was defined as "a natural apparatus for turning the earth inside out." In this process of bringing matter from the interior of the earth and depositing it upon the surface, water in some form or other plays a most important part. The geographical distribution of volcanoes was traced, their linear arrangement marked, and their proximity to the sea dwelt upon. The action of superheated steam was regarded as a prime factor in the production of volcanic phenomena. The evolution of steam from Stromboli and the discharge of steam forming the "pine-tree appendage" of Vesuvius, were described. Among other vapours and gases emitted from volcanoes are cited hydrochloric acid and various volatile chlorides, sulphuretted hydrogen, sulphurous acid, carbonic acid, free hydrogen and nitrogen, ammonia, and boric acid. The Solfatara, near Naples, was referred to as a volcanic vent in a lingering stage of activity, exhaling only vapours.

Turning to the liquids concerned in volcanic phenomena, water was mentioned as the chief body ejected by geysers. The nature of mud volcanoes was referred to. The principal liquid product in most active volcanoes is of course lava, or molten rock. Its composition, temperature, and physical properties were described, and its behaviour in cooling was noted. The formation of Pélé's hair, volcanic bombs, and the common characteristic forms of lava, was discussed.

The origin of a volcanic cone was traced to the gradual accumulation around the vent, of so-called ashes and cinders, often mingled with lava flows. The old "crater of elevation theory" was referred to only to be discarded. The formation of a cinder-cone of great size was illustrated by a description of the origin of Monte Nuovo, which is a conical hill upwards of 400 feet high, known to have been formed in 1538 by the accumulation of solid ejectamenta in the course of 48 hours. As a general illustration of the history of a volcanic mountain, the story of Vesuvius was told in some detail.

Brief reference was finally made to the former occurrence of volcanic activity in the British area. The old lavas of the Giant's Causeway and the Western Scottish Isles were described as the latest examples of volcanic products in this region, but the lingering effects of subterranean heat were evident in our thermal springs at Bath and elsewhere. Such phenomena as those of the Essex earthquake on April 22, 1884, serve to remind us that the crust of the earth beneath our very feet may at any time assume a dangerously unstable condition.

TUESDAY, OCTOBER 4th.

The third Lecture on "Richard Wagner" was given by Carl Ambruster, Esq.

The Lecture was illustrated by a series of extracts from the Tetralogy—"The Ring of the Niblung,"—which was performed by Miss Pauline Cramer and by the Lecturer.

The pianoforte was kindly lent for the occasion by Messrs, Broadwood.

TUESDAY, NOVEMBER 1st.

A Lecture, entitled "Hints to Amateurs in Photography," was delivered by Professor J. Millar Thomson, F.R.S.E., F.C.S., Lecturer on Photography at King's College.

At the commencement the Lecturer gave a short history of the development of the art. It has been known for centuries that light acts upon many substances, those which show the most marked change being known as salts of silver. That nitrate of silver, or lunar caustic, became darker under the influence of light, was known to the alchemists. Ritter discovered that the lunar caustic was acted upon more by the violet rays than by any other part of the spectrum. Wedgewood took nitrate of silver photographs, but he was unable to "fix" them. Dr. Wollaston took pictures on resins and gums, such as guaiacum. The first real advance, as far as picture-taking was concerned, was made by Niépce. Daguerre sensitised a silver plate with iodine, and obtained an image; the plate was then exposed in a cupboard to the vapour of mercury, and thus the picture was fixed, or made permanent. Whilst Daguerre was working with silver plates in France, Fox Talbot in England was using paper prepared with iodide of silver. Reade discovered the method of "development" after exposure. Sir J. Herschel suggested glass as a basis for the taking of pictures; and Scott Archer and Dr. Diamond used a sensitised emulsion of collodion poured on glass.

The Lecturer then described the manipulation of the wet-plate process.

In the collodion process, iodized collodion is poured on a plate of glass, the collodion dries, and then the glass is dipped in a silver solution. Chemical change ensues, and an iodide of silver is formed on the collodion film, wholly or partially on the surface. This is known as the wet-plate process. Collodion is made from gun-cotton. Nitric and sulphuric acid are poured on cotton-wool, and the cotton-wool is then carefully washed in water. The resulting gun-cotton then dissolved in ether is known as collodion.

In the emulsion process a definite amount of iodide of silver is used, and the whole of the material on the surface of the glass is impregnated with the chemical materials.

The difference between the old wet-plate process and the more modern emulsion processes was illustrated by the preparation of a collodion emulsion. In this process definite amounts of silver salt and soluble bromide are carefully mixed together in the previously prepared collodion; the plate being coated with this sensitive emulsion after it has stood for some time. Collodion emulsions are termed washed or unwashed, according as the emulsion is washed before it is poured on the plate or only after the plate has been coated with it.

In connection with apparatus, the two chief articles of importance are the camera and lens. The camera should be as light as possible consistent with strength, and absolutely light tight. With regard to lenses, the beginner should use at first *a single or view lens*, proceeding afterwards to a *rapid symmetrical* or *rapid rectilinear* more suitable for portraiture and instantaneous work.

The Lecturer then described the different forms of lenses used, and the employment of *diaphragms* or *stops* for cutting off the outer or peripheral rays.

The plate having been exposed in the camera, the next process is the development of the image. The development may be carried out in two ways: (*a*) by the acid method generally adopted in the wet-plate process, or (*b*) by the alkaline methods adopted for the more modern emulsion process. The process of development was illustrated on the screen, and the formulæ for different developers were shown by diagrams and tables. Retardation of the development may be brought about by the presence of an acid, or of soluble bromides or iodides in the developer; and acceleration of the process by the presence of excess of ammonia or potash. Over-exposure or excess of ammonia causes the phenomenon of fogging in the negative, which is due to the too rapid and general reduction of the silver salt. After development the picture is finally fixed by sodium hyposulphite, which dissolves the unacted-on silver salt.

The different printing processes were then described, and illustrations given of the process of toning silver prints with solution of gold chloride. Printing in platinum was also shown, this process consisting of two divisions: first, the printing of a faint image by sunlight on the sensitive surface; and, secondly, the development of the image by warm potassium oxalate. Rapid printing may also be carried out by employing a sensitive emulsion spread on paper instead of glass. In this case exposure to gas-light is sufficient to obtain prints. By employing sensitive emulsions on paper, enlargements from small negatives can be easily done, and an illustration of this was given with an ordinary sciopticon lantern.

The Lecturer concluded with a short description of the simple methods now employed for photographing microscopic objects with moderate powers.

TUESDAY, DECEMBER 6th.

A Paper, entitled "Human Measurement," of which the following is an abridgment, was read by the Treasurer of the Association, E. W. Brabrook, Esq., F.S.A., M.A.I.

For the complete measurement of a skull, forty-six separate measures are recorded, and in addition to these twelve indices are calculated; so that I suppose a competent person could rebuild a skull at any time from the materials thus given. The indices are calculations of the relation of one measurement to another, and are usually given in per-centages: thus, 100 times the breadth divided by the length gives the index from which we derive the hard words brachycephalic, dolichocephalic, and the like. Why long-headed and short-headed might not be used instead, it would perhaps be presumptuous to enquire. This particular index is known as the cephalic index. Others are derived from the face, the orbit, the nose, and so forth. It has been long considered that, for the purpose of obtaining the distinguishing characters of the skulls of different races, an index, or the relation of one measurement to another, offers a better test than the actual measurements themselves.

With regard to the cephalic index, a great step in advance has recently been taken at the instance of Dr. Garson, who has induced the French and German anthropologists to agree with the English authorities in adopting the same scheme of measurement and the same names for the varieties of the skull. Those of other nations have agreed in it, and there is now therefore practically one system adopted all over Europe. Hitherto, the Germans had adopted a scheme agreed upon at Frankfort, which the French had ignored; but Dr. Garson has very ably conciliated both sides, and obtained an agreement which would, I suppose, never have been arrived at had the French and German scientists been left to approach each other. We have now got, therefore, a clear understanding as to what the mysterious words heretofore adopted are exactly to mean in the future.

It is now defined that when you take the extreme breadth of a skull and divide it by the extreme length, you get for a mean value 75 to 80 (exclusive) per cent., and that is called a mesaticephalic skull. An increase in breadth, giving 80 to near 85 as the index, is that of a brachycephalic skull; while an increase in length, producing 70 to near 75, indicates a dolichocephalic skull. Percentages in stages of 5 are used to mark extreme cases of shortheadedness and longheadedness respectively. Thus, an index of 85 to near 90 is that of a hyperbrachycephalic skull; and one of 90 to 95 of an ultrabrachycephalic skull; beyond which nothing has yet been imagined: while an index of 65 to near 70 is that of a hyperdolichocephalic skull; and one of 60 to near 65 that of an ultradolichocephalic skull; and longer than that nothing has yet been imagined.

General Pitt-Rivers, in an account of recent explorations in Wiltshire, has discussed the means of ascertaining the probable stature of a man from the remains of his skeleton. From the coins and other relics discovered, there was little doubt that the remains were those of Britons of the latest period of the Roman dominion, or that which immediately succeeded it. They were found to be a remarkably small race of people. In the two villages at Woodcuts and Rotherley, and in the pit near Park House, their stature did not exceed 5 feet $2\frac{1}{2}$ inches for the males and 4 feet 11 inches for the females. Were they the remnants of a larger race of Britons, deteriorated by slavery and reduced in stature by the drafting of their largest men into the Roman legions abroad? Of the fifteen skeletons found, one was three inches taller than the tallest of the rest, and, in the opinion of both Dr. Beddoe and Dr. Garson, had marked characteristics of Roman origin. His nose was very prominent and aquiline—a Roman nose, in point of fact—his superciliary ridges and his chin prominent; his estimated stature being 5 feet $7\frac{4}{5}$ inches. He had a remarkably brachycephalic skull, his cephalic index being 84; while all the other skulls were dolichocephalic or low mesaticephalic, their mean index being 76. It is suggested that he was the one tall Roman resident in a village occupied by short Britons.

Much difference of opinion exists on the question at what period man attains his full stature. Some French writers maintain that growth in height goes on until the 32nd or 35th year, and Dr. Baxter arrives at the same conclusion from the statistics of the United States' army; while most English writers regard the 25th as the year of mature growth, and Dr. Beddoe places it as early as the 23rd year. It is not to the general results of the whole population, which are modified by the fact that those who die out of it may or may not differ from the average, and probably will do so, but to statistics, if they can be obtained, of the same individuals in successive years, that we must look for the answer to the question. Mr. Charles Roberts concludes that, allowing for these sources of error, and judging by the run of the curves formed by the means and averages, it is probable that little actual growth takes place after the age of 21, and that it entirely ceases by the 25th year.

In order to obtain continuous observations of individuals, and thus get rid of the difficulty arising from the elimination of the weaker in successive averages derived from observations of the general population, Mr. Francis Galton has published a work which he calls "The Life History Album." He prepared it under the direction of the Collective Investigation Committee of the British Medical Association, of the Life History Sub-Committee of which he was Chairman. Mr. Galton mentions a curious circumstance that Messrs. Berry, wine and coffee merchants, of St. James' Street, commenced in the year 1765 a plan of gratuitously registering the weights of their customers, and that their registers have been continued ever since, and contain many thousand entries. It does not appear whether they have applied these records to any special purpose, or formed any conclusions from them; though one can imagine a good many curious questions arising on such a record.

Mr. Galton desires that anthropometric observations should be made at the end of the fifth year of age, and in each subsequent year up to the 25th. The hearing and sight of children should be tested at frequent intervals, for it not unfrequently happens that children are blamed for carelessness and inattention when they are really suffering from loss of sight or hearing, and these defects, if detected, can often be remedied or their advance arrested. The colour of the hair and eyes is liable to change during childhood and youth, and should be recorded. The age at which the hair becomes grey should be noted; also that at which baldness appears. With regard to the strength of pull, he observes that, though an interesting observation, it is not one of primary importance; indeed, it is one of some uncertainty, as shown by the great range over which the recorded pulls extend,—the highest pull recorded by the Anthropometric Committee having been 150lbs., and the lowest 20lbs. The pull most frequently observed was, for an adult male 77½lbs., and for an adult female 40lbs. It is difficult to get the subject to exert all his strength, and to do it in the right direction.

In comparing weights, the weight of the clothing has, of course, to be taken into consideration. In a careful examination of the weights of boys at Christ's Hospital, made by Sir Rawson Rawson, the weights were taken without coats, waistcoats, or shoes, and the weight of the remaining clothes worn when weighed was ascertained to be 2½ pounds. If the weight of clothes should be more than usual,—say, should exceed 7lbs.,—the circumstance should be noted, in order to enable the necessary correction to be made. The height, weight, and chest girth of these boys has been recorded for a considerable time, and shows between the ages of 9 and 17 an average growth from 51 inches to 63 inches; an increase in average weight from 59lbs. to 104lbs., or 6½lbs. per annum; and in chest girth from 25½ to 30½ inches. The relation between the three measurements was very close, the weight and chest girth increasing steadily with the height; one boy of 5ft. 9in. heading the whole of the list of 1936 with a weight of 135lbs. and a chest girth of 33½ inches.

The ratio of weight to height among people generally varies from 2 to 2½lbs. to the inch of height. Among the lower averages are letter-carriers and militiamen; among the higher, the fire brigade and the police. Among growing boys in schools it is about 1½lbs. to the inch. The weight of adult persons between 25 and 30 is greater in England than in America or Belgium, being respectively 150, 149, and 146lbs. in the three countries. In America itself, the Anglo-Americans have the advantage in weight over Americans born. At earlier ages, from 21 to 25, the advantage seems to be in favour of the Americans over the English. In general, however, the curves representing the two countries run very closely together. As between the sexes, for the first 6 years of life girls are lighter than boys; their weights then gradually approximate, till at 12 years of age girls and boys are the same; up to 16 girls are heavier than boys; but from that age they begin to lose ground, until at 18½ boys have the advantage of girls by 20lbs.

We may take it as an established fact that the average height and weight vary with the social position and occupation of the people. The general body of the population may be roughly divided into 15 per cent. of the professional and non-labouring class, 47 per cent. of the labouring class, and 38 per cent. of the artizan and operative classes. Throughout life the first-named class has the advantage in height and weight over the others.

It is suggested by Mr. Roberts that the cause of these differences is to be found mainly in superior nurture; that where the influence of food, clothing, nursing, and domestic surroundings generally are more favourable, there the average height and weight will be the greater. Subordinate to this consideration, but still of great importance, is that of the climatic and sanitary surroundings. It becomes a very interesting question, therefore, how soon and to what extent do the influences of nurture and of climate exercise an influence on the growth of a child. For the answer, we may fairly look to the statistics of boys between the age of 11 and 12 years in the schools of various grades in various parts of the country. That will allow time for these influences to have exhibited themselves, and will exclude other influences which depend rather on the individual than the class he springs from.

The results are these:—In the public schools of the country the mean height of boys of the age mentioned is 55 inches; in the schools of the same class in towns, $54\frac{1}{2}$; in the upper middle class schools, 54 inches; the lower middle class schools, $53\frac{1}{2}$; in elementary schools among agricultural labourers in the country, 53 inches; among artizans in towns, $52\frac{1}{2}$; in factories and workshops in country districts, 52; in town districts, $51\frac{1}{2}$; in military asylums, 51; in pauper schools, $50\frac{1}{2}$; in industrial schools, 50:—the mean height of the whole male population at that age being $52\frac{1}{2}$ inches (4ft. $4\frac{1}{2}$in.). The gradation is so regular and so uniform that it would almost lead one to doubt the accuracy of the returns, for every statistician will know that you must expect irregularities in any curve derived from observation, which you correct by a mathematical process; but here these are the results directly derived from observation, though almost too good to be true; and they show clearly the degradation of stature as boys are removed further and further from the most favourable conditions of growth. The same state of things will be found to exist among adults.

Upon the interesting question as to the effect of heredity upon height and other physical characteristics, Mr. Galton has made some curious observations. The idea occurred to him about ten years ago of testing it by experiments on the produce of seeds of different size but of the same species. He derived from them a law that offspring do not tend to resemble their parents, but to be more mediocre than they. Anxious to confirm or disprove his conclusion by anthropological evidence, he made an offer of prizes for family records, carefully avoiding any allusion to this particular purpose for which they were desired. The result was even more striking than that of the experiment with the seeds. He obtained the heights of 930 adult children and their parentages 205 in number. In dealing with them he raised the female heights to their corresponding male equivalents by multiplying them by 1·08. The height of the female parent thus corrected and of the male parent together divided by two, give the height of the mid-parent; and the observations resulted in showing that where the mid-parents are taller than mediocrity, taken as 5ft. $8\frac{1}{4}$in., their children tend to be shorter than they by two-thirds of the difference; and the converse when the mid-parents are shorter than mediocrity, when the children tend to be taller in the like proportion. It results from this, that the parents do not precisely reproduce themselves in their offspring, but that one-third of their influence evaporates, so to speak; by whom is the missing one-third exercised? Mr. Galton answers, by the grandparents, and more remote ancestors.

The question arises, since nature seems always to seek to revert to the average, do we never improve? The answer is probably, that while nature resists the perpetuating extreme variations, she is always seeking to raise the average. I am not aware that evidence exists upon which we can rely to prove this, but one cannot help thinking that it ought to be true.

In the course of his researches, Mr. Galton desired to investigate the frequency of error resulting from the data supplied by his observations, and he submitted a question to a mathematical friend, Mr. Dickson, of Peterhouse, for his solution. He says, "I never felt such a glow of loyalty and respect towards the sovereignty and magnificent sway of mathematical analysis as when his answer reached me, confirming, by purely mathematical reasoning, my various and laborious statistical conclusions with far more minuteness than I had dared to hope. His calculations corrected my observed value of mid-parental regression from $\frac{1}{3}$ to $\frac{6}{17\cdot 6}$, that is, it increased it from $\frac{15}{45}$ths to $\frac{15}{44}$ths, a difference too small to be taken into consideration." In other respects, the differences between the mathematically-calculated law and the actual results observed were only 3 per cent., or two degrees in an angle: showing that while on the one hand the mathematical doctrines apply to the case in question, the observed statistics range over a sufficient number of cases to make them trustworthy.

The next important measurement to be referred to is that of chest girth. It is of course essential that that should be taken in a uniform manner, as you may make a difference of several inches by the way you hold the tape. Compared with the other dimensions, it appears that chest girth increases more slowly than weight: the boy of 10 having 2lbs. weight for each inch of chest girth, while the man of all ages above 17 has $4\frac{1}{3}$lbs. weight for each inch: while with regard to height, the increase is slightly the other way, though not so much as to disturb the general relation that the chest girth is about half the height—the exact figures being ·476 minimum at ages 13 and 14, and ·542 maximum in full manhood.

The next fact upon which statistics are desired to be obtained is strength of arm, as shown by pulling as an archer with a bow. For this purpose a spring balance is used, which the person holds in one hand, the arm being extended in a straight line from the shoulders, and the other arm pulling against it towards the ear. In this case, as the measurement depends in some respects upon the will of the subject, consciously or unconsciously exercised, the results are not so satisfactory as where the measurement is of a simple fact, such as height or weight.

Other observations taken have been those of breathing capacity, strength of arm, sight, and span of arms. The term measurement, however, comprises more than the question of mere dimension or weight, and, in its full significance, may be taken as opposed to estimate. Observations, therefore, of the colour of eyes and hair, and of complexion generally, have been included. In respect of these, it is of course of the greatest importance that the observers should know exactly what they mean, and that different observers should use the same term always to describe the same colour. It is possible to make almost endless distinctions between colours. I exhibit a colour scale, comprising 42 colours and 20 shades of each, or altogether more than 800 shades. All these are, of course, not necessary for such a purpose; indeed, all the various colours of eyes might be grouped under eight colours in the scale, and those of hair and skin under a similar number.

Branching out of this enquiry are those into eyesight and colour-blindness. For the purpose of testing eyesight, cards are used containing eighteen square dots of one-fifth of an inch wide, placed irregularly in two groups, and the greatest distance noted at which the person observed was able to count them. Inspector-General Lawson remarks that the most favourable circumstances for bringing out the acuteness of vision are to view a dark body against a well-illuminated bright-coloured background some way behind it. Finally, Snellen's test-types have been adopted. With regard to colour-blindness, Mr. Roberts has observed that it is frequent in persons with red hair, and he estimates that one person in every twenty-five is subject to this defect. Astigmatism exists, according to observations on the boys and masters at Marlborough School, in two out of every three individuals.

These are the principal enquiries undertaken by the Anthropometric Committee; others might have been added, as the size and shape of head, for the cephalic index can be calculated from the head of a living individual almost as well as from a skull; the length of the lower limbs, as shown by the difference between the sitting and standing positions; the girth, length, and breadth of other parts of the body:—but it was soon found that the simpler the requirements were, the more trustworthy would be the results, and that it is a great mistake to ask for too much.

For a test of hearing, Mr. Galton has devised a very pretty little instrument, consisting of a whistle sounded by squeezing air out of a small india-rubber bag, and marked with a graduated scale, the figure on which is to be observed at the moment the squeak of the whistle becomes inaudible. It is complicated, however, by the fact that the air leaving the mouth of the whistle makes a sound at the same time, and that the observer has to be careful to distinguish between the two. For ascertaining the faculty of distinguishing between slight differences of weight, Mr. Galton used cartridges which he filled, not with powder, but with weights increasing by small degrees. For the cartridges have now been substituted small brass cylinders.

Probably the largest collection of anthropometric statistics ever brought together was that published by the Government of the United States of America, in three volumes, of the soldiers in the armies of the Union at the conclusion of the War of Secession, edited by Dr. J. H. Baxter. As these men were not a picked military body, but were volunteers enrolled from all classes of the people, the statistics were of great value. Since their publication, Mr. B. A. Gould has published a work on the same subject; and Professor Bowditch, of Harvard, Mass., has made extensive anthropometric researches, especially with regard to the growth of children.

In Switzerland, observations on the colour of eyes, hair, and skin of 405,609 children have been recorded. In Belgium, Mr. Vanderkindere has published the result of 608,698 observations on the colour of hair and eyes of children in the primary and communal schools. In the North-Western provinces of Russia, M. Snigerev has published a considerable body of statistics of height and chest measurements. In Italy, the Government have published many important papers on anthropometric subjects. In France, Dr. Topinard, M. Hamy, and others, have made many valuable contributions to our knowledge of these questions. In Germany, Prof. Virchow has completed observations on the colour of the hair, eyes, and skin of 6,758,287 children in schools. In Denmark, the Rev. R. Malling Hansen has published his observations on the deaf-mutes in an institution under his care, and has deduced a number of coincidences between the variations in their weight and those in the temperature of the atmosphere.

These researches have not let us into any very deep secrets of nature, but they have at least shown us that which we might reasonably have expected to be the case—that health and well-being of all kinds are promoted by the extension of information and the advantageous circumstances that we have described under the head of nurture; from all which we may gather that the person who plants in a densely-populated district a People's Palace with its classes for learning, its gymnasia, and its grounds for recreation, is doing much to develop and improve the physical characteristics of the people, and may be able to give the Anthropometric Committee of another generation the pleasant duty of measuring taller and heavier and healthier men, with fuller faculties and greater powers and means of physical enjoyment.

*** *Members are particularly requested to notify any change in their address to either of the Honorary Secretaries.*

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