Brighton and Sussex Natural History and Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH THE

ANNUAL REPORT

FOR THE

YEAR ENDING JUNE 14TH, 1894.

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WEDNESDAY, OCTOBER 11th, 1893.

INAUGURAL ADDRESS

BY

DR. ARTHUR NEWSHOLME, M.R.C.P.

(President of the Society).

THE INFLUENCE OF CIVILIZATION UPON THE SURVIVAL OF THE FITTEST.

Starting with the assumption that nearly all men competent to form an opinion about it were convinced of the substantial truth of the Darwinian theory of the origin of species, and that, as the result of the struggle for existence, the healthiest, the strongest, and the most courageous, lived longest, obtained most food, and overcome their rivals in the choice of mates, thus becoming the progenitors of the future race, Dr. Newsholme pointed out that we thus obtained the "survival of the fittest," the evident result of this law of natural selection. Yet, he said, it was quite conceivable that natural selection and the resultant survival of the fittest might hold good for the lower animals, but might fail to adequately explain the more complex phenomena relating to man. This consideration governed the whole subject of the "Influence of Civilization upon the Survival of the Fittest." The Malthusian hypothesis, that population tended to increase more rapidly than the means of subsistence, evidently implied that natural selection must be in full operation for mankind as for the lower animals. It implied that mankind is constantly on the verge of starvation, and that food is only obtained for the inhabitants of this globe because the less worthy in the battle of life are driven out of the struggle by famine, or pestilence, or war, or vice, or other adverse conditions, or are prevented from entering on the struggle by prudential restraints. He confessed that, if the premises of Malthus were admitted, his conclusions were inevitable, but he pointed out that the theory was really limited in its application by a variety of causes, such as the actual fecundity being less than possible fecundity; that it was historically true that food had always increased faster than population, in spite of the alleged tendency to the contrary; that whole families and even whole races tended to become extinct, under circumstances not involving any deficiency or difficulty of subsistence (*e.g.*, the extinction of the title of Baronets from the failure of male heirs), and so forth, leading up to the conclusion that, until the earth is fully inhabited, the sole condition enabling population to increase without limit is that the population shall spread as they multiply. The habitable parts of the globe are not yet fully occupied. There is, therefore, at the present time no necessary or irremediable overcrowding, though there are unhappily local congestions of population and consequent poverty.

Coming to the main issue, Dr. Newsholme continued :— Civilisation and, still more, Christian ethics, have introduced a disturbing influence in the struggle, which may even go so far as to stop the struggle altogether. "Love's divine self-abnegation" imposes restraints on some of the competitors, and prevents them from asserting and maintaining their natural superiority. There is no better instance of this than the daily life of medical men, who are "the chosen ministers of the higher ethics," and who prevent the death of multitudes of weaklings and thus apparently check the operation of natural selection.

The careful treatment of the sick, diligent attention to weak infants, asylums for idiots and for lunatics, hospitals for general diseases and all kinds of special diseases, including small-pox and other infectious complaints, convalescent homes, district nursing, and Poor Law relief, all imply that the old individualism which is characteristic of animal and savage life is giving place to collectivism. Of such collectivism there are traces even among animals. Ants and bees have an orderly polity on a large scale. In man this collectivism is in our own country so far developed that the pressure of the struggle for existence has been transferred, in a large measure, from the individual to the body corporate. For instance, no man in Great Britain need die of actual starvation. The Poor Law machinery, cumbrous though it may be, is founded and worked on the principle that it is the duty of the community to prevent any of its members from dying of starvation. Thus famine can only operate in the remote contingency of national bankruptcy. War, again, has not in the present century been waged to such an extent or with such severity as to seriously affect the question. The mitigation and prevention of various forms of disease which is undertaken by the community similarly show that the strain has been transferred from the shoulders of the individual to those of the community.

The principle of unlimited competition which was taught as an article of faith by Adam Smith, for many years naturally led to non-intervention in industrial concerns. The philanthropist was the first to break through this barrier and make the country feel that human life was of greater value than to follow out the logical consequences of the "dismal science." Once the State had intervened by limiting the hours of labour of women and children and by forbidding them from undertaking certain kinds of labour, the sluice gates were opened and it only became a question of time as to how soon State Socialism on a gigantic scale should replace the strict Individualism of the older economists. When Trades Unions secured legal recognition of their activity a further momentous stride had been taken.

The Elementary Education of all children, and the provision of funds for assisting workmen to obtain a mastery of their trade through Technical Education, are further steps in the collectivist direction. The action of the central Government in undertaking the post-office and telegraph, and more recently the telephone, and in offering to collect savings and to insure lives; and of local bodies in undertaking to provide water, gas, and electricity, to run tramways, build houses, &c., for the community, are other instances in point. The last and most ominous sign is the demand that our local bodies shall provide work in winter for the "unemployed!" Nationalization of the land has not yet become a plank in any influential political platform in England; but in Australia and New Zealand it has been partially tried. None of these steps when once taken can be retraced. It is evident that the pressure of the struggle for existence tends to be more and more transferred from the individual to the community. When we pass from civilization to the principles of morality, and when the principle of self-denial becomes a powerful motive in the life of the members of a community, we have introduced a new moral environment which alters very largely the results of evolution. In this respect man to a large extent makes his own environment. It is evident that the effect of this altered moral environment,—the introduction of the doctrine of pity—may be to counteract or even to suspend the operation of natural selection, which previously tended to secure the propagation of a steadily improving type of humanity.

Physical degeneracy may be first considered. Has the condition of collectivism which we have now reached been followed by physical degeneration of our race? The evidence bearing on this point relates to the personal physique, to the duration of life, and to the diseases which are prevalent. As regards physique, it has become a commonplace remark that among the masses the average physique is degenerating. There is no question that town-dwellers as a rule have a poorer physique than country-dwellers; and the rural population of England, which was 37·7 per cent. of the total in 1861, having declined to 28.3 per cent. in 1891, it is reasonable to assume that some degeneration has been the result of this transference from rural to urban conditions of life. On the other hand must be placed the facts that workmen in towns obtain better wages and therefore better food than agricultural labourers, and that the sanitary conditions of factories and workshops and of working-men's houses in towns are steadily improving, though they have not yet reached their proper standard. The pariah class in our towns is diminishing. Anthropometric measurements on a sufficiently large scale to give trustworthy averages are still wanting, and we have no comparative measurements for a century or two ago. I believe there is no doubt, however, that the average man of the present time cannot get into the average armour of the past which is now stored in the Tower of London, and that the helmet is also too small. The chest width, and still more, the size of the head, have increased. On the other hand, we are told by Sir Thomas Crawford that "the masses, from whom the Army recruits are chiefly taken, are of an inferior physique to what they were twenty-five years ago," the proportion of rejections of would-be recruits have considerably increased. This conclusion has more recently been shown to depend on an erroneous use of the available statistics, which, when corrected, tend to show that the physique of the lower classes has improved rather than otherwise. That the physique of the middle and upper classes is steadily and markedly improving is quite certain. Never has so much attention been paid to various out-door games. Never have school boys in our large public schools been allowed such an inordinately large proportion of their time for out-door play. From the physical standpoint this has produced admirable results, the average height and chest girth having increased in both sexes. The size of the brain, especially of the sensory portions, is also increasing. The only drawback to this is the increased difficulty of child-birth, which is characteristic of civilised as contrasted with savage life. In physique, then, we may say that there is no serious evidence of degeneracy as the result of modern civilization.

Has the duration of life decreased? So far from this being the case, it can be shown that the duration of life has steadily increased during the present century. In England and Wales 1838-54 the expectation of life for males was 39·41 years, and in 1871-80 it was 40·85, and in Brighton 1881-90 it was 43·09. This is the average duration of life. It may be stated thus : Giving the duration of life for ages 25 to 65,—the most important working years of life,—100 males in the aggregate lived 69 more years in England at ages 25-65 according to experience of 1881-90 than during the same period of life according to the experiences of England in 1838-54. It is evident, therefore, that although a large share of the gain has been in the early years of life, it has been shared at the ages 25 to 65.

To sum up, then, so far as physical degeneration is concerned, notwithstanding the unfavourable influence of the increased proportion of urban population, there is reason to look favourably on our prospects. With increased provision of open spaces in our towns on which so much stress is now being wisely laid, with improved and better ventilated houses, with more attention to out-door sports, we can look to the future without any fear of serious physical degeneration.

When we turn to the question of mental degeneration, it is possible to speak much more hopefully. There is, in the first place, a larger inheritance of transmitted thought, than any previous generation has enjoyed. Thus each member of the community now starts at a greater advantage than ever before. It is probable that originality may become less frequent, and individual fame may become more difficult of attainment. In history the names of certain men stand out as associated with special discoveries. When these cases are examined it will generally be found that the discovery had been led up to by a series of discoveries which are now almost forgotten. In the future it is probable that this tendency will increase. In the multitude of scientific workers individual credit will suffer, but science will progress.

The outlook from a moral standpoint is even more favourable. The present standard of morality is much higher than ever before in the history of the world. The early Christians are so often appealed to in theological controversies that they have come to be regarded as the standard with which we are to be compared, forgetful of the fact that they had only just emerged from heathendom, and, notwithstanding the sincerity of their faith, were still smirched with the mire out of which they had been dragged. The man of the world of the present day would die of shame were he accused of the vices for which St. Paul rebuked the Corinthian Christians.

I have hitherto considered the question from the standpoint of our own country. But little time is left for the racial aspect of the question. Savage races are dying out before our eyes with the greatest rapidity. In North America the red man is little more than a memory. The Carib has almost disappeared from the West India Islands. In Australasia and the Pacific Islands, the Maori, the Kanaki, and the Papuan are swiftly dying out. Making the fullest allowance for the havoc wrought by war, and the vices and diseases introduced by civilized man, they do not fully explain the case. Some mysterious blight appears to have been cast over these races by the presence of a higher form of humanity, and they die out with a strange rapidity, notwithstanding in many instances the forbearing protection of the stronger European. It must be noted that none of these evanescent races have ever been very numerous, and they have never shown themselves capable of settling down in any steady way to industry. The same fate is not likely to arise for the Hindoo, the Negro, or the Chinaman. These are all too numerous and too firmly fixed on the soil to be ousted. In India, out of an estimated population of 220 millions, there are some 47 million persons in the proportion of 600 to the square mile. More than 36¼ millions of them are packed to the extent of 800 to the square mile or 1¼ persons per acre. The density in England is only about ½ person to an acre. English rule, by preventing internecine wars between Mahomedans and Hindoos (which would, if tolerated, effectually keep down the population), by forbidding infanticide, by taking measures to avoid famine and diminish the amount of malaria and cholera, is causing a rapid increase of the Indian population. I do not think this need produce alarm. There is still much uncultivated soil in India, and could the extortionate action of the landowners be stopped, and security of tenure be secured for the fellaheen, the soil will be equal to all requirements for many years to come. With increasing civilization and with the abolition of child marriages, the problem will tend to solve itself.

The Chinese number some 400 millions, and the surplus of such a population, if it went actively in for emigration, is sufficient to swamp the labour market of the world. Working men are quite alive to this fact. They have in Australia compelled the adoption of laws prohibiting the immigration of Celestials. In America, in "China Town" in San Francisco, it has been found necessary to adopt measures of increasing stringency. The difficulty there has indeed been created by that demand for "cheap labour" which first brought in the Irish, then the Germans, next the Italians, who were finally dispossessed by the Chinese. Chinamen were brought in by the contractors for the Central Pacific Railway. The fortunes of the contractors were secured, at the expense of that righteousness which exalteth a nation, and a great race difficulty was created. The Americans have another race difficulty on hand, that of the negroes, which was created by the national iniquity of slavery. The fears of the Australian democracy and the attempts of the Americans to rid themselves of the incubus of pro-Chinamen are well founded. The yellow race must be confined to the home of its birth, or only allowed to migrate into those countries like the Indian Archipelago, where the white man can never live except as an exotic. These islands cover an extent equal to half Europe, and they can never be permanently occupied by Europeans. We may therefore present them to the Chinaman; and should any further outlet for his energies be required, there are immense possibilities for the settlement of an industrious people in Central Asia. Into these China can pour in the surplus of a population of 300 or 400 millions, Russia (which at present practically controls these countries) the surplus of only 100 millions. The great struggle of the future will be between the Muscovite and the Mongolian, and until this is settled the Europeans and Anglo-Saxon races will have breathing space. China proper is twenty-two times the size of England, and should be able to maintain twice its present population. India may expand westward to Persia, which has three times the territory of France and a population only only one-and-a half times that of Belgium.

The chief danger to us lies in the industrial direction. Should the Chinese acquire the arts of civilization as the Japanese have so rapidly done, then, with their cheap labour and rich mineral products, they would be able to deluge us with manufactured goods at a price against which competition would be impossible. So it is argued. Such a pessimistic view assumes that the Aryan race will have remained stationary, while the

Mongolian is gradually acquiring his arts. The experience of the last fifty years shows us, however, that there is no such thing as standing still. When the Mongolian has reached to our present standard, labour questions will for him come to the front, the standard of living will have become higher, and the keenness of the competition with us will be abated. At the same time, advances in applications of scientific knowledge will have become more extensive. When our coal fields have become exhausted, and those of China are being fully worked, will not a fresh motor power have been discovered, rendering us independent of fuel? I decline to be pessimistic, or to indulge in jeremiads like those of Mr. Pearson in his recent and most important work. Past history does not justify pessimism. Unfavourable forecasts, however probable and plausible they may appear, we will not believe. There are too many instances in which prophecies have been falsified by events for us to believe those of Mr. Pearson. The Duke of Wellington, in 1832, said that "Few people would be sanguine enough to imagine that we shall ever again be as prosperous as we have been." Since that time the wealth of this country has advanced by leaps and bounds. The break-up of the Turkish Empire in Europe has been foretold for centuries. It is still in futurity. Malthus foresaw impending bankruptcy, unless the population was restrained. We are further removed from bankruptcy than in his time, although the population has trebled. The coal measures of England will some day be exhausted, but not one of us will stay his hand from the coal scuttle on a cold winter's day on this account. This attitude of mind, although superficially it appears selfish, is in reality the most proper to take. Our puny help is not required by providence. Whether we help or hinder in these great cosmic concerns, they will come to their destined issues. It is only for us to do right and fear nothing.

WEDNESDAY, NOVEMBER 8th.

Meeting for discussion of Dr. Newsholme's paper on "The Influence of Civilization upon the Survival of the Fittest."

WEDNESDAY, DECEMBER 13TH, 1893.

THE EVOLUTION OF THE BRACHIOPODA.

BY

MISS AGNES CRANE.

Brachiopoda, said Miss Crane, were the "arm footed" shell fish, a little lower than the oyster, and one of the main molluscan roots of the tree of animal life. It would, she remarked in passing, be well if all those who discuss the doctrine of Evolution were to study the life history of any one class of animals and trace the fossil ancestry of its present representatives, to investigate not only the inter-relations of such a group of organisms among themselves, but with those of the class below and the one above them, so as to realise better the true nature of collateral descent and what is meant by a common origin.

An epitome of the life history of the Brachiopoda was then given. It showed their universal distribution in existing oceans from shallow water down to 2,900 fathoms, the enormous depth of three miles and a quarter, in the Atlantic Ocean. Their range in time was no less extended, for the shells occur fossil in all marine deposits, ranging from the primordial to the quarternary genera, and species were most abundant "of old time." Two-thirds of the whole number appeared in the seas of the palæozoic epoch. The differences in the structure of the shells and animals belonging respectively to the two sub-classes of hinged and hingeless forms were described and illustrated. Of the thousands of species which existed "afore time," about 129 now survive, referable to 22 genera and seven families. According to the returns of the last census of the Brachiopoda taken and tabulated this year by Mr. Charles Schuchert, of Washington, 277 genera are now known and described, referred to 47 family groups, of which no less than forty have become extinct, whilst seven are represented in existing oceans. The Brachiopoda have been recently classed by Beecher, of Yale Museum, in four orders, based on the nature of the pedicle passage and the stages of shell growth. The evolution in time of these orders was shown by a large coloured diagram prepared for the occasion. It indicated their common origin and the divergence on either side of the hingeless Neotremata and articulated Protremata from the ancestral stock of hingeless Atremata with free pedicle passage through both valves. This order contains 24 genera, of which 22 were envolved during palæozoic time, and only two persisted through all the geological ages and still survive. Of the 31 genera of derived hingeless Neotremata, three are found in recent oceans, but out of 82 genera of articulated Protremata one only was spared to us, the little Lacazella, a thecidoid of the Mediterranean Sea. By far the larger number of living forms belong to the order Telotremata,the last to be differentiated. Its members had their rise in the Protremata, being envolved *via* the Cambrian genus *Kutorgina* from *Paterina,* the little father of all the Brachiopoda.

It was largely to American scientists, Miss Crane stated, that we owed the discovery of the radical stock of many of the invertebrate classes. Such radical for the Brachiopoda was the genus *Paterina,* a small inarticulated shell which passed through no earlier stages of development and bears a close resemblance to the first developed shell covering of both the larval brachiopod of recent species and fossil forms of many branches. It was demonstrated that many early fossil genera passed successively through a " paterine " and an " obolleloid " stage before assuming the " linguloid " shape, and that the larva or young of *Terebratulina* passed through its linguloid stage before attaining mature terebratuloid characters. Hence the individual or ontogenetic development of a species confirms the phylogeny or ancestral history of the race. The application of these important methods of investigation we owe to Heckel of Jena, Hyatt of Boston, and Beecher and Clarke ; and to Clarke and Professor James Hall, the philosophical contemporary of Davidson, we are indebted for magnificent works on the development of Silurian forms and the demonstration of the evolution of the palæozoic Brachiopoda in general.

During the last twenty years the history of the class has been completely re-written, and the Brachiopoda now seem to justify the prescience of Darwin. Formerly regarded as one of the most obstinate difficulties in the way of the demonstration of the evolution of invertebrate life on earth, they now bid fair to become a remarkable illustration in favour of it. It is no longer possible to doubt that the life history of the class does yield convincing testimony of the truth of the law of evolution ; and to the establishment of this fact, American scientists have largely contributed. Their work is the more creditable to them, because so often carried on amidst a constant fight for "appropriations," and a liability to upset from the exigencies of the political situation, —trials happily unknown to our more favoured scientists.

It had often been remarked, and Miss Crane thought with truth, that the doctrine of evolution was more readily accepted in America than in Europe. The seed fell on good ground in the western world, for the minds of scientific workers in general seemed more favourable to its acceptance as a working principle in biological investigations. They sought more to prove the argument than to controvert it. They were, perhaps, less blinded by that third eyelid, the nictitating membrane, which that genial and witty philosopher, Wendell Holmes, declared to be common alike to reptiles, some birds, and theological students, and by means of which he drily said, "they shut out not *all* the light—but all the light they do not *want*." The genus is not absolutely unknown on this side, although more rare than formerly! We all retain the vestiges of this membrane in our physical structure. It is now more than thirty years since Darwin first addressed a letter to Thomas Davidson, suggesting that no one could work out the question of the Evolution of the Brachiopoda better than he. The letter will be found on pp. 366 and 367 of that most interesting record, "The Life and Letters of Charles Darwin," edited by his son, Francis Darwin. Davidson felt compelled to answer the question with a direct negative in his classical memoir on "What is a Brachiopod?" first delivered before the Brighton and Sussex Natural History Society, on February 11th, 1876, and subsequently published in French in the annals of the Malacological Society of Belgium, and two years later in *The Geological Magazine*. In the summary of his great work on the British Fossil Brachiopoda, published in the volume of the Palæontographical Society for 1884, he did not modify his original opinion, stating that "he still found the subject of the descent with modification among the Brachiopoda beset with so many apparently inexplicable difficulties that year after year has passed away without my being able to trace in a satisfactory manner the descent with modification among the Brachiopoda which the Darwinian theory requires." He appears at most to have admitted a kind of dual control; species sometimes modified themselves, genera originated in a different manner. But, really, the supervision of generic creation and extinction among the Brachiopoda would have been no sinecure. The subject (proceeded Miss Crane) was frequently discussed between us, but we never agreed upon it, for, being ultimately convinced of the general application of the law of evolution of organic life on earth, a certain sense of humour prevented me from considering the Brachiopoda alone as specially created for Brachiopodists to describe. My views were sufficiently indicated in an article on the Molluscoida I contributed to Vol. V. of *Cassell's Natural History* in 1881. But it is one thing to assert *a priori* the logical postulate, another to substantiate it by cumulative evidence, as Hall and others have done recently. Truly, as Paley has well said, "They alone discover who prove." Davidson held "that it was probable that at least a large proportion, if not all, of so-termed species may be nothing more than modifications of shapes by descent of a limited number of primordial types, but it is very difficult in the present state of our information to show passages between the genera among the Brachiopoda, as well as among other groups of animals, which the theory of evolution requires." In 1893, thanks in a great measure to the life-long researches of James Hall and the enlightened views of John M. Clarke, palæontologists to the Geological Survey of New York, it is impossible to deny the existence of such passages between many of the palæozoic genera. Much of the evidence was really accumulated by both Davidson and Barrande (who shared the same views), although they failed to recognise its full significance. It is well to remember, as Lowell has well said, "That the foolish and the dead alone never change their opinions."

The results of recent research in this direction were presented in full with numerous illustrations. It was shown that synthetic or mixed types were by no means rare, reversionary or atavistic forms not uncommon; that the study of individual development of larval forms of recent species reveals long past phases in the history of the origin of genera, and agree geologically with their chronogenesis or birth in time. The existence of numerous passage forms, intermediate in structure between the hingeless and hinged sub-classes, showed those divisions were not really based on fundamental distinctions. Ordinal evolution was conclusively demonstrated and numerous instances and illustrations were given of the successive "paterine," "obolleloid," and "linguloid" character of ancient genera. Instances of development on parallel lines were cited in the families *Lingulidæ Rhynchonellidæ* and *Terebratellidæ.* The lecturer paid a passing tribute to Madame Pauline Œhlert as the only other member of her sex who was actively interested in the study of Brachiopoda, and an earnest fellow worker with her distinguished husband, M. Daniel Œhlert, Curator of the Laval Museum. Conjointly they have produced splendid work on the recent and fossil Brachiopoda.

It is impossible, Miss Crane concluded, to go further into details to night of the descent with modification among the Brachiopoda. We have seen as we searched together the records of the ancient fossiliferous rocks how the confines of the classes merge into one another,—that orders converge and certain so-called genera pass almost insensibly the one into the other. Our knowledge has, indeed, advanced with giant strides of late, thanks to the critical and searching investigations of the numerous able scientists of diverse nationalities interested in this group of organisms, and to those of France and America in particular. I feel sure there is awaiting us in the not far distant future a complete demonstration of the evolution of the Brachiopoda.

WEDNESDAY, JANUARY 10th, 1894.

NATURAL SELECTION AND EVOLUTION,

BY

MR. E. T. WYNNE, M.B.

After briefly considering the various kinds of objections urged against Darwinism, and instancing some of the commonest misapprehensions of the theory, the writer proceeded to show by quotations the significance of the expression natural selection as used by Darwin, and its limitations. The attempts to formulate a theory of evolution up to the time of Darwin and Wallace were indicated, especially the theory of Lamarck. Darwin and Wallace showed that the origin of present species was earlier species, and that their existence was due to the result of heredity, variability, natural selection, and some other factors. Natural Selection, which implied a struggle for existence, was the most important factor in determining the direction of evolution.

The evidence of a wide-spread struggle for existence was examined, and examples of extreme variability in higher animals were given.

Variations may occur not only in the adult, but also *in utero*, and probably in the ovum itself.

The occurrence of transposition of the viscera was an instance of variation *in utero*, and the different means by which the food supply of the embyro was assured were good examples of variations which natural selection would readily deal with.

Darwin and Wallace having proved that species were not special creations, and shown the extreme importance of natural selection, it became possible to formulate a theory of evolution. The Darwinism theory of evolution is simply an extension of the theory of the origin of species.

So far the mode of action of natural selection as the result of the struggle for existence alone had been investigated, but for a complete exposition of evolution an examination into the nature of heredity and variability was essential.

Darwin attempted an explanation of heredity by means of his gemmule theory or pangenesis. The causes of variation, except in so far as they resulted from heredity combined with sexual reproduction, he did not attempt to solve.

Pangenesis has not met with much support, chiefly because it is based on pure assumption of the existence of bodies (gemmules) which have never been and from their nature probably never could be demonstrated.

In spite of attempts by various investigators to modify this theory it has failed to become a working hypothesis.

Nægali and Weismann have attempted a solution of the problem from an entirely different direction, and their theories have been founded on demonstrable facts, each interpreting the same facts in his own way.

The facts on which these theories rest are briefly these.—The presence in the reproductive cells of particles of protoplasm differing in their nature (as shown by their re-actions to dyes, &c.) from the general protoplasm of the cell. These particles are called chromatin rods, or threads. They undergo peculiar changes before and after fertilization of the ovum.

A portion is destroyed, but a portion remains, which by fusing with a similar portion from another individual forms the starting point for the development of the off-spring. The chromatin rods are found in both male and female reproductive cells.

In unicellular forms of life the reproductive cell is identical with the individual.

According to Nægali these chromatin rods vary independently of any outside circumstances. According to Weismann they can only vary as the result of some outside stimulus and he regards natural selection as such a stimulus. It is obvious that Weismann uses the term natural selection in a very different sense to Darwin.

There is a tendency to attribute every form of variation to natural selection. To do so, it is necessary to expand the meaning, so that natural selection becomes equivalent to selection by nature, and thus the inseparable condition of a struggle for existence is ignored, without which struggle there can be no survival of the fittest. There are of course variations which cannot be accounted for by natural selection (survival of the fittest as Herbert Spencer expresses it), such for example as the change in the shape of the jaw in civilized races.

A difficult point in the problem of heredity is the question whether acquired variations are inherited. Part of the difficulty is the definition of acquired variation.

Weismann holds that acquired variations are never transmitted, and there is certainly little or no trustworthy evidence of mutilations being transmitted, while on the other hand numerous experiments have failed to show that they can be transmitted. Brown Esquard's experiments on guinea pigs stand alone in favour of an occasional transmission, but serious doubts have been thrown on the correctness of the interpretation he put on the results obtained.

Variation in unicellular forms and the lowest multicellular beings is produced, in Weismann's opinion, by the direct action of the surrounding medium. Thus in amœba the surrounding medium has caused a differentiation of the cell protoplasm into endo and ecto-sarc. In all forms having sexual reproduction this fact is itself a cause of variation as no two individuals (at least in higher animals) are exactly alike, and thus by heredity the peculiarities of both parents are transmitted to the offspring, which therefore differs from both parents.

The Theory of Evolution does not confine itself to the explanation of man's body alone, but may also be used to examine into his mental and moral nature. This field has as yet been but little investigated, and practically not at all by means of the light thrown on it by Nægali's and Weismann's researches. These researches will doubtless in the future produce valuable results for the construction of true science of Sociology.

WEDNESDAY, FEBRUARY 14th, 1894.

THE MOVEMENT OF WATER IN TREES,

BY

MR. HENRY EDMONDS, B.Sc.

FRIDAY, MARCH 2ND, 1894.

SOIRÉE AT THE ROYAL PAVILION.

The Soirées of the Society, which had been held annually from 1872 to 1885, but which had been discontinued since the last-mentioned date, were resumed this year. A Committee was formed to carry out the arrangements connected therewith, and consisted of Mr. D. E. Caush (Chairman), Messrs. Newsholme, J. Colbatch Clark, De Paris, H. Davey, jun., T. P. Slingsby Roberts, Dr. Treutler, H. Edmonds, G. Foxall, W. Harrison, T. Lewis, W. W. Mitchell, E. J. Petitfourt, and E. Alloway Pankhurst, who acted as Secretary. Sub-Committees were also formed of the Photographic, the Microscopical, and Botanical Sections to arrange for the exhibits, &c., in their general departments.

The proceedings commenced at 8 o'clock with a few words by Dr. Newsholme (President), who welcomed the guests to the Soirée of a Society which had for a period of just on forty years striven to encourage in Brighton that love of natural science, and that devotion to scientific pursuits which otherwise would perhaps have languished and died out in the enervating social atmosphere of a town whose name was associated more with pleasure than arduous study. Dr. Newsholme then introduced Mr. W. Martin Conway, who gave his lecture on "Climbing and Exploration in the Karakoram," which was illustrated by a splendid series of photographs which he had taken at different altitudes in his expedition in the Himalyas, during which he had attained the unprecedented height of 23,000 feet. During the evening short addresses were given by different gentlemen in connection with the objects exhibited in the rooms.

Mr. T. Lewis, of New Shoreham, spoke on the Lavant Caves which he had explored in connection with his friend, Mr. C. Dawson, F.G.S. The articles discovered in them, which he exhibited, included flint implements, spear heads, a lamp, bronze ornaments, &c. Mr. Clarkson Wallis, in the absence of Mr. C.

Dawson, the exhibitor, described a large fossil iguanodon, recently discovered, which was illustrated by a drawing, and also a photograph representing the footprints of one on a piece of sandstone. Mr. C. A. Wells showed how a spectroscope was used, and spoke on the important results which had been obtained by its aid.

At intervals during the evening Mr. D. E. Caush gave in the Octagon Room, a demonstration by means of the projecting microscope and the lime light. In the King's Apartments, Mr. R. C. Quin exhibited and described electrical meters, and demonstrated the welding of two pieces of iron together under water by means of the electric current.

In the further room, Mr. W. A. Smith, of the Platinotype Company, exhibited the process of Platinotype printing.

In the Music Room Dr. Harrison and Mr. G. Foxall gave, after Mr. Conway's lecture, an exhibition by means of the lime light, of a series of lantern slides, which were selected from the work of Messrs. C. Job, T. H. Fowler, A. H. Webling, W. C. Wallis, E. J. Bedford, T. Curteis, and G. Foxall.

In the South Drawing Room, Mr. Henry Willett contributed to the exhibits a large case full of rare and interesting objects, including carved opals, diamonds, jade ornaments, a unique Caxton, and a series of illuminations of the 12th, 13th, and 14th centuries, &c., &c. The Rev. Ambrose D. Spong sent a remarkable collection of over 10,000 butterflies and moths, and a case of beetles obtained by Dr. Livingstone, in Africa. Messrs. Pratt showed a case of the very rare butterfly, Bhotannis Ledderdalli, and also one of rare Sussex birds. Mr. C. Booth sent two model boats made by the late Mr. Wallis. Mr. Clarkson Wallis exhibited a case of Egyptian antiquities which he had collected at Memphis and Bubastes; also a series of bones which had been obtained from the bed of the Thames near Reading.

In the North Drawing Room was a large number of exceedingly fine photographs exhibited on stands down one side of the room, representing nearly every different style and variety of photographic printing. Mr. G. Foxall, the Secretary of the Photo. Section, was mainly instrumental in getting this fine collection together, and the Society was largely indebted to Mr. R. C. Job for much valuable work in the arrangement, &c., of the exhibits.

On the other side of the same room between twenty and thirty microscopes were exhibited, the greater number lent by Members of the Society, with some object of interest, which was described by the owner. The charge of these was undertaken by Mr. W. W. Mitchell, the Secretary of the Microscopical Section.

Light refreshments were supplied in the Banqueting Room. About 300 persons attended.

WEDNESDAY, MARCH 14th, 1894.

VARIATION IN THE PLUMAGE OF BIRDS,

BY

MR. ARTHUR F. GRIFFITH, M.A.

Mr. Griffith pointed out that variation in the plumage of birds might be classed as either normal or abnormal, examples of the latter class being also frequently known as "sports."

Normal variation usually proceeds along one of four lines, and depends on either

1. Age,
2. Sex,
3. Season ; or
4. Locality.

1. The variation depending on age was exemplified by the Greater black-backed gull, the young of which is greyish white, spotted over with grey spots (which vary considerably in size and shape in individual specimens, though their general effect is much the same in all specimens), the adult bird being strikingly white underneath, and of a dark French grey on the back.

The speckled plumage of the young robin showing no red breast, was also referred to.

2. To show differences of plumage presented by the different sexes, Hen-harriers and capercaillie were exhibited. In the former, the adult males are clear slatey-grey, while the hen birds are

brown, spotted with darker, and with a white patch over the tail, from which the bird gets its name of ring-tail. The latter are well-known, the male being a very large bird with the greater part of its plumage of a metallic black hue, the hen bird being less than half the weight of her consort and light brown, mottled with darker.

It was pointed out that many of the birds of the same class as the capercaillie exhibited great differences in the sexes, as for example the domestic fowl and black game, while in others the differences were scarcely perceptible, as in the case of the red grouse, partridge, and quail.

It was also pointed out that in most cases both sexes of the young birds resembled the adult hen bird in plumage, but not always, as *e.g.* the robin, in which both sexes of the young are alike, both sexes of the adult bird being also alike.

3. Ptarmigan in their spring and winter plumage and golden plover in their winter, summer, and autumn plumage were exhibited to show the different appearances assumed in different seasons. The warm grey feathers of the ptarmigan in spring harmonize well with the lichen-covered rocks on the tops of the mountains where the birds have their home and nests. With the snow comes the change to their pure white winter plumage.

The advantage to the golden plovers of the changes that they undergo in the different seasons is not so obvious. The difference between the winter and autumn plumage is slight, consisting in a greater or less golden hue in the spots on the back and wings. But in the spring and summer (*i.e.*, in the breeding season) the grey colour of the breast feathers is replaced by a band of deep black on a purer white ground, and the whole bird assumes (in both sexes) a much more brilliant appearance. A similar change occurs in or before the breeding season in the males only of several species, as for example in the mallard, the Lapland bunting, and the ruff.

4. As examples of variation found in different localities, the English sparrow was contrasted with his Spanish cousin, which is altogether more brilliant, with brighter chestnut, deeper black, and clearer white in his plumage, than ours can boast. This form is separated from ours by the Pyrennees, which appears to form an impassable barrier to some birds, though many species pass the mountains regularly.

On the other hand, the habitat of the hooded crow, with his bluish-grey back is not separated from that of the carrion crow, with his uniform sheeny-black coat, by any barrier. Though their ancestral homes appear to be different, they mingle freely in many localities, as, for example, in the North of Scotland, where the lecturer has taken eggs from a nest occupied by a pair of birds, the one a hoodie, the other a carrion crow ; nor is this inter-breeding by any means rare. But the result of such inter-breeding is rarely distinguishable from one or other of the parents, although one would have expected the offspring always to show character intermediate between the two forms.

(Immediately after the lecture it was pointed out by Mr. Langton that the Arctic Skuas afforded another and even better example of the peculiarity observed in the offspring of the two forms of crows. The two forms of the Arctic Skua are well known, and are so distinct that they were for long considered to belong to distinct species. Both forms occur together, and constantly inter-breed. Yet the offspring retain one or other of the original forms, and are very rarely, if ever, intermediate in plumage between their parents). This is equally the case with the bridled and common Guillemot.

The lecturer then instanced two groups of birds where the plumage offered but a slight criterion of the distinctness of allied species. Chiffchaffs, willow warblers, wood wrens, and lesser whitethroats, differ widely in their habits, their nests, and their notes. In fact, in a state of nature they cannot be mistaken for one another. Yet but few naturalists can distinguish the birds at a glance when dead, while the females are almost indistinguishable by their plumage. Similarly, though in a less degree, the three species of snipe, being exhibited side by side, showed a very close series of resemblances of plumage, though the birds are so widely different in their habits, as well as in size.

The most interesting group of the abnormal or irregular variants was exemplified by a male Marsh harrier, showing in some of the wing feathers the same soft grey colour which is in all cases assumed by the adult males of the other two British species of harriers. As mentioned above, the females of the Hen harrier (and of the closely allied Montagu's harrier) are brown birds, while their consorts are of a uniform slatey grey colour. The two sexes of the Marsh harrier on the other hand are usually alike, blackish-brown, with a white pate and nape. But the males in rare cases show a partial approximation to the grey colour of their cousins, most usually in some of the wing feathers and very rarely indeed in the tail or elsewhere.

Other abnormal variations were stated to fall generally into one of these groups, in one of which (as in the case of the town sparrow and the Irish snipe) the colours are darkened. The second is caused by defect in the quality of the colouring-matter of the feathers, rendering them pale, and in some cases almost mouldy looking. In the third group, either single feathers or the whole plumage become a bright white. Beautiful examples of the last two groups were exhibited by the kindness of Mr. Pratt.

These broad lines of variation are found to apply equally to other branches of living creatures, butterflies and moths (lepidoptera) being especially instanced; and it was observed that experiments on lepidoptera were now being carried on by various persons with the object of learning the composition and modification of the colouring-matters, the manner in which the colour of insects is modified in nature, and other questions relating to variation, that group of insects affording considerable facilities for the purpose. Our own member, Mr. Merrifield, being one of the pioneers in such investigations.

The lecturer concluded by stating that he had as far as possible confined his remarks that evening to facts, reserving the theories founded on them for another occasion.

WEDNESDAY, MARCH 14TH.

CERTAIN DEVELOPMENT THEORIES ILLUSTRATED BY VARIATION IN THE PLUMAGE OF BIRDS,

BY

MR. ARTHUR F. GRIFFITH, M.A.

Mr. Griffith pointed out how strongly variation in the plumage of birds supported the theory of evolution, but referred to the great difficulty in the way of the acceptance of Darwin's or any other existing theory as a complete account of the method in which evolution works. This difficulty he stated as follows: That the struggle for existence should perpetuate an advantageous variation requires that one individual of one sex with an advantage over its fellows and no countervailing disadvantage should, out of the innumerable possible mates meet with one of the opposite sex similarly circumstanced, or, at any rate, free from disadvantage; and that succeeding generations should be equally fortunate until the variation should become permanent. This "chance upon a chance" demonstrated to a mathematical certainty that some controlling force, not hitherto recognized by scientific theorists, must operate to control the perpetuation of forms of variation. He remarked that the usual explanation given of the difficulty (viz., the enormous number of individual cases from which the selection had to be made) was, when properly understood, seen to be really the root of the difficulty which requires explanation.

He also pointed out the great difficulty involved in endeavouring by the existing theories of natural selection to account for the perpetuation of periodical variation in the plumage of the same species, as for example the assumption of white plumage in snow-time or of more brilliant plumage in spring-time, to be succeeded annually by a return to another state when the snow has melted or the summer gone; this difficulty not being in the least diminished by the obvious advantages accruing to the species by the variations in question. Also in accounting for such well marked and persistent differences as are found in the two forms of the Arctic Skua or the common Guillemot mentioned in the former lecture.

WEDNESDAY, MAY 9th, 1894.

THE ORIGIN OF BIRDS,

BY

MISS AGNES CRANE.

Modern Science regards birds as having been remotely evolved from ancient reptilian ancestors by gradual processes of natural transformation during the lapse of incalculable ages of geological time. Existing birds may be said to differ principally from living reptiles in the possession of a four-chambered heart, warm blood, and an external covering of feathers. Many characters formerly regarded as peculiar to reptiles are now known to occur in fossil birds, and the rudiments of others, traceable only during the embryonic stages of the living forms, forcibly illustrate the progressive history of the avian race. Birds also agree with reptiles in their method of reproduction, for both groups are propagated by eggs hatched by external heat after extrusion. The eggs of the tortoise resemble those of the hen, those of the crocodilia an elongated duck's egg. The microscopic structure of the shells of the eggs of birds and reptiles offers slight differences which, although not sufficient for systematic classification, yet afford data for the reference of fossil eggs either to the reptilian or avian class. The eggs of the struthious birds differ most from the rest. Those of the anomalous *Apteryx,* which lays the largest egg relatively of any bird of its size, according to Mr. P. Gervais, possess chelonian affinities, and alone diverge in so marked a manner as to justify the classification of that curious reptilian bird in a group by itself. It is an interesting and significant fact that the neb present on the beaks of young birds in the shell is also developed in many young reptiles. It is used to break the shell.

The parental and nest-constructing instinct is not equally developed in all groups of birds. Most aquatic species lay their eggs on the bare ground. Some land birds, like the brush turkeys of Australia, cover them with leaves or decayed vegetable matter, and leave them to their fate. Nor are all passerine birds careful of their young, which by some species are entirely left to the vicarious attentions of others. The incubating and brooding instinct is also susceptible to artificial stimulation, as in the case of the domestic capon, which not only hatches the eggs but cherishes with anxious demonstrations of maternal solicitude the young birds entrusted to its care. Some kinds of snakes hatch their eggs by the heat of their own bodies. Other reptiles, like the tortoise and crocodile, merely hide them in the sand, but the alligators of South America are " mound builders " in their way, piling over them a conical heap of dead leaves. There is, therefore, a certain amount of community in the habits of living representatives of both the avian and reptilian classes. It has further been inferred as probable that some extinct "sauropsids," the flying reptiles of the Secondary epoch, "reared their young with affectionate care."

In no point do birds differ more from existing reptiles than in the nature of their external covering. The *hiatus* between the cold-blooded reptile covered with scales or skin, and the warmblooded bird clothed in feathers is very considerable. It is one, moreover, that existed apparently at a remote period, for it is known that the most ancient bird of which we have any actual record was distinguished from its reptilian contemporaries in a similar manner, as the impressions of true feathers occur associated with its remains. Some external characters, however, are common to both classes. Scales defend the naked legs of many birds, and the terminal claws of the extremities are often attached to the wings as well as to the feet, as in the spur-winged goose, the lapwings, the jacanas, and the chakar or crested screamer of South America, which Kitchen Parker considered to be the nearest living ally to the fossil Archæopteryx, and as half rail, half goose. But the plumose covering clothing the greater portion of the bird's body, and the source of much of its attractive beauty, is peculiarly appropriate to the life that the creature leads, subjected to great variations of temperature. It is also more complicated in structure and growth than all modifications of the epidermic system. The plumage of birds influences the contour of their bodies and their capacity for sustained flight, and in a measure regulates their way of life. The shape of the quill feathers of the wing differs much in the various flying birds. They are acuminate in the *swifts*, or so short and rounded in the *gallinaceous* birds as to enable them to fly only short distances "with an exertion and vibratory noise well known to every sportsman."* In the *hawks* and *owls* a loose soft plumage, permitting them a noiseless flight, assists in the capture of their prey.

All feathers, notwithstanding great differences in size, consistence, and colour, are composed of the same elements, a quill or barb supporting the shaft, whence a beard or vane diverges on either side. They resemble allied structures such as hair, bristles, and spines, all termed *dermatophytes*, or skin plants by Nitzsch, as being produced by the skin and rooted therein. But the hair-producing organ is always present and active, while the feather capsule is in a state of alternate activity and repose. Of the four principal kinds of feathers present in the generality of birds, the chief are the contour feathers exposed to the surface, and the inner or down feathers which underlie them. The surface feathers are ruffled by a series of complex muscles, as many as 12,000 being developed in one species (*Anas marila*) for that purpose, a remarkable instance of the development of specialised

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*Mr. Charles Dixon in his "Migration of Birds" shows these characteristics to be functional resultants, the birds that migrate the farthest having the longest and most slender wings.

organs. The integumentary covering varies as considerably within the limits of the bird class as in that of the mammalia. Thus, we have the uniform hair-like feathers of some struthious birds and the dense fur-like covering of the scale-winged penguin and other aquatic forms; while the same organs produce the porcupine quills of the cassowary, the soft down and bristles of nestlings, the horse-hair tufts pendent from the breast of the male turkey, the beautiful wing appendages of the birds of paradise, tails of the humming birds, the crests of the cockatoo, peacock, and toucan, and other variations of plumage. Perhaps the most beautiful examples of all variations of occasional or seasonal plumage are the loose slender decomposed feathers characteristic of the nuptial dress of the egret-herons. This beautiful race will soon become exterminated in South America—it has already been driven out of Britain—if mercenary man be not restrained from the ruthless slaughter of the parent birds, leaving the young fledgelings to perish of hunger, in order that thoughtless fashionable feathered women may deck themselves with so-called "aigrettes." I say thoughtless women, because I honestly believe that very few members of my sex would purchase and wear such dainty plumes merely for ornament if they really know how they were obtained.

Of the various stages following on the primary assumption by the highly modified reptilian ancestors of the true bird group of a simple rudimentary covering of down, or fur-like feathers, we are, and may ever be, entirely ignorant.

But the subject of the origin and development of the colouration of the plumage of birds is one of extreme interest. The views of Mr. A. R. Wallace on this question differ considerably from those of Dr. Darwin, who originally maintained that all brilliancy of colouring resulted from the continuous and conscious selection of the handsomest males by the females, thus producing a succession of bright-coloured offspring. It is, however, contended that such voluntary selection is but rarely exercised, and would further be neutralised by the fact that :—

"There swims no goose so grey but soon or late
She finds some honest gander for a mate."

If the poet's view be the correct one, it is obvious that the less brilliant individuals would be at no disadvantage, and would leave numerous descendants to perpetuate their sobriety of colouring. To Mr. Wallace's theory that the beauty and brilliancy of the plumage depends upon the superabundant vitality, there can be no such objection. For it necessarily follows that the brightest coloured birds having the best constitutions would be strongest and most successful in all the struggles of existence. They would therefore, leave most descendants, and, these characteristics becoming intensified in each generation, the origin and development of brilliancy of colouring is naturally explained.

Mr. Grant Allen, on the other hand, while fully admitting the force of Mr. Wallace's main argument as to colour resulting from excess of vital power, maintains that this view fails to explain the development of one hue in preference to another. Mr. Allen, therefore, invokes the agency of sexual selection influenced by a love of bright hues, and introduces an entirely fresh factor to account for their origin. Associating the colours of birds with their food, he argues that most of the gorgeously coloured species feed on bright-hued insects, flowers, or fruit, while the dusky forms are nourished by dingy food-stuffs such as murky insects, seeds, or carrion. From the evidence in favour of this theory, most clearly and exhaustively stated in his fascinating volume on "The Colour Sense," he infers that the avian taste for, and perception of, colour has not only effected the diffusion and coloration of fruits, but, strengthened by pleasurable exercise, has also re-acted on the birds themselves, in developing an appreciative love of bright hues, and, thus influencing their choice of mates, has resulted in the perpetuation and gradual intensification of brilliancy of plumage.

In considering the evidence relating to the theory of the reptilian origin of the avian races, it is especially necessary to make due allowance for the influence of such important factors as the imperfection of the geological record, tendencies to vary, the effect of surrounding circumstances in retarding or developing those tendencies, and the survival of the fittest in the struggle for existence.

Many imperfections in the geological records of the avian class have been explained by the assumption that birds gifted with the power of flight would be less liable to be destroyed by sudden floods than other animals, an argument which is strengthened by the fact of the comparative abundance of fossilised wingless forms, as compared with the greater scarcity of those of the flying birds. It has also been suggested that their remains would float longer on the surface of the water, and so be more liable to be devoured. That numerous kinds of birds existed in the later Secondary epoch may be justifiably inferred from the marked and divergent characters of the few preserved to us. Others, possibly entombed in unsuitable deposits, were dissolved away without leaving any traces of their existence. The skeletons of birds are undoubtedly often absent under circumstances that would lead us to infer the presence of birds, as in the Eocene deposits of Monte Bolca, where feathers are abundantly preserved. Again, in the Tertiary deposits of the gypsum the footprints of birds occur in profusion, associated with those of the multitudes of herbivorous and carnivorous animals described by Cuvier. The bones of mammalian animals are preserved in the same strata with those of the reptiles that perished with them in the overflowing waters charged with sulphuric acid, the immediate cause of their destruction, and subsequently of the formation of the gypseous marls. But not a single fragment of a bird's skeleton has as yet been discovered after fifty years' search in that particular locality. Eggs and feathers are found in the marls of Aix, but no osseous fragments occur in the same strata. The numerous footmarks imprinted on large areas of Triassic sandstones in Connecticut, once regarded as those of wading or wingless birds, but now referred to extinct bird-like reptiles, afford another example of the existence of numbers of animals of which at the time of their discovery we had no further record. Thus, it is very evident that our knowledge is founded but on shreds and patches, a link here and there, with many a gap between, which if all the birds that once lived on the earth could be restored to life might be bridged over. Then, the conception of the remote reptilian ancestry of all the varied existing forms of diving, flying, perching, running, fruit eating, flesh devouring, aud insect feeding birds, with all their diversities of colour, form, and habit would seem less marvellous and inexplicable.

At least 12,000 species of existing birds are known, of which perhaps two-thirds are enumerated in Mr. Bowdler Sharpe's Catalogue of the Birds in the British Museum, in twenty-three volumes. The fossil forms known are included in one volume by Mr. Lydekker.

The reptilian birds and bird-like reptiles of the Cretaceous and Jurassic epochs illustrate a few of the intermediate steps in the process of evolution, and were doubtless in turn the descendants of that ancestral reptilian stock whence all the subsequent birds and reptiles were successively evolved. The occurrence of teeth in the immature parrot, webbed feet in the robin (first noted by Agassiz), and the similarity of structure which at some stages of growth is alike characteristic of the fore and hind limbs of birds, afford further evidence of reptilian descent. But in thus tracing back the genealogy of some existing classes of birds to some of the primary groups, it must not for a moment be imagined that those ancient carinate and cursorial forms resembled the present representives of their race. That, indeed, as Professor Huxley has tersely expressed it, "would be as absurd as to suppose that the fact that a given nobleman is directly descended from a Norman baron, compels us to believe that a photograph of the one would serve for a portrait of the other." In other words, the existing forms doubtless differ as widely from their ancestral representatives, as they in turn differ from the varied forms of bird-like creatures which evolutionists regard as the remote reptilian ancestors of the whole avian race; while the ultimate source alike of living mammals, birds, and reptiles, must be sought in the amphibia, the lowest forms of which can scarcely be distinguished from the true fishes.

WEDNESDAY, JUNE 13TH

(ORDINARY MEETING).

SOME STEPS IN THE HISTORY OF BOTANY AS SHEWN BY ITS HERBALS.

Following the preliminary remarks and allusions to the Botany of the Ancients, the Invention of Printing in the middle of the 15th century was mentioned as bearing equally in its importance to Botanical as to other Sciences, the quaint old Herbal being practically one of the fruits of that discovery. At first they were published quite as Medical handbooks, but gradually more attention was given to the structural detail, cultivation, &c., of the plants enumerated, and they undoubtedly helped develop Botanical Science as it exists in modern times.

Probably the first Herbal printed was one published at Vicenza, in the year 1491, taken from the writings of Arnold de Nova Villa and Avicenna. It is a small quarto, written in Latin, contains 150 chapters, each devoted to one plant, and prefaced by a woodcut of the same, which with few exceptions is the only guide to the recognition of the plant, the letterpress being descriptive of its medicinal properties.

The first English Herbal was one entitled "**The Grete Herbal whiche giveth parfyt knowledge and understanding of all maner of herbes and there gracyous vertues,**" and was published in 1516, being based on a work shortly before published on the Continent, called 'Ortus Sanitatis; it contains chapters devoted to drugs and plants, and abounds with fairly representative woodcuts, and gives a few details concerning the appearance and habitat of the plants. In the year 1540, or earlier, a small work called **Macer's Herbal** was published, and was a translation of certain Latin verses, written by one Macer Floridus, in the 12th century, it contains no woodcuts, the arrangement as in the preceding Herbals being alphabetical. Dr. Wm. Turner, the Father of English Botany as he has been called, published the first part of his Herbal at London, in 1551, a work subsequently completed and published in 1568. Lyte's translation of Dodonæus, the Flemish physician and botanist, an author already well-known on the Continent, appeared in 1578. It is a black letter folio, entitled "*A Niewe Herball or Historie of Plantes,*" and is adorned with a fine allegorical frontispiece and some hundred woodcuts. It is divided into six books, in which the alphabetical arrangement of the earlier Herbals has to a certain extent been departed from, and there is a tendency to group plants according as there is a natural affinity between them. The following description of one of the plants in this Herbal may be interesting :—

OF GOAT'S BEARD OR JOSEPH'S FLOWER, CHAPTER XVIII.

Goates beard hath a round straight knottie stem covered with long narrow leaves, almost like to garlick leaves. At the top of the stems it beareth fayre double floures, and full of colour, sometimes blewishly purple with golden threades in the middle and sometime yellow, the whiche in the morning at sunne rising do open and spread abroade, and do turne and bend towards the sunne and do close again and go togither at noon; after the vanishing of whiche floures, out the knoppes or heads, from whence the floures are fallen there groweth a certayne long seed with a hearie tuft at the top. And when this seed is ripe his knoppie head openeth and is changed or turned into a round hearie baull lyke to the heads of Dantedelyon, which fleeth away withe the winde. The roote is long and as thicke as a finger, in taste sweete. The whole herbe withe his stemmes, leauves, floures, and roote is full of white sappe or iuyce like milk, the whiche commeth forth when the plante is broken or brused.

Contemporary with Rembert Dodoens, lived certain other botanists to whom attention was directed as men who were doing something towards reducing to a system that natural arrangement of plants, which was no doubt as apparent to our predecessors in the science as to ourselves, although they were then unable through lack of definite knowledge in many essentials, to comprehend it to the same extent as is done in the present day. In the year 1570, Peter Pena and Matthias Lobel published in London their "Stirpium Adversaria Nova," and in 1576, Lobel further published his "Observationes" which was joined with the "Adversaria." In these works they put together those plants which have most resemblance, as grasses, bulbous plants, trefoils, &c., judging the classes principally by the form of the leaves. In the year 1583, Andreas Caesalpmus, an Italian physician and Professor at Pisa, published a history of plants wherein "he maketh the chief affinity of plants to consist in the similitude of their seeds and seed-vessels."

The well-known Herbal of John Gerard, first appeared in 1597, at London; it is a thick folio containing hundreds of woodcuts and one of the last printed in black letter. It was based on the works of Dodoens, but the arrangement followed was that of Lobel. The method is best explained by quoting Gerard himself in his introduction to the 1st book of the History of Plants.

"In three bookes therefore as in three gardens all our plantes are bestowed, sorted as neere as may be in kindred and neighbourhood."

"The first booke hath grasses, rushes, corne, reeds, flags, bulbous, or onion rooted plantes."

"The second, most sorts of herbes used for meat, medicine, or sweet smelling."

"The third hath trees, shrubs, bushes, fruit-bearing plantes, rosins, gummes, roses, heather, mosses, mushroomes, coral, and their several kindes."

"Each booke hath chapters, as for each herbe a bed."

The edition of Gerard by which he is best known is that of 1633, which was edited by Thomas Johnson, Apothecary, of London, who corrected it and added considerably to the number of plants described; and in his address to the reader gave a complete History of Botany from the earliest times to his own, a performance of no little merit, forming a basis on which many modern writers can work.

Other authors noticed in the course of this paper were :

John Parkinson, author of the "Paradisi in Sole, Paradisus Terrestris, or a garden of all sorts of pleasant flowers," 1629, and the "Theatrum Botanicum," 1640, in which descriptions were given of some 4,000 plants.

Robert Morison, Professor of Botany, at Oxford, and John Ray, sometime Fellow of Trinity, Cambridge. To these two men, Great Britain is indebted for being the first to raise Botany as distinct from Medicine to an exact science.

Hooke, author of "Micrographia," which was published by the Royal Society, in 1665, gave in it his records of enquiry into the anatomy of plants.

Salmon's Herbal, published in 1710, was the last noticed, it has been a popular work, but like all these works becomes rarer to meet with as times goes on. It is a large thick folio consisting of 752 chapters, each representing a genus and describing the different species; it again reverted to the alphabetical arrangement, but notwithstanding this its botanical descriptions are very good.

Copies of the following works were exhibited in illustration of the subject of the paper:

Arnold de Nova Villa, Vicenza, 1491.

Lobel's Stirpium Adversaria Nova, Antwerp, 1576.

Gerard's Herbal (Johnson's Edition), London, 1633.

Morison's Plantae Umbelliferae, Oxford, 1672.

Salmon's Botanologia, The English Herbal, London, 1710.

A small and scarce work of Dodoens, illustrating certain plants, published in 1551, which was lent for the occasion.

WEDNESDAY, JUNE 13TH.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 13TH, 1894.

Your Council has much pleasure on being able to congratulate the members of the Society, not only on an increase of members during the past year, but also on the larger audiences which have assembled at the Ordinary Meetings.

A glance at the titles of the papers read will show what a leading part the theory of Evolution has played in our discussions.

The President's inaugural address which opened up the wide questions and difficult problems which it involves, seems to have given the dominant tone to the scientific thought of the year. It may also be remarked to what a large extent Ornithology has been called upon to furnish facts and materials connected with Variation, Heredity, Natural Selection, and the Origin of Species.

The reports of the different Sections will show that the work, which they had set themselves to do, is being earnestly carried on. The members of the Botanical Section have obtained in all 700 specimens of plants for the Sussex Herbarium. The Photographic Section has been busy with the survey of Brighton and neighbourhood, and a large number of prints already enriches its collection.

The most important event to be recorded, however, in the annals of the Society for the past year is, undoubtedly, the Soirée which was given in the Pavilion on the 2nd of March. After being allowed to lapse for nine successive years it was decided to revive, at any rate for this year, those pleasant reunions of the members and their friends which form so conspicuous a feature in the past records of our Society.

Notwithstanding the attractive programme issued, and the efforts made to render the Soirée of 1894 a greater success than any of its predecessors, your Council regrets to state that only 70 members of the Society supported it by their presence, and that the total number of those who attended did not exceed 300. There is consequently a deficit of a little over £31 in the statement of receipts and expenditure connected with it. The smallness of the sum standing to our credit in the balance sheet for the year is mainly to be attributed to this loss on the Soirée. It should, however, be remembered that outstanding subscriptions for the current year amount to nearly £20, and that an equal sum has been expended on books ordered last year.

Since our last annual meeting the Society has lost 13 members by death, resignation, &c., and has acquired 23 new ones; leaving a net increase of 10.

The papers read before the Society have been as follows:—

Oct. 11th, 1893.	The Influence of Civilization on the Survival of the Fittest: THE PRESIDENT.
Nov. 8th, „	Discussion of the above.
Dec. 13th, „	Evolution of the Brachiopoda: MISS CRANE.
Jan. 10th, 1894.	Natural Selection and Theories of Evolution: MR. E. T. WYNNE, M.B.
Feb. 14th, „	The Movement of Sap in Trees: MR. EDMONDS.
March 14th, „	Variation in the Plumage of Birds: MR. A. F. GRIFFITH, M.A.
April 11th, „	Certain Development Theories illustrated by Variation in Birds' Plumage: MR. GRIFFITH.
May 9th, „	The Origin of Birds: MISS CRANE.
June 13th, „	Some Steps in the History of Botany as shown by its Herbals: MR. E. F. SALMON.

EXCURSIONS.

15th July, 1893.	Special Excursion, OLD PLACE, LINDFIELD. By the kind invitation of C. Kempe, Esq.
16th June. 1894.	NEWICK PARK, and the Rock-Garden. By the kind invitation of J. H. Sclater, Esq.

Brighton and Sussex Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 13TH JUNE, 1894.

Dr.

	£	s.	d.
By Balance in the hands of the Treasurer, 14th June, 1893 ...	41	4	9
,, Annual Subscriptions and arrears to 1st October, 1893 ...	6	0	0
,, Annual Subscriptions to 1st October, 1894 ...	64	10	0
,, Annual Subscriptions to 1st October, 1895 ...	1	10	0
,, Entrance Fees ...	7	10	0
,, Annual Subscriptions of Associates ...	0	5	0
,, Dividends on £100, 2¾ per cent. Consolidated Stock to 5th April, 1894, one year ...	2	15	0
	£123	14	9

	£	s.	d.
Balance in hands of Treasurer, 13th June, 1894 (at Messrs. Barclay, Bevan, and Co's. Bank) ...	2	3	2
NOTE.—A sum of £100 is invested in £2 15s. per cent. Consolidated Stock in the names of the Treasurer and Hon. Secretaries as Trustees for the Society ...	100	0	0

Cr.

	£	s.	d.
To Books and periodicals ...	19	11	2
,, Bookbinding ...	3	7	3
,, Printing Annual Report and Abstract of Proceedings ...	11	12	6
,, Printing and Stationery ...	11	9	2
,, Postage, &c....	9	7	8
,, Scientific Secretary, Honorarium for the current year ...	10	0	0
,, Subscriptions to Societies...	3	2	5
,, Assistant Secretary, salary ...	2	2	0
,, Commission to Collector for Subscriptions ...	2	13	3
,, Gratuities to Assistants at Museum ...	3	10	0
,, Expense of Soirée, beyond receipts ...	31	6	7
,, Alteration to Electric Lantern and Accessories	4	10	9
,, Repairs to Bookcase ...	1	5	0
,, Expense of Meetings ...	1	5	0
,, Cost of Tea and Coffee at Meetings ...	0	9	5
,, Photographic Section, general expenses ...	4	1	5
,, Fire Insurance premium ...	0	18	0
,, Portfolios for Botanical Specimens ...	1	0	0
,, Balance in hands of Treasurer, 13th June, 1894	2	3	2
	£123	14	9

Audited with books and vouchers and found correct.

F. G. CLARK, F.C.A.
HENRY DAVEY } *Hon. Auditors.*

LIBRARIAN'S REPORT.

The recent great increase in the number of books borrowed by members has not been maintained during the past year, the whole number taken out amounting to 180, slightly under that reported on the last occasion. It is intended to issue a new catalogue during the forthcoming year; about 100 works have been acquired since the existing catalogue was published in 1886.

Beyond the serial publications to which the Society subscribes, there has been no purchases during the past year. The Society has to thank Mr. W. J. Smith for the gift of a catalogue of Works, Papers &c., on the Geology of Australia and Tasmania, by Etheridge and Jack, and Mr. H. Willett for a continuance of his kind presentation of the Quarterly Journal of the Geological Society.

H. DAVEY, Jun.,
Honorary Librarian.

PHOTOGRAPHIC SECTION.

REPORT.

The meetings held during the year were as follows:

Nov. 3rd,	1893.	Lantern evening.
Dec. 1st,	„	Demonstration by Mr. G. Foxall, on mounting and finishing photographs and lantern slides.
Jan. 19th,	1894.	Demonstration of lantern slide making by Mr. A. H. Webling.
Feb. 23rd,	„	Lantern evening.

No meeting was held during March owing to the Soirée of the Society.

The excursions last summer being poorly attended, your Committee recommend that the Section excursions be amalgamated with the excursions of the Society for the coming season.

Your Committee feel that the part taken by the members of this Section, contributed in no small degree to the admitted success of the Soirée given by the Society.

Six sets of slides were sent by the Section to the National Lantern Slide Competition, open to all Photographic Societies, and the judges placed this Society third on the list.

Your Committee regret that more interest was not taken in the survey, and trust that more active interest will be shown in the work during the ensuing year.

Your Committee also regret that the members, generally, have not availed themselves of the competitions to a greater extent, and have re-arranged the classes, trusting that the members will take a greater interest in the competitions during the coming year.

Your Committee note with satisfaction that the membership of the Section has considerably increased, several ladies and gentlemen having joined during the past year.

G. FOXALL,
Hon. Secretary, Photographic Section.

MICROSCOPICAL SECTION.

REPORT.

In presenting their annual report the Committee of the Section regret having so little to notice as regards progress. Although five meetings were arranged, owing to the Society's Soirée and other unforeseen causes, it was only found possible to hold one of them :

This was on November 23rd, the subject, Uni-cellular Plants: their Structure and Development, by Mr. D. E. Caush.

Commencing with the simpler forms, Mr. Caush proceeded to describe the various cells of yeast, volvox, &c., carefully showing the various methods of propagation, viz.—budding, cell-division, and bursting ; also mentioning the different changes yeast cells are said to undergo when placed on porous stone. Then advancing a stage higher, gave a brief account of the compound cells of the desmids, illustrating his remarks throughout by diagrams on the blackboard, and afterwards showing the objects themselves under the microscope.

The Section also took part in the Society's Soirée, furnishing eighteen microscopes and many objects of interest.

The annual meeting was held on May 10th, 1894, when Mr. J. Lewis was elected Chairman for coming year, Mr. W. W. Mitchell re-elected Secretary for coming year, and Messrs. Caush, Petitfourt, and Dr. Wynne as Committee.

W. W. MITCHELL,

Hon. Secretary, Microscopical Section.

BOTANICAL SECTION.

REPORT.

The meetings of the Section have not been very largely attended, but there have been some very interesting and instructive gatherings. On October 26th, Mr. Hilton exhibited a number of dried specimens of plants found by him during the past summer.

On November 23rd, Mr. Edmonds commenced a paper on the Movement of Water in Trees. By request, however, he afterwards gave the whole paper at a general meeting of the Society.

No meetings were held in December, January, and February.

On March 29th, Mr. Edmonds read a paper on some Modern Discoveries as to the Source of Nitrogen in Plants.

On April 26th, Mr. Salmon commenced a paper on Herbals and a glance at Historic Botany. By request this was also read at a general meeting of the Society.

At the annual meeting of the Section held in May, Mr. Lewis was elected Chairman for the ensuing year, Mr. H. Edmonds, Hon. Secretary, and Messrs. Hilton, Lomax, Salmon, and Treutler as members of the Committee.

During last summer some 500 plants have been sent in towards the Sussex Herbarium. Of these, 120 have been named and mounted and the others are in process of arrangement.

Our thanks are especially due to Messrs. Hilton and Farr, who have supplied the bulk of the specimens; Mr. Lomax, who examined those already arranged; and Mr. Jenner of Lewes, who has kindly undertaken to fill Mr. Lomax's place in the future.

H. EDMONDS,

Hon. Secretary, Botanical Section.

Observations taken at the Municipal Meteorological Station, Old Steine, from July, 1893—June, 1894 (compared with the averages for the period, 1877-90).

Month.		Temperature of Air during Month. Highest.	Lowest.	Mean of. All Highest.	Mean of. All Lowest.	Mean Temperature of Air.	Mean Degree of Humidity. Saturation = 100.	Wind. Number of days of. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	Rainfall. No. of days on which Rainfell.	Amount collected in inches.
July,	1893 ...	78·8	50·8	69·4	57·5	63·4	78.	1	7	3	2	4	6	3	5	...	16	4·15
,,	1877-90 ...	...	...	67·3	55·0	60·5	73.	1·6	2·9	0·9	1·8	1.8	13.2	4·8	3·6	0·4	13	2·44
August	1893 ...	82·2	48·8	72·6	58·4	65·5	76.	2	5	3	2	1	13	1	4	...	7	0·91
,,	1877-90 ...	...	...	67·3	55·6	61·2	75.	2·5	4·7	1·5	2·2	1.2	8·6	5·4	4·3	0·6	12	2·59
September,	1893 ...	74·8	39·6	66·2	51·4	58·8	74.	5	11	0	1	0	5	5	3	...	16	3·95
,,	1877-90 ...	...	...	63·6	51·4	57·3	79.	3·7	6·2	1.2	2·0	1·6	6·6	2·0	5·0	0·7	12	2·62
October,	1893 ...	65·2	31·4	59·6	48·3	53·9	79.	5	4	1	1	0	12	4	4	...	19	4·15
,,	1877-90 ...	...	...	57·0	45·2	51·0	78.	4·2	6·6	1·9	2·1	1·6	5·6	2·9	5·3	0·6	15	3·84
November,	1893 ...	57·8	29·8	48·3	38·3	43·3	84.	5	9	2	1	0	5	4	4	..	20	1·82
,,	1877-90 ...	...	...	50·1	41·0	45·5	86.	3·0	5·3	1.1	1·3	2·3	7·9	3·6	5·0	0·5	16	3·61
December,	1893 ...	53·4	26·6	47·1	37·7	42·4	89.	4	6	1	0	6	10	4	0	...	15	2·48
,,	1877-90 ...	...	...	45·4	36·5	40·0	83.	3·9	6·3	0·9	1·7	1·8	7·2	3·4	5·6	0·2	14	2·47
January,	1894 ...	49·0	13·2	43·9	35·3	39·6	90.	2	6	1	2	3	11	5	1	...	23	4·23
,,	1877-90 ...	...	...	43·7	34·8	39·3	86.	3·3	6·5	1·9	2·3	2·6	6·6	2·6	4·9	0.2	15	2·83
February,	1894 ...	52·4	26·4	46·8	38·1	42·4	86.	1	5	2	1	1	10	5	3	...	14	2·12
,,	1877-90 ...	...	...	45·1	37·7	40·9	81.	3·0	4·7	1·6	2·4	2·2	6·2	3·6	3·8	0.4	14	2·28
March	1894 ...	61·8	3·20	52·2	39·6	45·9	80.	3	9	1	2	1	6	6	3	..	15	1·46
,,	1877-90 ...	...	...	48·0	35·6	41·7	81.	3·2	7·2	2·2	2·3	1·2	6·2	2·9	5·3	0·5	12	1·82
April	1894 ...	70·8	36·8	58·1	45·5	51·8	76.	0	8	4	5	4	7	2	0	...	11	2·40
,,	1877-90 ...	...	...	52·7	40·5	46·8	81.	3·0	10.0	1·6	2·5	1·8	5·7	2·5	2·6	0·3	12	2·03
May	1894 ...	73·2	35·4	58·9	45·3	52·1	74.	5	9	0	1	3	8	1	4	...	15	1·22
,,	1877-90 ...	...	...	59·3	46·0	52·4	73.	2·7	8·7	1·4	3·2	2·6	8·1	1·6	2·4	0·3	11	1·93
June	1894 ...	82·8	46·4	64·7	52·8	58·7	78.	4	6	0	1	1	12	3	3	..	16	1·84
,,	1877-90 ...	...	...	65·6	52·5	58·8	72.	2·4	6·2	1·4	2·2	1·8	9·6	2·6	3·6	0·2	11	1·90
Entire Year ...	...	82·8	13·2	57·3	44·7	51·4	80.	36	85	18	19	24	105	43	34	0	187	30·73

BRIGHTON.

HOURS OF BRIGHT SUNSHINE.				SUNLESS DAYS.		
Month.	1891-92.	1892-93.	1893-94.	1891-92.	1892-93.	1893-94.
July ...	214·3	226·35	212·81	0	1	1
August ...	161·5	191·64	258·59	3	1	0
September ...	161·9	137·60	167·39	3	1	2
October ...	120·2	108·33	141·37	7	6	5
November ...	69·4	50·08	69·48	9	14	10
December ...	74·2	60·22	66·30	9	12	8
January ...	60·1	29·75	78·73	9	16	9
February ...	80·9	80·62	97·23	8	8	9
March ...	146·5	193·80	202·90	3	3	1
April ...	231·7	280·65	175·96	1	0	3
May ...	228·9	223·40	220·28	1	0	0
June ...	232·5	247·54	184·39	1	1	2
	1782·1	1830·48	1875·43	54	63	50

ARTHUR NEWSHOLME, M.D.

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

It was proposed by Mr. Pankhurst, seconded by Mr. Caush, and resolved—

That the following alterations of the rules be made :

Rule 18. That the words "and Secretaries" be added after the word "Chairmen."

Rule 26. That the words "and Secretary" be added after the word "Chairman."

After the Reports and Treasurer's Account had been read, it was proposed by Mr. Lewis, seconded by Mr. Wykeham Jacomb, and resolved—

"That the Report of the Council, the Treasurer's statement, the Librarian's Report, and the Reports of the Committees of the several sections now brought in be received, adopted, entered on the minutes, and printed for circulation as usual."

It was proposed by the Rev. C. Pugh, seconded by Mr. Mitchell, and resolved—

"That the Treasurer's Account now brought in be received and submitted to the Hon. Auditors for examination, and subject thereto, be adopted, entered on the minutes, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

"Mr. G. D. Sawyer, Dr. J. Ewart, F.R.C.P., Mr. J. E. Haselwood, Mr. G. de Paris, Dr. W. A. Hollis, F.R.C.P., Mr. W. Seymour Burrows, M.R.C.S., and Mr. D. E. Caush."

And that in pursuance of Rule 42 the Council had appointed the following gentlemen to be Honorary Auditors—

"Mr. F. G. Clark, F.C.A., and Alderman H. Davey, J.P."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office under Rule 26, be members of the Council—

"*Photographic Section*: Mr. J. P. Slingsby Roberts; *Microscopical Section:* Mr. J. Lewis; *Botanical Section:* Mr. J. Lewis; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be members of the Council:—*Photographic Section:* Mr. D. E. Caush; *Microscopical Section* Mr. W. W. Mitchell; *Botanical Section:* Mr. H. Edmonds.

It was proposed by Mr. PLAYER ISAAC, seconded by Mr. HILTON, and resolved—

> "That the following gentlemen be officers of the Society for the ensuing year:—*President:* Dr. A. Newsholme, M.R.C.P.; *Ordinary members of Council:* Dr. W. J. Treutler, Mr. E. F. Salmon, Mr. A. Griffith, Mr. G. Foxall, Mr. E. J. Petitfourt, and Mr. W. Clarkson Wallis; *Honorary Treasurer:* Dr. E. McKellar; *Honorary Librarian:* Mr. H. Davey, jun.; *Honorary Curator*: Mr. B. Lomax, F.L.S.; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 12, Clifton Road; Mr. J. Colbatch Clark, 64, Middle Street."

It was proposed by Mr. LEWIS, seconded by Mr. PLAYER ISAAC, and resolved—

> "That the sincere thanks of the Society be given to the Vice-Presidents, Council, Honorary Librarian, Honorary Treasurer, Honorary Auditors, Honorary Curator, and Honorary Secretaries for their services during the past year."

It was proposed by Mr. G. DE PARIS, seconded by Dr. MCKELLAR, and resolved—

"That the sincere thanks of the Society be given to Dr. A. Newsholme for his attention to the interests of the Society as its President during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* members of the Society:—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass , U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Society.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club.
Folkestone Natural History Society.
Geologist' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History.
North Staffordshire Naturalists' Field Club and Archæological Society.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institute, Washington, U.S.A.
South London Microscopical and Natural History Club.
Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Sussex Natural History and Philosophical Society.

1894.

N.B.—Members are particularly requested to notify any change of address at once to Mr. J. C. Clark, 64, Middle Street, Brighton.

When not otherwise stated in the following List the address is in Brighton.

ORDINARY MEMBERS.

Ashton, C. S., 27, Clifton Terrace.
Abbey, Henry, Fair Lee Villa, Kemp Town.
Andrews, W. W., 10, Springfield Road.

Burchell, E., 5, Waterloo Place.
Burdon, Rev. R. T., 19, York Place.
Brown, J. H., 6, Cambridge Road, Hove.
Badcock, Lewis C., M.D., M.R.C.S., 10, Buckingham Place.
Bethell, The Hon. Slingsby, 47, Sussex Square.
Boxall, W. Percival, J.P., Belle Vue Hall, Kemp Town.
Balean, H., 15, Alexandra Villas.
Booth, E., 70, East Street.
Baber, E. C., M.B., L.R.C.P., 97, Western Road.
Burrows, W. Seymour, B.A., M.R.C.S., 62, Old Steine.
Billing, T., 86, King's Road.
Barwell, G. E., 32, St. George's Road.
Bedford, E. J., Municipal School of Science and Art, Grand Parade.
Black, R., M.D., 16, Pavilion Parade.
Bevan, Bertrand, Withdean.
Breed, E. A. T., 41, Grand Parade.
Brown, G. D., 50, The Drive, Hove.
Bower, W. R., Municipal School of Art, Grand Parade.

Campbell, A., 40, Park Crescent.
Cobb, F. E., Furze Dean, Furze Hill.
Clark, John Colbatch, 64, Middle Street.
Cox, A. H., J.P., 35, Wellington Road.

Caush, D. E., 63, Grand Parade.
Coningham, W. J. C., 6, Lewes Crescent, Kemp Town.
Clark, F. G., 56, Ship Street.
Cowell, Samuel, 143, North Street.
Couchman, J. E., Down House, Hurstpierpoint.

Dennant, John, 1, Sillwood Road.
Davey, Henry, J.P., 82, Grand Parade.
Dennet, C. F., Milton Hall, Montpelier Road.
Day, Rev. H. G., M.A., 55, Denmark Villas, Hove.
Denman, Samuel, 26, Queen's Road.
Dodd, A. H., L.R.C.P., M.R.C.S., 14, Goldstone Villas, Hove.
Davey, Henry, Junr., 24, Norfolk Square.
Davis, Harry, 74, High Street.
Deedes, Rev. Canon, 2, Clifton Terrace.

Edmonds, H., B.Sc., Mount Caburn, Ditchling Road.
Ewart, J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Montpelier Hall.
Earp, F., 37, Upper Rock Gardens.
Elgee, E., Mountjoy, Preston Road.

Friend, D. B., 72, Western Road.
Fletcher, W. H. B., Fair Lawn House, Worthing.
Fowler, H., 76, Dyke Road.
Foxall, G., Woodlands, Port Hall Road.
Friend, S. B., 77, Western Road.

Glaisyer, Thos., 96, London Road.
Goldsmid, Sir Julian, Bart., M.P., 105, Piccadilly, London.
Grove, Edmund, Norlington, Preston.
Griffith, Arthur, 15, Buckingham Place.

Haselwood, J. E., 3, Lennox Place.
Hart, E. J. T., M.R.C.S., 4, Gloucester Place.
Hurst, H., Ship Street.
Hobbs, James, 62, North Street.
Hack, D., Fir Croft, Withdean.
Hollis, W. Ainslie, M.D., F.R.C.P., 8, Cambridge Road, Hove.
Holder, J. J., 8, Lorne Villas.
Haynes, J. L., 49, Shaftesbury Road.
Henriques, A. G., F.G.S., 9, Adelaide Crescent, Hove.
Harrison, Walter, D.M.D., 6, Brunswick Place, Hove.
Hodgson, Dr., 35, Montpelier Road.
Howlett, J. W., 4, Brunswick Place, Hove.
Harding, N., Wynnstay, Stanford Avenue.
Horniman, F. J., Surrey Mansion, Eastern Terrace.

Hardcastle, S. B., 71, East Street.
Histed, E., 2 and 3, Upper St. James's Street.
Hilton, Thomas, 16, Kensington Place.

Infield, H. J., 130, North Street.
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Brighton and Sussex Natural History and Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH THE

ANNUAL REPORT

FOR THE

YEAR ENDING JUNE 19TH, 1895.

Brighton:
THE SOUTHERN PUBLISHING COMPANY, LIMITED, 130, NORTH STREET

1895.

Brighton & ~~Sussex~~ Hove
Natural History & Philosophical Society.

64 Middle Street

Brighton, 13 March 1900.

Dear Sir,

In reply to your circular letter of the 9th. inst. - I enclose reports of the above Society for the years 1895 to 1899 (both inclusive). I will add the Natural History Library to the list of Societies and Associations to which the publications of this Society are sent.

Yours truly,

Henry Cane
Asst Hon Sec

B. B. Woodward Esq.,
Assistant in Charge,
General Library,
British Musuem, (Natural Hist
Cromwell Road,
LONDON. S. W.

Brighton and Sussex Natural History and Philosophical Society.

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SESSION 1894-95.

WEDNESDAY, OCTOBER 17TH, 1894.

INAUGURAL ADDRESS

(*Given in the King's Apartments, Royal Pavilion*),

BY

DR. ARTHUR NEWSHOLME, M.R.C.P.

SOME ASPECTS OF HEREDITY.

Dr. Newsholme commenced by saying that it was his first duty to express his thanks for the honour which the members of the Society had conferred on him by electing him as their President for a second year. A presidential address inaugurating a new Session should deal with the affairs of the Society during the year which had passed. It was not, however, necessary for him to say much on this head, because the Report of the Council dealt authoritatively with the work which had been done.

The large share which the Evolution Hypothesis had had in the papers and discussions of the year was shown by the fact that out of nine meetings of the Society, no less than seven were occupied by different aspects of this great question.

We were indebted to Miss Crane for two papers dealing with this question. One on "The Evolution of Brachiopoda," a subject in which she stands among the first of living authorities; and the other on "The Origin of Birds." Dr. Wynne also dealt with the same important subject in its relation to natural selection, and Mr. Arthur Griffith in two papers referred to many of the ornithological problems connected with the same great problem.

The Soirée held in March last was admitted by everyone present at it to have been one of the most successful, as far as the Programme was concerned, that the Society has even given.

The Council was much indebted to Mr. Henry Willett for securing the services of his friend, Mr. (now Sir William) Martin Conway, the great Himalayan traveller, whose lecture on his exploration of these mountains was one of the most notable attractions of the Soirée. The slides shown by the members of the Photographic Section formed one of the most interesting features of the evening, and afforded abundant evidence of the splendid work which our photographers were doing.

It would be interesting to all to learn that the Botanical Section has already collected, mounted, and named no less than seven hundred specimens of plants for an Herbarium of Sussex; and in connection with this most important work it is a mere matter of justice to mention the name of Mr. T. Hilton, whose labours in connection with it have been indefatigable.

In concluding these introductory remarks Dr. Newsholme expressed on behalf of himself, of the Council, and of the members generally the gratification all experienced in seeing Mr. J. Colbatch Clark, to whom for 35 years the Society had been so deeply indebted, again amongst them, after an absence which all deplored, in renewed health and vigour.

Dr. Newsholme then proceeded to the subject of his address, viz.:

"SOME ASPECTS OF HEREDITY,"

of which the following is but a brief abstract:—

Dr. Newsholme quoted Herbert Spencer, who had said in the October number of the *Contemporary Review* that "The question whether acquired characters are inherited is the most important question before the scientific world." He added that the subject of heredity formed a natural sequel to that of his presidential address for the preceding year on "The Influence of Civilization on the Survival of the Fittest." The simplest living organism was the Amœba, in which one cell carried on all the essential functions of life. This enjoyed a kind of immortality, as multiplication was by simple fission, while in multicellular organisms this potential immortality was confined to special cells, produced by the fusion of cells of two individuals, and subsequently known as the germ-plasm. Darwin had shown how the struggle for existence secured the survival of those fittest for the existing conditions of life, and that this was competent to produce the different species of animals. He, however, still held to the opinion that not only natural selection (resulting from the struggle for existence) was at work, but that characters acquired during the life of the individual were also inherited. Thus the long neck of the giraffe was caused by both these factors. Weismann, on the other hand, believes in "the all-sufficiency of natural selection," and holds that peculiarities acquired after birth are not inherited. The lecturer then explained the theories as to heredity of Darwin and Weismann in detail, and claimed that Francis Gatton had anticipated Weismann in his doubt of the doctrine of inheritance of acquired qualities. The real question turned on whether the effects of use and disuse were inherited. Herbert Spencer went so far as to say "either there has been inheritance of acquired characters, or there has been no evolution"; but he stood almost alone in this view. The examples quoted by Spencer were then discussed. Doubt was thrown on the statement that the modern human jaw had diminished in size. The blindness of crabs in the mammoth caves of Kentucky was explicable on the theory of cessation of natural selection (panmixia) rather than as the inherited result of disuse. The special apparatus of the woodpecker for extracting maggots from tree holes was similarly explicable.

Use and Disuse.

It was to be remembered that nature was in no hurry, and that the production of varieties had often extended over vast periods of time. There was little direct evidence of the inheritance of the effects of use and disuse. The favourable coincidences were remembered, unfavourable cases were overlooked. The Chinese female children had had their feet cramped and confined from birth for a large number of generations, but there was no evidence that they were now born with smaller feet than other children. The case of neuter insects appeared to exclude the influence of inheritance of acquired powers. They were sterile and yet varied again considerably; some again becoming atrophied, &c. It might be imagined, from the preceding remarks, that the environment of the individual had no effects upon the fortunes of the race. Weismann, however, agreed that conditions affecting the embryo might influence its development. Mr. Merrifield's experiment on butterflies showed that low temperatures applied in the pupal stage produced a deepening of the ground colour and an extension of the dark markings; while high temperetures had an opposite effect. The effect of environment was also seen in bacteria, which were unicellular organisms. The anthrax bacillus could be deprived of some of its virulency by growing it in a particular way. Vaccine lymph was probably simply small-pox-lymph essentially modified by being grown in the tissues of the cow. There could be no doubt also that the conditions of nutrition of the mother in fœtal life must greatly affect the health of the young. In certain families there was a special immunity from infectious or other diseases. Was it not possible by selection to extend this special immunity? With a more complete biological knowledge and a higher standard of conduct much might be done to prevent the spread of inherited disease. Education appeared to count for more than heredity in the advance of humanity. In the case of man there was a *quasi*-heredity which was almost unrepresented in other animals. He inherited the results of the experience of past generations, and all the benefits of civilization which had gradually accumulated.

WEDNESDAY, OCTOBER 17TH, 1894.

SPECIAL MEETING FOR DISCUSSION ON "HEREDITY."

WEDNESDAY, NOVEMBER 21ST.

NATURE IN THE HEBRIDES.

BY

MR. A. F. GRIFFITH, M.A.

WEDNESDAY, DECEMBER 19th.

AN EVENING FOR THE EXHIBITION OF SPECIMENS.

WEDNESDAY, JANUARY 16TH, 1895.

JUNGLE LIFE IN INDIA.

BY

MR. JOHN LEWIS.

The tract of jungle I am going to describe lies between Allahabad, the chief city of the North-West Province of India, and Jubbulpore, a military station in Central India. Its extent, north and south, between those two places, is about 200 miles; while east and west, it runs up in a north-east direction to the Ganges, near Mirzapore, and to the south-west it extends, I believe, as far as the farther confines of Malwah.

The country is of varied topographical character: low bush covered hills; forest clad ranges of mountain tract; broad streams, which in the rainy seasons are roaring torrents, while in the hot seasons they are dry beds, with pools at intervals; arid rock-strewn plains; and stretches of fertile valleys; and in these fertile valleys the villages that dot the country are to be found. The villages are of the most primitive kind, with mud-walled, one-storied houses, thatched with jungle-grass, and now and then with tiles. The villagers are chiefly agriculturists, with a small artizan element that makes the ploughs, forges their simple iron work, and gins, spins, and weaves the small amount of cotton clothing they require. The flocks and herds graze in the adjacent jungle, which also supplies wood for their charcoal.

All the industries are of the most primitive kind, oxen tread out the grain, winnowing it is by the simple process of holding it aloft and on letting it fall the wind carries the chaff away, the grain remaining. Women grind the corn in small hand mills the produce being made into coarse unfermented bread. No artistic works of any sort are made by these people, and those we found there evidently came from Benares, and such like places where more cultivated workmen abound. In fact, so poor a class of workers were they that we could only utilize them for the roughest of our work—railway construction.

The district as a field for the researches of the geologist, mineralogist, botanist, naturalist, and sportsman, is a perfect paradise. Coal, iron, manganese, and rich lime stone abound—while traces of copper have been found in one place. None of these however, could be worked profitably, but an oxide of iron exists which makes when mixed with oils, or preparations of lead, a most valuable preservative of iron; this is being worked to the present day and is in use all over India. The timbers are not of any great commercial value, but can be worked up into very pretty articles, such as boxes, table tops, and small turnery goods.

The non-edible fauna are tigers, leopards, hyenas, sloth bears, wild dogs, wolves, jackals, foxes, and monkeys. The edible game is deer, pigs, antelope, partridges, pea fowl, bustard, and quail. Porcupines are a nuisance, so are the alligators, snakes, and scorpions. In fact life in a jungle is one continued struggle against conditions adverse to what we call civilized life. Even the native servants if taken from the stations object to live there, and we have to make use of the best we can get from the jungle villages. But for all that jungle life has its charms, freedom from restraint and the tax collector being not the least of them. You can go where you like, you can see nature and the people as they were many centuries ago, and as I fancy they will be for years to come.

Are there other drawbacks? Yes! Cholera and dysentry are ever present, so is jungle fever. Leprosy in its most revolting forms, is to be seen in most of the villages, especially in the Rewah district. Wolves take to man eating, locusts eat up the vegetation, famines occur and reduce the population to vanishing point, while snakes are constantly answerable for deaths among the natives. White ants eat everything that teeth can make an impression upon, and the wonder is that man can hold his own under such conditions. Yet he does, and there are evidences in this very jungle of a high state of civilization having existed there in days gone by, an account of which I will detail on some future occasion, if such a subject is one that will interest our members.

THURSDAY, FEBRUARY 14th.

Lecture at the Banqueting Room, Hove Town Hall,

ON

CURIOUS DWELLERS ON OUR SHORES

(WITH LANTERN ILLUSTRATION).

BY

MR. W. H. SHRUBSOLE, F.G.S.

WEDNESDAY, MARCH 20th.

THE DEVELOPMENT OF THE CHICK.

BY

MR. E. T. WYNNE, M.B.

WEDNESDAY, APRIL 17TH.

A NATURALIST'S RAMBLES AMONG THE CENTRAL PYRENEES.

BY

MR. H. MARRIAGE WALLIS.

The Pyrenees run 250 miles east and west from the Mediterranean to the Atlantic. Geologically speaking they are, as we now see them, older than the Alps, much older than the Himalayas, but compared with the Western Highlands they are of somewhat modern elevation.

The highest points of the chain are usually granite "*massifs,*" as the French call them, centres of upheaval which have lifted the sandstone formations upon their shoulders as they rose.

Long before the human period the work was done. Tertiary deposits are bedded unconformably upon and against the tilted secondary strata on the flanks of the range.

Passes are few and high: the railways cross the range at its extreme ends: for a hundred miles or more there is no road practicable for wheels. The range is as typical a racial frontier as any in Europe. A morning's walk takes one from a French speaking village to one where perhaps hardly a word of French is understood, and where dress, physiognomy, and habits, are different from anything on the French side. Passing from Gavarnie to Torla one steps back two or three centuries and finds a substantially-built town with scarcely a glazed window, without a hotel, a post office, a shop, or a piece of road upon which a cart can travel.

One recognises the forerunners of a southern type of flora soon after passing the frontier. Rounded cushions of *Ulex Horrida*, the Spanish gorse, come into view, and the large pale blue butterwort grows in wet and shady clefts. Here and there one comes upon the rare *Aphyllanthes* thrusting a tough leafless stem through the stony soil and carrying aloft its dark blue star with gummy petals. The insects change also, instead of the two swallow-tail butterflies (*Machaon and Podalirius*), common on the French side as elsewhere in central Europe, one comes at once upon *Papilio Feisthamelii*, the dusky variety of *Podalirius*. The rose-chafer burrowing amidst the pollen of the elderflower will be of a slightly different shape and sculpturing to those common north of the range.

The bird life is the same on both sides as far as can be noticed by a casual observer, and very few species will be seen which have not at one time or other occurred in Great Britain. Many that are unusual, rare or very rare, will be seen and that is one of the joys of foreign travel. Before leaving Pau one sees buzzards, kites of two species, the so-called "common," and the misnamed "black," flap low over the waters of the shallow mountain streams among the foot hills. Irby's long-tailed tit shows its pale scapulars among the foliage of the public gardens at Pau. These species one leaves behind as one ascends. The Fire-Crest and Crested Tit one sees higher up, the latter among the yew trees near the frontier. The Red-Start one soon loses, but its first cousin the Black Red-Start takes its place and is abundant up to the edge of the snows. As in the Alps, the Tyrol, and elsewhere this bird takes the place the robin occupies in England, the robin among the Pyrenees is found in dense thickets or in Northern Spain among the recesses of pine forests.

Soon after leaving Pau the sparrow drops behind to be replaced as street scavenger in the mountain villages by the Chaffinch and Yellow-Ammer. The *cia* bunting, a close congener of the Yellow-Ammer, abounds in the hedgerows of the foot hills, but does not enter the passes. In these a new set of birds appear, the house martin replaces the swallow, the Gray Wagtail (*Boarula*) takes the place of *Alba*. The green finch (*Chloris*) drops out, although the Bullfinch persists, but as we get higher it too is left behind, and the tiny Serin Finch alone remains, and when on the Spanish side that also is missing one is gratefnl for the song of the Citril, a bird very much like our Siskin, almost confined to the pine regions of mountainous Europe south of the North Sea.

One soon loses the rook and jackdaw, the carrion crow, jay, and magpie go to the edge of the timber line. Above that one sees an occasional raven and innumerable choughs, both the Alpine and the red-legged, the former predominating.

Game is very, very scarce. Neither rabbits, hares, marmots, pheasants, or grouse of any kind is one likely to come across. A ptarmigan or so at the edge of an old drift is possible, and by good luck and keeping very still an occasional French partridge may be seen in some of the dryer and stonier gorges. Chamois (*izard* here) are common on the French side but do not penetrate more than a mile or two into Spain, nor does the Spanish ibex (a rare animal now) ever cross into France as it did a century since.

Among the upper ranges just under the snow line one sees our common wheatear and the Water Pipit (*A. Spipoletta*) and on outcrops of rock among the snow or upon isolated peaks from 8,000 to 10,000ft. one is sure to see the Alpine Accentor and the Snow Finch, though not so commonly as in Switzerland.

The little brown Crag Swallows and the brilliantly coloured Wall Creeper haunt the quiet upper ends of secluded glens, and wherever there is water one sees the Dippers which are said to be the pale-backed variety *Albicollis*.

Large birds of prey are not uncommon; the Griffon vulture breeds I believe on both sides of the frontier. The Egyptian vulture is quite common in Northern Spain and strays across the chain. Its pointed white tail and strongly contrasted plumage distinguish it on the wing. The Lammergeyer of the Alps, here called *Gypäete*, is a noticeable bird with racquet-shaped tail and immensely long narrow pinions. Easily distinguished from the foregoing is the Golden Eagle which has a tawny head and nape,and the Imperial Eagle which when adult is liver-coloured splashed irregularly with white.

This summary by no means exhausts the list of birds that one may reasonably expect to see among the higher ranges.

The flora of these ranges is rich and striking, jonquils daffodils, the large yellow and the pure white, several orchisis, primulæ, and campanulas will be found. The little blue hyacinth (*Amethystina*) and the large and handsome Pyrenean columbine are characteristic plants. So is the *Ramondia*, a plant without any near cousins in Europe but very closely allied to the *St. Paulia* of South Africa. About forty plants have been named *pyrenaica*, and the region is rich botanically. The little black and yellow salamander is common and small snakes and lizards abound.

WEDNESDAY, MAY 15TH.

THE FLINTS OF THE CHALK.

BY

MR. E. ALLOWAY PANKHURST.

PART I.

There are few of the phenomena of geology which have occasioned so much discussion, given rise to so many conflicting theories as those black nodules interspersed amidst the white chalk with which we are so familiar.

Two things could hardly be more dissimilar than this brittle, hard, black, insoluble siliceous oxide, which we call flint, and this soft, white, soluble carbonate of lime, popularly chalk.

Let me at the outset remark that aggregations of siliceous matter, in many respects resembling flint, are met with in almost every geological formation, at any rate from the Devonian upwards, and that they are associated with sedimentary strata, of marine origin, which have remained practically unaltered, and of which, it may be added, carbonate of lime forms one of the constituents.

When I speak of "The Flints of the Chalk" I do not wish to imply that true flints are found in no other strata, neither do I wish it to be understood—as it is very often supposed—that this particular part of the chalk is the only part in which the typical flint is found. Here in Brighton we are mostly concerned with the basement beds of the Upper Chalk, which are here particularly rich in flints. The Middle Chalk beneath us is devoid of flints, and the lowest beds, as far as we have ascertained, also are without them, but they occur in the Middle Chalk in some parts of England, and in the Lower Chalk in Devon, Dorset, and Yorkshire. On the Continent the Upper Chalk is almost devoid of flints, the great grey nodular masses of silica, which represent our flints, are confined to the Lower Chalk. There must then have been at the time when the chalk was formed as a whitish or grey mud at the bottom of the sea, or, since its elevation, certain conditions favourable to the accumulation of this flinty matter in one case and not in the other.

History of the Inquiry.

These flinty concretions having, as I have said, aroused so much interest in minds curious about such things, let me glance for a few minutes at the history of the inquiry itself, as given by Sollas in his paper on "Affinities of the Genus Siphonia."

1665. The first notice of them that is to be found is in Aubrey's "Natural History of Wiltshire," under the date 1665: "I desired Dr. William Harvey (the discoverer of the circulation of the blood) to tell me how flints were generated, he sayd to me, 'That the black of the flint is but a natural vitrification of the chalk.'" An answer of the great doctor which betrayed considerable ignorance both of the nature of chalk and of the nature of flint, glass, and of a great deal else besides.

1751. Guettard declares them to be sponges and corals—he evidently mistook a branching sponge for a coral.

1758. In 1758 Baier talks of fossil figs as "lusus naturæ," but in another part of his work refers them to marine vegetables.

1769. In 1769 Walch speaks of these "corælline figs" as marine mushrooms.

1770. In 1770 Guettard comes to the conclusion that they were formed by polyps.

1822. In 1822 Mantell referred them to the alcyonites. He gave the name *choanites* to a genus, a name long retained, and figured to himself a curious creature swimming about by the aid of many tentacles and rushing away from the petrifying fluid which suddenly entered his home, and by which it eventually became changed into flint.

1833. It was Bowerbank, however, who finally placed the sponge theory on a firm basis and showed how the forms of the spicules were determinative of the species and genera of sponges.

He, however, attempted to show that flints were silicified HORNY sponges—the horny sponge being of the kind we associate with the bath.

Sponges, therefore, having by the concurrent testimony of all later observers played a prominent part in the formation of flints, it behoves us to devote a little time to the consideration of their structure and physiology.

What is a Sponge?

A sponge, according to Dr. G. J. Hinde, in the ordinary acceptation of the word, is the internal framework or skeleton of an animal whose soft vital parts are composed of cellular protoplasm. This protoplasm in the living sponge is differentiated into two layers—an inner of ciliated cells, and an outer layer named the synctium, in which the cell structure in the ordinary condition is not recognizable. It is in this synctium or exoderm (outside skin) that the skeleton is secreted. This skeleton may be either keratose or of horny fibre, as in the sponges of commerce, and composed of a substance, which, in its ultimate analysis, much resembles silk ; of carbonate of lime, or of silica.

Thus there are three great divisions of sponges

1 Keratose,
2 Calcareous,
3 Siliceous.

With the first two we are little concerned in our present inquiry. It is the siliceous one which demands our attention, but there are some points common to all three classes which it will be necessary to touch on. The sponge in its natural state is a very different body from that with which we are familiar. The skeleton of a man would hardly give to one unacquainted with humanity an adequate idea of the living creature. It is so with the sponge. In life then, this skeleton is clothed with a pellucid semi-transparant gelatinoid substance called sarcode, very like white of egg. It is variable in colour and insoluble in water. A specimen of an ordinary commercial sponge when placed in spirit directly it is taken from the sea has the whole of the interior nearly as solid and firm as a piece of animal liver.

This jelly-like matter is traversed by innumerable canals. "If viewed with a lens under water," says Mr. Gosse, "while in a living state they display vigorous currents constantly pouring forth from certain orifices, and we necessarily infer that the water thus ejected must be constantly taken in through some other channel. On tearing the mass open we see that the whole substance is perforated in all directions by irregular canals leading into each other, of which some are slender, and communicate with the surface by minute but numerous pores, and others are wide and open by ample orifices ; through the former the water is admitted, through the latter it is ejected." Instead of an excurrent system of canals there are in some orders great cloacal cavities extending from the top to the bottom of the sponge, which receive the water and excrementitious matter. Enveloping the entire mass of the sponge is the dermal membrane, pierced by the orifices of incurrent or excurrent canals.

From this short general view of the structure and physiology

DESCRIPTION OF FIGURES ON PLATE I.

RECENT SILICEOUS SPONGES

(BRIGHTON MUSEUM),

ONE-FOURTH NATURAL SIZE.

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1 Corallistes, a siliceous Sponge from Barbadoes.

2 Pheronema Grayi, a singular Sponge dredged off the coast of Portugal, and found at depths of from 2,000 to 3,000 feet. The roots are a tangled mass of fine hair-like fibres of silica.

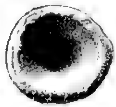
3 Hyalonema Sieboldii, dredged in Pacific Ocean, particularly off the coast of Japan. The long root is of beautiful glass-like threads of pure silica.

4 Euplectella aspergillum, commonly known as Venus' flower-basket. This, the most beautiful of sponges, is found at depths of from 1,000 to 2,000 feet in several parts of the Pacific.

5 Patuloscula precumbens. Australia.

6 Caulospongia plicata. A Sponge with spiral convolutions similar to forms often observed in Flint. There is a good example of this, near the specimen figured, in the Museum.

PLATE I.



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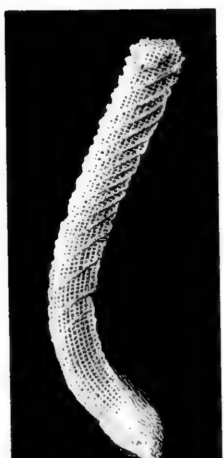

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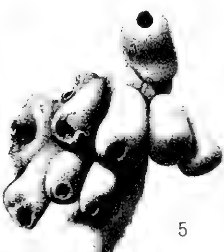

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of a sponge, let us return to the kind we are more immediately concerned with, the order of

SILICEOUS SPONGES.

Let us take the beautiful *Euplectella* as an example :—"In life the glassy framework masked by a soft brown earthy coating of sarcode. It would be difficult to imagine that the thick somewhat clumsy brown tube, perforated with irregular openings contained any arrangement of support, so delicate and symmetrical."—Sir Wyville Thomson, *Good Words*, July, 1873.

Now besides this siliceous or flinty skeleton the whole mass of sponge-flesh, or sarcode, which surrounds it, was crowded with needles of silica—spicula as they are termed. These vary much in form in different genera of sponges. Generally speaking they are exceedingly minute but sometimes of a size distinguishable by the unaided eye. Whence is the siliceous matter of these spicula and of the skeleton derived? Undoubtedly from the waters of the ocean in which the sponge organism lives; and this although the quantity of silica in the waters of the sea is so exceedingly small that the most refined analysis can only detect "a trace" of it.

These siliceous sponges still cover the bottom of the sea in some localities, where the conditions of existence are favourable, in enormous numbers. Sir Wyville Thompson, in his "Depths of the Sea," speaks of a certain species of siliceous sponge which forms a kind of bush or shrub and appears to clothe the bottom in some places like heather on a moor.

There must, therefore, in the course of years, be an enormous accumulation of silica on the floor of the ocean, especially, as Sollas informs us, that many of the siliceous sponges *shed* their spicules.

There are, no doubt, several here who can remember what a sensation was caused in the scientific world when the first deep dredging of the Atlantic revealed the fact that foramimfera were building up the chalk floor of the bottom of the Atlantic precisely as in times past they built up the chalk mud of the ancient ocean on which we are now living. That was more than thirty years ago, and since then we have accumulated much additional evidence as to the life of the sea and the conditions under which it exists.

"This calcareous mud," says Sir W. Thompson, "is the home of multitudes of exquisitely formed glassy and other siliceous sponges. . . . The mud was entirely filled with the delicate siliceous root fibres of the sponges, binding it together like hairs in a mortar. It stuck together in lumps as if there were white of egg mixed with it; this was the sarcode of sponges."

In the beautiful *Hyalonema Sieboldii* and *Pheronema Grayi* we have examples of recent sponges whose beautiful glassy root fibres interpenetrate the floor of the Atlantic as Sir W. Thompson describes.

Here again is a modern siliceous sponge from Barbadoes, which very few would take to be a sponge at all, so much it resembles a piece of somewhat light and porous sandstone, formed into a vase-like shape.

PART II.

PROBLEMS SUGGESTED BY THE EXAMINATION OF INDIVIDUAL SPECIMENS OF FLINT.

From the foregoing we have obtained some idea of the manner in which, in all probability, the chalk of the ancient seas was deposited, and the circumstances under which silica was associated with it. Let us now see from an examination of some specimens of flint and flinty concretions which are furnished to us by the unique collection which the Brighton Museum owes to the enthusiasm and liberality of Mr. Henry Willett, what further questions they suggest, and what light they throw on the problems presented to us.

And first of all it will be necessary to define more accurately what flint is. Scientifically then flint "is a sub-translucent amorphous variety of chalcedony, having little or no action on polarized light." Its very blackness being, according to some, only an optical effect, as water is itself dark blue or black under certain conditions. Pounded flint is quite white.

The definition above given demands some explanation. For the further question naturally arises — what is chalcedony? Briefly then the Protean forms of this interesting substance silica — rock-crystal, quartz, amethyst, cairngorm, agate, chalcedony, cornelian, opal, and many others may be classified under three heads—*crystallized silica*—such as quartz and rock crystal, *crypto-crystalline*, such as chalcedony, in which incipient crystallization is shown, and which has some action on polarized light, and the amorphous—formless — *colloid* silica. The word colloid is derived from a Greek word signifying glue or gum. Colloid silica is a gelatinous form, which is largely soluble in akalies and some acids. It enters readily into combination with various substances. It is the unstable form of silica; the crystalline form is the stable one and is quite insoluble. Opal is a combination of this jelly-like silica with water. The silica of sponges contains about seven per cent. of combined water. In nature we find colloid silica passing into the crystalline by an infinite series of gradations; chalcedony is one of these forms.

Now let us glance at these pieces of silicified wood obtained either from the chalk in the neighbourhood or the beach. Note especially this mass of translucent chalcedony in which the form of every fibre, and of every vessel is accurately preserved. The woody substance itself has gone, it has been replaced by silica. What are the conclusions forced upon us by such a fact? First, that the silica must have been dissolved in some fluid which was able to penetrate into the interior of the wood. Next that a chemical combination must have taken place between the silica, or the solution in which the silica was dissolved, and the substance of the wood, so that the silica took the place atom by atom of the woody fibre. In some of the other specimens of silicified wood the process is in a measure seemingly incomplete.

There are many points in this curious history of the transformation of a piece of wood into a mass of chalcedony still enshrouded in mystery. But the fact still remains that the replacement *has* taken place. It is a chemical process, and, as I have said, all the steps of it are not quite clear to us. But silica replaces other things besides wood. Here is a piece of coral from Barbadoes gradually being converted into chalcedony. And Professor Rupert Jones is not without some justification in making *replacement* the basis of his theory of the formation of flints. "Flint," he says, "is a siliceous pseudomorph of the chalk mud . . . the fine calcareous detritus which filled the internal tubules of sponges and the cavities of sea-urchins has been changed atom by atom into exquisite siliceous casts of such hollow interior."

Here for instance is the shell of an echinus or sea-urchin entirely filled with flint. The silica has replaced the organic matter of the body of the animal, but has left the shell itself practically untouched. The carbonate of lime of which the shell consists is in a form evidently which offers more resistance to the chemical reactions necessary in any *replacement*. In another example the test has disappeared but the delicate markings of the interior are faithfully copied on the flint which filled it. Carbonate of lime, when in the form of aragonite, is seldom or never replaced by silica. Hence portions of the tests of Inoceramus are often seen quite unaltered in the middle of a flint.

Here is a beautiful example of a sponge partly converted into chalcedony. The tubules of the original sponge, were the moulds into which the flint was formed, and the long twigs as it were of chalcedony now represent them. Nature has kindly allowed us, one might say, to see some of the steps of this interesting process of the conversion of a sponge into a flint, as if to whet our appetite for more information concerning it, but has carefully hidden from us that which we most desire to know.

In many of these chalcedonic nodules where the process has gone further, some of the spicules and sponge fibre of the once living organism, may still be discerned. Why are these left? By what process was all the rest dissolved? For it is only occasionally that we meet with spicules or fibre in these flints which must have derived their silica from vast quanties of the spiculæ and skeletons of sponges.

Ventriculites. — "These are cup-shaped or vasi-form sponges, hollow within, freely open above, and below tapering to a point which is enclosed in a surrounding sheath of fibres" (Sollas). These sponges belong to the same great order as the recent *Euplectella* and *Hyalonema*, specimens of which are exhibited, and in the latter may be seen the sheath of fibres similar to that by which the ventriculite was anchored to the bottom of the sea. Only one species of a modern sponge has been discovered as yet that in its structure is allied to the ventriculites, and that is represented by a single insignificant specimen (*Myliusia Grayi*) in the British Museum. It differs however, widely in form from them, and it may be said that the ventriculites which were so abundant in the seas of the Cretaceous epoch have left no direct representatives. The curious forms which they now assume as flinty concretions have obtained for them the name of fossil mushrooms, fossil figs, &c.

Choanites.—Perhaps the most beautiful forms which a flint pebble when cut and polished presents to us are associated with Choanites — sponges of the genus "Siphonia" as they are now termed—the fossil sea-anemones of some shop windows. They are particularly characteristic of our Brighton beach, many having been, no doubt, derived from the old beach now to be seen embedded in the chalk cliffs between Black Rock and Rottingdean. The siliceous matter has often aggregated round them in that beautiful translucent form which is termed chalce-

DESCRIPTION OF FIGURES ON PLATE II.

FOSSIL SPONGES, &c.

(BRIGHTON MUSEUM),

ONE-FOURTH NATURAL SIZE.

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1 A Ventriculite with roots in chalk. At A a deposition of Silica is shown, the commencement of a Flint.

2 Impression of a Ventriculite in calcined Flint, found in a piece of lime.

3 Fungiform Flint, a Ventriculite.

4 Siliceous cast of the internal cavity of a Ventriculite in a hollow Flint.

5 Ventriculite.

6 Branching Sponge in Flint. Up: Chalk, Chatham.

7 Remarkable example of a Choanite (Siphonia) in a matrix of Silicified Ferruginous Chalk. The broken and interlaced slender rods are the casts in Flint of the canals which opened into the central cavity.

8 A beautiful example of a Choanite in grey translucent chalcedony.

9 Test of an echinoderm filled with Flint, the best itself is often unaltered carbonate of lime.

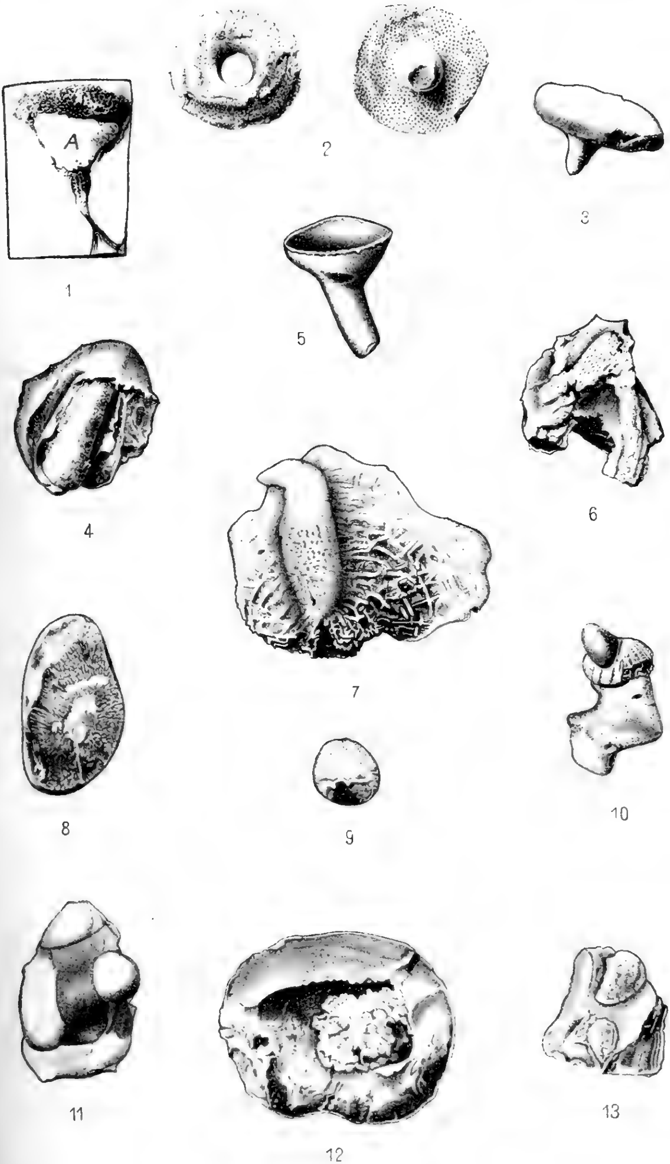
10 A curious Flint passing through the broken test of an echinoderm.

11 Interesting example of a Flint in which there is a layer of Silica evidently deposited subsequently to the formation of the original mass.

12 Large Flint broken to show cavity in the interior partly filled with a mass of small quartz crystals.

13 Example of a Flint, not uncommon, in which two or more Sponges have formed the nucleus of the deposited Silica.

PLATE. II.



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dony. Floculent masses of green or red oxide or carbonate of iron are disseminated through it and give rise to the "moss-agates," as they are termed, of the jewellers' shops.

Here is a very remarkable one in grey chalcedony, and near it is another, not so beautiful, but still more remarkable, a large choanite partially transformed into flint. These tentacles of the mythical sea-anemone are the tubules of the sponge, which were probably filled to some extent with the finer mud of the chalk sea, and have still retained some of its colour. This darker part in the centre is the cloacal cavity.

But the true "choanites" like the ventriculites have long since disappeared, and no modern representative is left of these curious tubular sponges.

Hollow Flints.—There are several examples of these exhibited, and they present many curious problems. They have evidently been formed round a sponge, for the sponge structure is visible on the internal walls. Considering what a fragile substance sponge is, one is surely correct in drawing the inference that the first coating of silica round the substance of the sponge must have been a comparatively rapid process. At any rate, it could not have taken place centuries after the formation of the sponge, and when the chalk was to a great degree consolidated. Some of the hollow spherical flints contain when broken open a fine grayish-white dust. On examination under the microscope this dust is found to be composed of the spicules of—not *a* sponge—unfortunately. Nature in all that concerns this problem seems to take a pleasure in making it perplexing. It is not the spicules of *one* kind of sponge that is enclosed in this hermetically sealed hollow sphere, but the siliceous remains of several genera and as many species. How were they gathered together and enclosed within this stony envelope? And how was the stony envelope itself formed? For the silica of any individual sponge can furnish but a very small portion of the flint which has assumed its form.

It is in these hollow flints that we find the silica passing into the stable crystalline form of rock-crystal. Very often there is an intermediate layer of purer chalcedony on which the clear crystals of quartz have grown. These used to be mounted as jewels and sold as Brighton diamonds, when found at Clifton as Clifton diamonds, and in Ireland, where they are often mounted in bog-oak, they are termed Irish diamonds.

In the production of these hollow flints the process known as dialysis comes probably into play. We owe the discovery of this to Graham. (See reference in Bibliography.) He found that through a thin membrane, as parchment, crystallizable bodies will pass, colloid bodies will not. Hence this supplies a means of separating the two. A liquid holding silicia in solution, such as one containing salt, and different carbonates, would pass through the membrane of the original sponge perhaps, or through the first thin coating of colloid silica deposited on the exterior, and the colloid silica be left behind.

Here is a singularly interesting specimen of a flint which has evidently received a considerable addition to it since its first formation. It is clear from this that the silica of the flint which served as a nucleus must have been consolidated previous to the later deposition. But the question is, and much depends upon it—How long after the *first* deposition did the *second* take place?

Looking at the flints then generally we may note that there is almost always something *not* flint which served as a nucleus round which the silica aggregated. It is a shell, or the test of an echinus, or more probably a sponge. But the manner in which the silica was held in solution, what caused it to form concretions round these substances, what determined its solidification—are some of the most important problems yet to be solved.

Banded Flints.—In all probability Nature has followed more than one method in the production of these. The "banding" has sometimes arisen from structural differences in the sponge about which they are formed, or from chemical reactions between the silica and the iron, &c., dissolved in the water which has enveloped the nodule since its formation. (See references to Ruskin and Woodward in Bibliography.)

PROBLEMS CONNECTED WITH THE MANNER IN WHICH FLINT OCCURS IN THE UPPER CHALK.

In most places where there are cliffs or quarries in the Upper Chalk in this neighbourhood, the flint may be observed to occur in the following modes:—

1st, Layers of nodular concretions, passing often into tabular masses, both following the planes of bedding. These layers are from two to five feet apart.

2nd, Sporadic nodules, nodules appearing here and there irregularly in the chalk.

3rd, True vein courses inclined at various angles to the planes of bedding.

Now the problem which soon suggests itself to the observer is,—Were the flints formed contemporaneously with the deposition of the chalk, or have they been formed since its consolidation? And further, if formed after the chalk was consolidated, how long after? Had the chalk been elevated and become dry land when they were formed or did this segregation of the silica take place when it was a more or less compact ooze still at the bottom of the sea?

Let us see then what evidence is furnished to us on this question by observation of the modes in which it occur. For convenience we will take the last division first.

True Vein Courses.—In the upper portion of the chalk cliffs and quarries, both east and west of the town, narrow veins of flint may be seen running through the chalk, especially where the chalk is in what may be termed a *rubbly* state. My own observation shows that these narrow oblique veins of flint are more often met with near the surface than at great depths.

There can be little doubt that this flint has been deposited since the consolidation of the chalk, in all probability since it has been uplifted and become dry land, or perhaps it might have been during the long slow process of the uplifting of the chalk. Water holding silica in solution has no doubt been the agent.

2. Layers of Nodular Flints and Thick Tabular Sheets. —Seeing that the flint of the veins just considered has undoubtedly been deposited since the solidification of the chalk why not it may be asked the nodules, &c.?

There seem to be many difficulties in the way of such an explanation of their origin. The hollow flints must have had a coating of silica formed round the sponge, which in so many cases is the origin of their form, before the decay or disintegration of the delicate framework and tissues of the sponge skeleton. The wood, whose finest fibre and structure is preserved, had no time to decay before it underwent "a sea change into something new and strange" and became the beautiful mass of chalcedony to which we have before referred. Dr. Hinde in his "Fossil Sponge Spicules from the Upper Chalk," speaks of a quantity of flint-meal, as it is termed, the greyish powder we have before spoken of, in the interior of a large spherical nodule, and says respecting it: "Without entering here into the vexed question about the formation of the flints in the chalk, it may be as well to notice that the beautifully perfect state of preservation of the various delicate fossil organisms in the interior of this flint, when compared with the nearly complete obliteration of their structure in the enveloping chalk, points to the conclusion that the period in which the flints were formed must have been previous to that consolidation of the mass of the chalk by which the smaller fossils were mostly destroyed." It may not be uninteresting to note that in the flint meal (about two pounds in weight) of this one nodule, Dr. Hinde found 160 different forms of spicules which he divided among 38 *species and* 32 *genera of sponges.* Besides these there were fossilized remains, entire or fragmentary, of Foraminifera, Echinoderms, Annelids, Cirrepedia, Ostracoda, Polyzoa, Brachiopoda, Lamellibranchiata, and lastly Fishes (p. 6, op. cit.)

It was evidently a portion of the ooze of the cretaceous ocean which had thus been enclosed in this siliceous envelope and so preserved to us.

The chalk itself, though bearing much analogy with the globigerina ooze of the Atlantic, must have been deposited under somewhat different conditions, and much more rapidly than that is at present being formed. The fragile arms of the Cidaridæ are still in their natural position, the scales of the fossil fish are still undisturbed and undecayed.

Was the Formation of the Flints Strictly Contemporaneous with that of the Chalk?

The argument for the contemporaneity of the chalk and flints is well put by Dr. Wallich in his paper on "The History of Cretaceous Flints" (Journal of the Geological Society, vol. 36). Dr. Wallish sees on the floor of the Cretaceous ocean the ooze interpenetrated with fibres and spicules of sponges, and also with the sarcode or protoplasm, as at present obtains over wide areas of the bed of the Atlantic. This protoplasm enters into combination with the silica, and the first step is thus taken towards a layer of nodules. Then a period ensues during which the Foraminifera are in the ascendant and their accumulated calcareous tests go to form the pure white chalk. After a time there is again an exuberant growth of siliceous organisms. Hence the intermittent layers of flint. But there is too much here purely speculative, too much taken for granted, and the balance of authoritative opinion is certainly against such a hypothesis. Most geologists consider that these siliceous nodules must have been formed while the chalk was still beneath the water, though perhaps some way beneath the actual floor of the sea. Here the chalk would be still in a more or less mobile and plastic state. Such a condition would allow to all its constituents a certain amount of movement; they would be subject to the chemical and molecular changes which the pressure resulting from a great depth of water would help to being about, the affinities it would call into play, the solutions it would facilitate.

The Hypothesis of their Formation of Flint since the Upheaval and Solidification of the Chalk.

The argument for this is well put by Professor Green in his "Geology for Students" (page 173). Balls, lumps, or nodules of different composition from the rocks in which they are found, are common in many rocks. That such have in many cases been formed since the upheaval and solidification of the rock is shown by the lines of stratification running through the nodules. A shell, plant, fish, or even a grain of sand has served as a nucleus round which the nodules have consolidated and has even determined their shape. The matter of which these nodules consist must have been disseminated through the rock, but Professor Green candidly admits that he speaks of *concretionary action*, as he terms it, as being the cause of the formation of these nodules, he has no explanation to offer of what this action really is. It is alleged on good authority, however, that when flints have been ground up into powder and mixed with clay for pottery purposes, the silica after a time separates out and forms incipient concretions of flint. And this is not the only instance of such segregation that has been observed. Such facts may be adduced, they may illustrate, but do not explain, the sporadic nodules of flint in the chalk, and still less the layers of them, or the thick tabular sheets which in some places take their place.

If it be asked why these flinty nodules occur in such regular layers parallel to the planes of bedding, it must be admitted that neither of the hypotheses just reviewed can furnish an adequate explanation.

Few researches have been made of late years more important than those bearing on the amount of colloid or soluble silica still found disseminated through certain rocks. In the chalk of Collingbourne, Messrs. Jakes-Brown, and Hill found no less than 38·69 per cent. (On the Lower Chalk of Berkshire and Wiltshire).

They say further "One bed contains very definite siliceous concretions of irregular shapes comparable to nodules of flint, but unlike such nodules in being so closely united with the surrounding chalk that they are not readily separated from it." The colloid silica which they contain to so large an extent is in the form of minute globules which Dr. Hinde, the highest English authority on such a subject, regards as being derived from the spicules of sponges.

The spicules in the nodules are seen to have passed, or perhaps to be passing into the chalcedonic form of flint. In the higher beds of the upper chalk in some parts of Yorkshire, and at Trimingham, nodules which have been evidently moulded to a great extent on sponges, have been found in all stages of silicification from the mass scarcely harder than the surrounding chalk and containing but a trace of silica, to flints as black and as hard as those in the chalk at Brighton. In this case the blackest and hardest flint is in the *interior* of the nodules (Sollas "On the Flint Nodules of the Trimingham Chalk").

In the oceans of the Cretaceous epoch there is little doubt that sponges flourished to a far greater extent than at present. In the greensand which lies at the base of the chalk there are beds of chert, an impure variety of flint, and siliceous rock 20 or 30ft. in thickness and extending over many square miles. On microscopic examination these beds are found to be largely composed, or at any rate to have been derived from the spicules of sponges (Hinde). One piece of malmstone from near Godalming yielded on analysis no less than 72 *per cent. of colloid silica* (Way and Paine).

In the chert near Merstham in Surrey there are blueish-grey nodules locally known as flints; in these the silica has aggregated into denser masses than the rock which encloses it. These nodules are disposed like the chalk flints in definite planes of bedding. Dr. Hinde also speaks of sponge-beds, as they are technically termed, in Westphalia, almost wholly composed of the spicules and fibres of sponges, which extend to a great distance and in places obtain the enormous thickness of 492ft. Now, when we consider that the silica in the most siliceous sponge known is not more then 12 per cent. of the total weight of a flint the same size as the sponge, we may form some idea of the extraordinary luxuriance of the sponges on the bed of this ocean, and at the length of time that must have elapsed during the accumulation of 500ft. of their debris.

It is seen that there is no question as to the *supply* of silica whatever its original source may have been. But the problem is still to be solved why in some places the silica has segregated into nodules and in others it is still disseminated through the rocks. It is no doubt at bottom a chemical question. Wherever the calcareous strata are *pure carbonate of lime* there the flints are

DESCRIPTION OF FIGURES ON PLATE III.

FLINTS DERIVING THEIR FORMS FROM SPONGES.

ONE-SIXTH NATURAL SIZE.

These figures are taken, with the exception of the first five (which are from Dixon's Geology of Sussex), from Dr. G. J. Hinde's notable "Catalogue of the Fossil Sponges in the British Museum."

1A A fungiform Ventriculite, often termed a fossil mushroom.
2A Ventriculite, showing foldings of sponge on upper edge.
3A Ventriculite, with root.
4A V. Townshendi.
5A Outline of Ventriculite in Flint.
6A V. infundibuliformis, with transverse section.
7A Dermal layer of Callodictyon, enlarged a little more than twice.
8A Structure of Spicules in internal wall of sponge, enlarged as above.
9A Skeletal mesh of Ventriculite.
10A Branching Sponge. Up. Greensand.
11A Empty mould of a branching Sponge in Flint.

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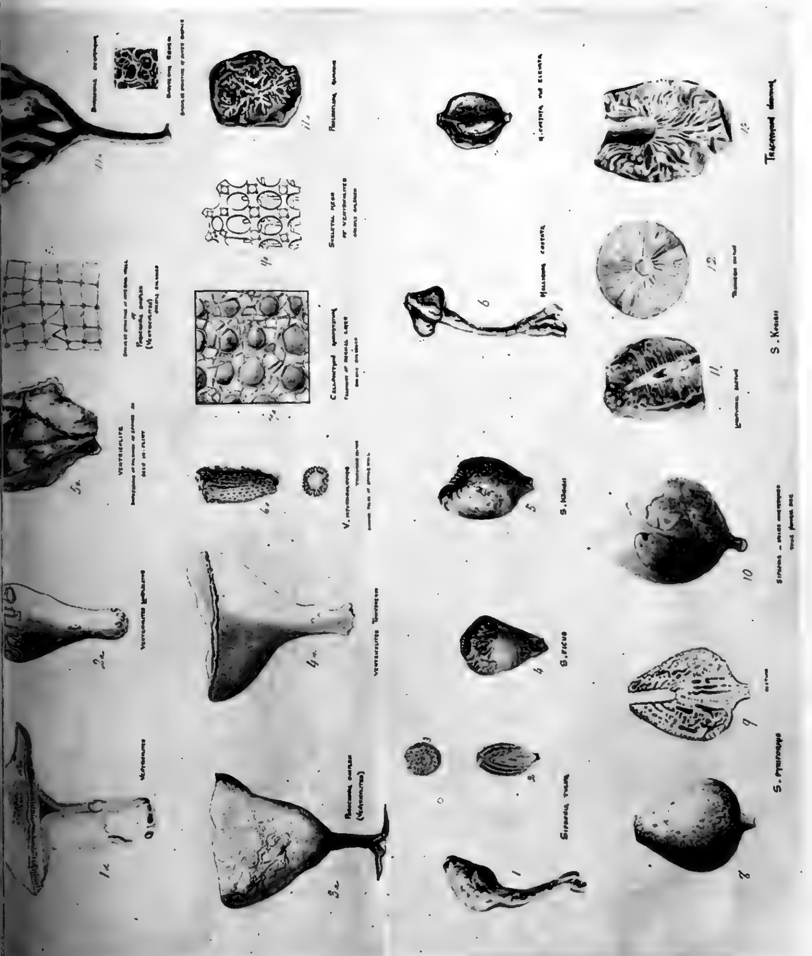
1 Siphonia Tulipa. Up. Greensand, Warminster.
2 & 3 Vertical and transverse sections.
4 Siphonia Ficus. Grey Chalk, Dover.
5 Siphonia Könige (Choanite). Up. Chalk.
6 Hallirhoa Costata. Up. Greensand.
7 ,, ,, (One-ninth, natural size).
8 S. Pyriformis.
9 Section of same.
10 Genus Siphonia—Species undetermined.
11 & 12 Vertical and transverse sections of S. Könige.
13 Flint, showing funnel-shaped cloaca of a Sponge, and the courses of the canals opening into it.

PLATE III.



most characteristically developed. Where the limestone is impure there the siliceous nodules become cherty, but even where carbonate of lime is absent, as in the sponge-beds of Westphalia, there is a tendency to form nodules. These were at first taken to be gigantic sponges—resembling somewhat the Paramoudras of the Norfolk Chalk—but were afterwards shown by Zittel to be "nodular masses of rock, filled with sponge spicules or their casts" (Hinde).

But in truth the question of the formation of Flints is part and parcel of a still wider question; one which must take into account such phenomena as the silicification of huge trees—a forest in fact—in the plains of Arizona, the silicified wood of the desert near Cairo and of New Zealand. Unfortunately the *Chemistry of Geology* lags far behind the phenomena for the explanation of which its help is required, and geologists must wait for the help of the sister science before they are able to solve many of the problems which now perplex them.

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WEDNESDAY, JUNE 19TH.

ORDINARY MEETING.

"THE MINERALS OF THE CHALK,"

BY

MR. E. ALLOWAY PANKHURST.

WEDNESDAY, JUNE 19TH.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 19TH, 1895.

The annals of the Society for the past year present no feature calling for particular notice. The ordinary meetings have been well attended, and the various Sections have maintained the interest in the different branches to which they are devoted.

Since our last annual meeting the Society has lost no members by death; three however have resigned. Nine new members have been enrolled, the number therefore shows a net increase of six over that of last year.

The Council have much pleasure in congratulating the Society on the increased balance shown by the Treasurer's Report.

The Hon. Librarian has carefully gone through the Library, amended and revised the catalogue and brought it up to date. He reports that our books are in a fairly satisfactory condition. The thanks of the Society are due to Mr. Davey for the great attention he has given to this matter.

A new catalogue is about to be printed, and it is hoped that it will be in the hands of members before next Session. It is also proposed to incorporate with it a catalogue of the microscopical slides in the Society's Cabinets.

The Council, in order to relieve Mr. J. Colbatch Clark of some of the arduous duties which he has discharged as one of the Hon. Secretaries, with such advantage to the Society for the last 33 years, have nominated Mr. Hy. Cane as Hon. Assistant Secretary. Mr. Cane has been for many years in Mr. Clark's office and has materially assisted him in all matters connected with the Society and is familiar with all the details of its finance, &c.

The following papers have been read and Lectures given before the Society :—

Oct. 11th, 1894.	Inaugural Address by DR. NEWSHOLME, in King's Apartments, Royal Pavilion, on Some Aspects of Heredity.
Nov. 7th, „	Discussion on Dr. Newsholme's Paper.
„ 21st. „	Nature in the Hebrides: MR. ARTHUR GRIFFITH, M.A.
Dec. 19th, „	Evening for Exhibition of Specimens.
Jan. 16th, 1895.	Jungle Life in India: MR. J. LEWIS.
Feb. 14th, „	Lecture in Banqueting Room, Hove Town Hall, on Curious Dwellers on our Shores: MR. W. H. SHRUBSDLE, F.G.S.
March 20th, „	The Development of the Chick—a Study in Comparative Embryology: MR. E. T. WYNNE M.B.
April 17th, „	A Naturalist's Rambles among the Central Pyrenees: MR. W. H. MARRIAGE WALLIS.
May 15th, „	The Flints of the Chalk: MR. EDWARD ALLOWAY PANKHURST.
June 19th, „	The Minerals of the Chalk: MR. EDWARD ALLOWAY PANKHURST.

The excursions during the year have been as follows :—

May 18th, 1895.	GORING.
June 15, „	GRAVETYE, by kind permission of W. Robinson, Esq.

Brighton and Sussex Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 19TH JUNE, 1895.

Dr.

	£	s.	d.
By Balance in the hands of the Treasurer, 13th June, 1894	2	3	2
,, Annual Subscriptions and arrears to 1st October 1894	11	10	0
,, Annual Subscriptions to 1st October, 1895 ...	76	0	0
,, Annual Subscriptions to 1st October, 1896 ...	0	10	0
,, Entrance Fees	10	10	0
,, Dividends on £100, 2¾ per cent. Consolidated Stock, to 5th April, 1895, one year	2	15	0
,, Over payment on account of Section Expenses, 1894, now returned	0	10	0
,, Amount received for Sale of Electric Lantern Accessories	1	0	0
	£104	18	2

	£	s.	d.
Balance in hands of Treasurer, 19th June, 1895 (at Messrs. Barclay, Bevan, and Co's. Bank) ...	21	4	10
NOTE.—A sum of £100 is invested in £2 15s. per cent. Consolidated Stock in the names of the Treasurer and Hon. Secretaries as Trustees for the Society	100	0	0

Cr.

	£	s.	d.
To Books and periodicals	11	12	3
,, Bookbinding	1	13	7
,, Printing Annual Report and Abstract of Proceedings	11	12	6
,, Printing and Stationery	7	9	0
,, Postage, &c.	10	8	1
,, Scientific Secretary, Honorarium for the current year	10	0	0
,, Subscriptions to Societies	2	9	6
,, Clerk's salary	2	2	0
,, Commission to Collector for Subscriptions ...	3	10	0
,, Gratuities to Assistants at Museum	3	10	0
,, Electric Lantern Accessories	3	1	4
,, Repairs to Bookcases	1	17	6
,, Expense of Meetings, Lecturers' Fees, &c. ...	5	16	6
,, Cost of Tea and Coffee at Meetings	0	12	7
,, Expenditure on Herbarium, Botanical Section...	1	10	0
,, Cost of Medals, Photographic Section	3	0	0
,, Photographic Section, general expenses... ...	2	10	6
,, Fire Insurance premium, for books	0	18	0
,, Balance in hands of Treasurer, 19th June, 1895	21	4	10
	£104	18	2

Audited with books and vouchers and found correct.

F. G. CLARK, F.C.A. }
HENRY DAVEY, } *Hon. Auditors.*

LIBRARIAN'S REPORT.

During the past year 187 books have been borrowed from the Library. A new catalogue has been completed, and will shortly be issued to the members of the Society.

The fine series of "Challenger Reports" in the Library has been further augmented by the two volumes of Botany. Mr. H. Willett has very kindly presented the Society with Dr. John Hill's "British Herbal," a splendidly illustrated folio volume, published in 1756; and the thanks of the Society are also due to the same gentleman for his continued donation of the Quarterly Journal of the Geological Society.

H. DAVEY, Jun.,
Honorary Librarian.

PHOTOGRAPHIC SECTION.

Chairman: Mr. Clarkson Wallis.

Committee: Messrs. J. P. Slingsby Roberts, D. E. Caush, G. Foxall, W. Harrison, W. W. Mitchell, W. H. Payne, H. V. Shaw, C. Berrington Stonor, and A. H. Webling.

Secretary: Mr. R. C. Ryan, 43, Compton Avenue.

This Section meets on the first Friday of the month, at 8 p.m., generally in the Librarian's Room, Free Library.

REPORT.

In presenting this report your Committee regret that, owing to the influenza epidemic and other causes, the attendance at the Sectional Meetings have not been quite so numerous as in past years.

There has been three ordinary meetings and three lanterns nights; the attendance at the latter has been most satisfatory.

There have been two Competitions during the session, one for Lantern Slides, in which there were seven entries with 16 sets of slides sent in, the other for Prints, in which there were three competitors and 23 prints sent in.

Six members of the Society also entered the "Camera and Lantern Review" Annual Competition, and though we were not successful in obtaining either first or second place your Committee are glad to inform you that we were placed amongst those Societies obtaining "hon. mention."

Your Committee desire to tender their best thanks to the Photographic Section of the Croydon Microscopical Club for adjudicating in both competitions.

The best thanks of this Section are also due to Mr. J. P. Slingsby Roberts, the Chairman, and to Mr. D. E. Caush, the Secretary, for their attendance to the duties of their offices.

MICROSCOPICAL SECTION.

Chairman : Dr. Arthur Newsholme, M.R.C.P.

Committee : Messrs. Joseph Lewis, D. E. Caush, and E. T. Wynne, M.B.

Secretary : Mr. W. W. Mitchell, 66, Preston Road.

The Section meets on the third Thursday of the month at 8 p.m. The place of meeting is notified to the members each month by the Secretary.

REPORT.

At the conclusion of their year of office the Committee beg to report that the Section has held three meetings with the object of promoting the work of the Section, viz., November 22nd, January 31st, and March 28th.

At the first (November 22nd) the subject was "Acari," introduced by Mr. D. E. Caush.

After giving a detailed account of the life of a beetle's parasite through the four stages of egg, larva, pupa, and insect, Mr. Caush showed slides of cheese mites, parasites of beetles, bees, housefly, gnat, &c., with short notice of any peculiarity present.

January 31st, 1895, "The development of the Eye," by Mr. E. T. Wynne, M.B.

After an explanation of the diagram representing the human eye, and pointing out the difference between that and the eye of the bird, Mr. Wynne proceeded to give a description of the development of the eye of the domestic fowl, taking this instance on account of the comparative ease with which embryos can be obtained at any age. Commencing with the embryo at 16 hours old, the development of the eye was gradually traced by means of diagrams and a free use of the blackboard, till the perfect organ was reached. This most interesting and instructive subject was brought to a close by an exhibition of slides illustrating all that had been said.

March 28th, an exhibition of microscopical slides of bacteria, micrococci, spirillum, &c., by the President, Dr. Newsholme, with explanatory description of each.

BOTANICAL SECTION.

Chairman: Mr. Joseph Lewis.

Committee: Messrs. T. Hilton, B. Lomax, E. F. Salmon, and Dr. Treutler.

Secretary: Mr. Hy. Edmonds, B.Sc., Municipal School of Science, Grand Parade.

The Section meets on the fourth Thursday of the month at 8 p.m., in the Librarian's Room, at the Free Library.

REPORT.

The meetings of the Section have, during the past winter, continued to be poorly attended, but those who have been present have thoroughly appreciated the papers read. As it was felt that the hour (nine o'clock) at which the meetings have been held in the past was rather late, and may have prevented the attendance of some, arrangements have been made to commence at eight o'clock in the future.

Papers have been read by the following gentlemen to whom the thanks of the Section are given:—

Mr. Lewis, Chairman, Opening Address.

Mr. E. J. Petitfourt, B.A., on "Carnivorous Plants."

Mr. H. Edmonds, B.Sc., on "Cross Fertilization."

Mr. F. Douglas, B.Sc., on "Alternation of Generations."

During the summer of 1895 interesting excursions were made to Shoreham, Lewes, and Hassocks, on Tuesday evenings.

The collection of Sussex wild flowers is steadily progressing. Boxes have been purchased to contain the specimens already mounted and a copy of the London catalogue for reference. The thanks of the Section are specially due to Mr. Hilton and Mr. Jenner for the great care they have shown in naming and mounting the specimens.

METEOROLOGICAL REPORT.

Number of Hours of Bright Sunshine and Sunless Days in 1893-4 and 1894-5.

(Campbell-Stokes Sunshine Recorder).

Hours of Bright Sunshine in Brighton.			Sunless Days in Brighton.	
Month.	1893-4.	1894-5	1893-4	1894-5
July, 1894 ...	212·81	201·51	1	2
August ...	258·59	159·96	0	1
September ...	167·39	146·05	2	5
October ...	141·37	92·54	5	5
November ...	69·48	95·16	10	8
December ...	66·30	63·06	8	13
January, 1895 ...	78·73	71·81	9	5
February ...	97·23	99·42	9	5
March ...	202·90	125·32	1	6
April ...	175·96	149·54	3	6
May ...	220·28	278·30	0	3
June ...	183·39	271·39	2	0
Total for the year ...	1874·43	1754·06	50	59

ARTHUR NEWSHOLME, M.D., M.R.C.P.

Observations taken at the Municipal Meteorological Station, Old Steine, from July, 1894—June, 1895.

Month.	Temperature of Air during Month.				Mean temperature of Air.	Mean degree of Humidity. Saturation = 100.	Wind.									Rainfall.	
			Mean of				Number of days of										
	Highest.	Lowest.	All highest.	All lowest.			N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	No. of days on which Rainfell.	Amount collected in inches.
July, 1894	81·6	50·6	67·8	57·0	62·4	77	0	5	0	1	3	15	4	3	0	17	5·15
August, ,,	70·0	46·4	66·9	56·4	61·6	80	1	5	1	0	0	14	4	5	1	19	1·88
September, ,,	71·4	41·4	63·6	50·6	57·1	78	8	18	2	1	0	0	0	0	1	11	2·23
October, ,,	64·8	36·2	57·6	47·7	52·6	81	4	14	1	0	2	7	2	0	1	16	3·63
November, ,,	61·0	38·2	53·0	44·8	48·9	85	4	6	0	1	6	8	3	2	0	15	3·64
December, ,,	52·6	28·4	47·7	39·1	43·4	86	3	6	0	1	2	7	6	6	0	17	2·15
January, 1895	48·6	23·4	39·8	31·6	35·7	88	8	7	0	3	2	5	1	6	0	22	2·55
February, ,,	44·4	17·4	36·5	26·1	31·3	80	4	16	4	0	0	0	1	3	0	5	0·15
March, ,,	56·0	25·4	46·3	36·3	41·3	88	3	4	1	1	2	10	0	6	4	20	1·89
April, ,,	64·6	32·4	51·9	42·0	46·9	86	1	7	1	2	3	9	3	3	1	14	2·27
May, ,,	73·0	36·2	63·4	47·3	55·3	69	8	5	2	5	1	4	0	6	0	3	0·19
June ,,	77·4	39·4	67·5	51·8	59·6	70	9	6	1	2	1	6	1	3	1	10	0·46
Entire Year	81·6	17·4	55·1	44·2	49·6	80	53	99	13	17	22	85	25	42	9	169	26·19

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Mr. Breed, seconded by Mr. Knight, and resolved—

> "That the Report of the Council, the Treasurer's statement, the Librarian's Report, and the Reports of the Committees of the several sections now brought in be received, adopted, entered on the minutes, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Sir J. Ewart, F.R.C.P., Mr. J. E. Haselwood, Mr. G. de Paris, Dr. W. A. Hollis, F.R.C.P., Dr. A. Newsholme, and Mr. D. E. Caush."

And that in pursuance of Rule 42 the Council had appointed the following gentlemen to be Honorary Auditors—

> "Mr. F. G. Clark, F.C.A., and Alderman H. Davey, J.P."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, under Rule 26, be members of the Council—

> "*Photographic Section:* Mr. W. C. Wallis; *Microscopical Section:* Dr. A. Newsholme; *Botanical Section:* Mr. J. Lewis; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be members of the council:—*Photographic Section:* Mr. R. C. Ryan; *Microscopical Section:* Mr. W. W. Mitchell; *Botanical Section:* Mr. H. Edmonds."

It was proposed by Mr. Jennings, seconded by Mr. Bower, and resolved—

> "That the following gentlemen be officers of the Society for the ensuing year:—*President:* Mr. E. J. Petitfourt, B.A., F.C.P., ; *Ordinary members of Council:* Mr. A. Griffith, Mr. W. Harrison, D.M.D., Mr. G. Foxall, Mr. J. P. Slingsby Roberts, Mr. E. T. Wynne, M.B.; and Mr. T. Hilton; *Honorary Treasurer:* Dr. E. McKellar, J.P.; *Honorary Librarian:* Mr. H. Davey, jun.; *Honorary Curator:* Mr. B. Lomax, F.L.S; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 12, Clifton Road; Mr. J. Colbatch Clark, 64, Middle Street; *Assistant Honorary Secretary:* Mr. H. Cane.

It was proposed by Mr. Wells, seconded by Mr. Dennet, and resolved—

> "That the sincere thanks of the Society be given to the Vice-Presidents, Council, Honorary Librarian, Honorary Treasurer, Honorary Auditors, Honorary Curator, and Honorary Secretaries for their services during the past year."

It was proposed by Mr. Salmon, seconded by Mr. Wallis, and resolved—

> "That the sincere thanks of the Society be given to Dr. A. Newsholme for his attention to the interests of the Society as its President during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* members of the Society :—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical and Natural History Club.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club and Archæological Society.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institnte, Washington, U.S.A.
South London Microscopical and Natural History Club.
Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Sussex Natural History and Philosophical Society.

1895.

N.B.—Members are particularly requested to notify any change of address at once to Mr. J. C. Clark, 64, Middle Street, Brighton.

When not otherwise stated in the following List the address is in Brighton.

ORDINARY MEMBERS.

Ashton, C. S., 27, Clifton Terrace.
Abbey, Henry, Fair Lee Villa, Kemp Town.
Andrews, W. W., 10, Springfield Road.

Burchell, E., 5, Waterloo Place.
Burdon, Rev. R. J., 19, York Place.
Brown, J. H., 6, Cambridge Road, Hove.
Badcock, Lewis C., M.D., M.R.C.S., 10, Buckingham Place.
Boxall, W. Percival, J.P., Belle Vue Hall, Kemp Town.
Balean, H., 15, Alexandra Villas.
Booth, E., 70, East Street.
Baber, E. C., M.B., L.C.R.P., 97, Western Road.
Burrows, W. Seymour, B.A., M.R.C.S., 62, Old Steine.
Billing, T., 86, King's Road.
Barwell, G. E., 32, St. George's Road.
Bedford, E. J., Municipal School of Science and Art, Grand Parade.
Black, R., M.D., 16, Pavilion Parade.
Bevan, Bertrand, Withdean.
Breed, E. A. T., 41, Grand Parade.
Brown, G. D., 50, The Drive, Hove.
Bower, W. R., Municipal School of Art, Grand Parade.

Campbell, A., 40, Park Crescent.
Cobb, F. E., Furze Dean, Furze Hill.
Clark, John Colbatch, 64, Middle Street.
Cox, A. H., J.P., 35, Wellington Road.

Cane, H., 64, Middle Street.
Catt, B. W., 37, West Hill Road.
Caush, D. E., 63, Grand Parade.
Coningham, W. J. C., 6, Lewes Crescent, Kemp Town.
Clark, F. G., 56, Ship Street.
Cowell, Samuel 143, North Street.
Couchman, J. E., Down House, Hurstpierpoint.

Davidson, Capt., 95, King's Road.
Davey, Henry, J.P., 82, Grand Parade.
Dennet, C. F., Milton Hall, Montpelier Road.
Day, Rev. H. G., M.A., 65, Denmark Villas, Hove.
Denman, Samuel, 26, Queen's Road,
Dodd, A. H., L.R.C.P., M.R.C.S., 14, Goldstone Villas, Hove.
Davey, Henry, Junr., 82, Grand Parade.
Davis, Harry, 74, High Street.
Deedes, Rev. Canon, 2, Clifton Terrace.
Douglas, J., B.Sc., 14, Clifton Terrace.

Edmonds, H., B.Sc., Municipal School of Art, Grand Parade.
Ewart, Sir J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Montpelier Hall.
Earp, F., 37, Upper Rock Gardens.
Elgee, E., Mountjoy, Preston Road.

Fletcher, W. H. B., Fair Lawn House, Worthing.
Foxall, G., Woodlands, Port Hall Road.

Glaisyer, Thos., 96, London Road.
Goldsmid, Sir Julian, Bart., M.P., 105, Piccadilly, London.
Grove, Edmund, Norlington, Preston.
Griffith, Arthur, 15, Buckingham Place.

Haselwood, J. E., 3, Lennox Place.
Hart, E. J. T., M.R.C.S., 4, Gloucester Place.
Hurst, H., Ship Street.
Hobbs, James, 62, North Street.
Hack, D., Fir Croft, Withdean.
Hollis, W. Ainslie, M.D., F.R.C.P., 8, Cambridge Road, Hove.
Holder, J. J., 8, Lorne Villas.
Haynes, J. L., 49, Shaftesbury Road.
Henriques, A. G., F.G.S., 9, Adelaide Crescent, Hove.
Harrison, Walter, D.M.D., 6, Brunswick Place, Hove.
Hodgson, Dr., 35, Montpelier Road.
Howlett, J. W., 4, Brunswick Place.
Harding, N., Wynnstay, Stanford Avenue.

Horniman, F. J., Surrey Mansion, Eastern Terrace.
Howard, Rev. J., 29, Beaconsfield Villas.
Hardcastle, S. B., 71, East Street.
Histed, E., 2 and 3, Upper St. James's Street.
Hilton, Thomas, 16, Kensington Place.

Infield, H. J., 130, North Street.
Isaac, T. W. Player, 114, Marine Parade.

Johnson, J., 24, Norfolk Square.
Jennings, A. O., LL.B., 50, Brunswick Place, Hove.
Jenner, J. H. A., East Street, Lewes.
Johnston, J., 12, Bond Street.

Kilmister, Charles, F.R.H.S., 56, Buckingham Road.
Knight, John J., 33, Duke Street.

Lomax, Benjamin, F.L.S., C.E., Free Library.
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Brighton and Sussex Natural History and Philosophical Society.

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SESSION 1895-96.

WEDNESDAY, OCTOBER 9TH, 1895.

INAUGURAL ADDRESS

BY

MR. E. J. PETITFOURT, B.A., F.C.P.

THE FOUNDATIONS OF SCIENTIFIC PROGRESS.

Having heartily thanked Members for the honour conferred upon him by his election to the Presidency, Mr. Petitfourt adverted to the continued prosperity of the Society and to the increase in Lady membership of late years; he also expressed a hope that more of their younger fellow-townsmen would take advantage of the special benefits conferred on Associates, and that greater general interest would in future be taken in the work of the Sectional Meetings.

Turning to the subject of his address, the question arose "How was it that-apart from social influences—scientific progress had been so much more rapid in modern times?" The Greeks had great powers of ratiocination, but applied them to statecraft, ethics, and psychology, and believed in the acquisition of knowledge chiefly from within. The Romans were too practical, and in later times under Greek influence. Early Christianity, Chivalry, and Scholasticism continued to bar the way to progress. The authority of great writers was paramount and observation was relegated to the background. The superior of Scheiner the monk could refuse to accept the former's discovery of sun-spots on the negative authority of Aristotle. Prejudice again produced such strange results as the vicissitudes of Peruvian Bark before its final acceptance as a valuable medicine.

But the formal studies of the Schoolmen were to give way to the realism of the Baconian Philosophy, and experience in its two forms, observation and experiment, was to supersede authority. Such sciences as Botany depended chiefly on observation, others like Metallurgy on experiment. The latter led to more rapid progress, our knowledge of the constitution of the stars and nebulae being due to the quasi-experimental work of the spectroscope. Nature herself occasionally so to speak performed the experiment, as in transits and eclipses. Success in observation and experiment depended (1) on the absence of bias, e.g., on kinetical principles the relative superiority of a flea's leap was no proof that it was comparatively stronger than a man. Again, it did not follow that the darkness of a sun-spot implied a colder interior to the sun. (2) The operation should be performed with a distinct object in view; aimless experiment was of no value.

Having dwelt on the importance of scientific classification, nomenclature, and terminology to secure a clear co-ordination of knowledge, and words devoid of ambiguity to name the things classified and describe their attributes, Mr. Petitfourt explained the Inductive Methods of John Stuart Mill, which consisted of five canons:—

SUMMARY OF THE INDUCTIVE CANONS.

A. Quantitative Methods.

I. Method of Agreement (chiefly used in observation; imperfect, owing mainly to the plurality of causes).

The sole invariable antecedent of a phenomenon is probably its cause.

Example.—The iridescent colours of (*a*) mother-of-pearl; (*b*) impressions of mother-of-pearl on wax; (*c*) diffraction gratings, are due to the only thing common to the three cases, viz., the nature of the surface. Instances of its application—the Theory of Dew, geological stratification, diagnosis of disease, bacteriology, etc.

II. Method of Difference (chiefly experimental).

If an instance of a phenomenon and an instance of its absence differ only in one circumstance (that one occurring in the former case), this circumstance is causally connected with the phenomenon.

Example.—When the gas of a soda-water bottle expels the cork, it performs work and thus consumes heat; this may be observed by the deflection of the thermo-electric pile. (Tyndall.)

Instances.—All chemical tests and "crucial instances" for deciding between rival hypothesis.

Caution.—One factor only must be varied at one time.

Example.—The celebrated Cavendish experiment for determining the weight of the Earth by measuring the force of attraction of two large lead weights on two small lead balls rigidly connected with a thin rod and delicately poised. To avoid draughts of air the apparatus was placed in a closed room and worked from without, and light was thrown on the scales from outside, and positions read off by means of a telescope similarly placed. Corrections were also made for the mutual attractions of the different parts in different positions.

III. The joint method of Agreement and Difference consists in the successive application of I. and II. to phenomena.

Example.—Whenever incandescent hydrogen is present two bright lines (C and F) are always present, and absorption spectra obtained by light passing through incandescent hydrogen, always shows the same two lines, but dark. On the other hand no other incandescent substance produces these two lines.

B. Qualitative Methods
(especially fruitful in results).

IV. Method of Residues.—Subtract from a phenomenon such part as is known to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents.

Example.—The disturbance in the motion of Uranus forms a residual phenomenon, which could be accounted for by the existence of an outer planet; this led to the discovery of Neptune by Adams and Levevrier.

V. Method of Concomitant Variations.—Whenever phenomena vary conjointly in any manner, there is a casual relation between them.

Example.—History shows that in proportion as Vesuvius has been active the volcanic region round about (Bay of Baiae, Iscnia, Solfatara, &c.) has been quiescent and subsiding, and *vice versa.* Lyell accounts for this by supposing that Vesuvius forms a natural vent, and when active diminishes the internal pressure of the molten rocks.

Such was the complexity of scientific phenomena that these Canons were mostly combined in the search after truth. The most important form of imperfect Induction was Analogy, which was only valuable when the points of resemblance greatly outweighed the points of difference. The problem of the climate of Mars and its habitability was a good instance of this difficulty. The resemblances to the Earth consisted mainly in the similar distribution of land and sea, and the existence of polar caps which changed with the seasons. The chief differences were (*a*) much less heat obtainable from the sun owing to greater distance; (*b*) much longer time of revolution; (*c*) force of gravity about two-fifths of ours, thus affecting the density, pressure, and temperature of its atmosphere. The whole subject was very complex and did not lend itself to treatment by Analogy.

The Inductive methods, however, led mainly to the discovery of empirical laws, for which causes could not be assigned; the highest generalizations required the application of Hypothesis, and Nature must be anticipated. From the days of Newton this had produced most important results, such as the discovery of the Law of Gravitation and that of Conservation of Energy. Hypothesis was especially powerful when used as a part of what Mr. Mill calls the Deductive method, which consisted of three steps:—

(1) A fact was established provisionally by direct Induction.

(2) A Hypothesis was formed which reasonably explained the fact.

(3) Severe appeals to observation or experiment in test cases finally determined the fate of the Hypothesis.

Such were in brief outline the forms of reasoning specially used, whether consciously or unconsciously in scientific research, and their study and application were valuable to those who wished to avoid mistakes. Failures would, however, occur as in the past. Throughout all an unbiassed attitude must be maintained, such as Michael Faraday expressed in the following words:—"The world little knows how many of the thoughts and theories which have passed through the mind of a scientific investigator have been crushed in silence and secrecy by his own severe criticism and adverse examination; that in the most successful instances not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions have been realized."

WEDNESDAY, NOVEMBER 13TH, 1895.

BACON'S PLACE IN SCIENCE—A CRITICISM AND AN INDICTMENT.

MR. J. VILLIN MARMERY
(Author of "Progress of Science," "A Manual of the History of Art," "Wit, Wisdom and Folly," &c.)

The name of Bacon is associated with inductive philosophy so generally that he is popularly regarded as the founder of the system. Whether that association of Bacon with inductive philosophy is founded on facts, or whether it is due to a misconception of facts is an interesting inquiry. The questions involved in this inquiry are:—(1) Was Bacon a natural philosopher? (2) Was he an inductive philosopher? (3) Was he qualified to speak on science with authority? (4) Is the inductive method synonymous with the Baconian method? (5) Has Bacon exercised any influence on scientific progress? To these questions his disciples reply in the affirmative. Can this affirmation be maintained by the light of Bacon's works, and the history of science before and since Bacon's time?

Those who have studied Bacon and scientific history, oppose the verdict of Bacon's disciples. They reject his claim to be considered as a qualified authority on matters scientific, as a natural philosopher, as an inductive philosopher, although he was an advocate of Induction. They deny that he exercised any influence on scientific progress. They deny that the Baconian method is synonymous with the scientific method. They even declare that the Baconian method is rather antagonistic to the scientific method than in harmony with it. We have to inquire which verdict is founded on facts.

Bacon's supporters are hardly responsible for the popular fame of Bacon as an inductive philosopher and founder of the experimental school. They merely repeat, without independent inquiry on their part, the assertions made by earlier writers. They first believe what Bacon himself states. Bacon having asserted that science had stood still since Aristotle's time, and that he opened a new scientific era—they repeat the assertion blindfold. Voltaire and the Encyclopædists having declared Bacon was the founder of the experimental method, they endorse this view, and praise Bacon as being the father of the inductive system—and they make it their business to propagate the myth without the least suspicion of its being groundless. These popular exponents of Bacon's greatness as a natural philosopher to whom the scientific progress since his time is due, are Whewell, Ellis, Spedding, Lewis, Buckley, Macaulay, Lecky, Church, and Abbott. Dr. Abbott's verdict of Bacon's scientific greatness is the only summary we need examine. According to Dr. Abbott—"Bacon's gigantic soul, conscious of gigantic purposes such as the regeneration and improvement of mankind; conscious that he was born for the service of humanity; and sure that he had found the infallible key to absolute success, became blind to all else to insure his purpose; sacrificed everything to become rich and powerful, because riches and power alone could insure his scheme of scientific renovation."

"Regeneration of mankind!" Would it not seem that Dr. Abbott had never heard of the Renaissance and the Reformation; or that these two unparalleled intellectual revolutions were the work of Bacon? We are told that Bacon at the age of fifteen had conceived a dislike to Aristotle, and thus early planned a scheme of scientific and philosophical reform. But what are the facts. At fifteen he went to Paris as a junior "attaché" to the British Embassy. In Paris he followed the course of lectures of the Ramists, who thundered against Aristotelian philosophy. This was his first inspiration. Then he studied the works and views of the Anti-Aristotelians of the time—the works and views of Basso, Taurellus, Severinus, Patrizis, and Telesio—all directed against Greek philosophy, all advocating the study of nature and the pursuit of experiments. This was the source of his second inspiration. Three centuries before, Roger Bacon had founded the experimental school and preached inductive philosophy—and a century before Francis Bacon was born, Leonardo da Vinci had expounded the principles of experimental research—and we have evidence that Francis Bacon studied the works of those two great reformers. Lastly Luther, long before Bacon, had opened the era of free inquiry and contempt of authority. From those various sources it was that Francis Bacon drew his materials and principles. He was one of a numerous phalanx—a phalanx headed by great men. He received the scheme, the plan of scientific reform ready made. He was merely a straw floating on the stream. We are told that he destroyed scholastic philosophy, but those who assert this forget that Paracelsus, Rabelais, Montaigne had dealt mortal blows to the Schoolmen long before Bacon! Bacon, on returning from Paris—a philosophical fledgling—stood up as a champion of science. He took his cue from Ramus in two particulars (1) In asserting the worthlessness of Aristotle's logic; (2) In inventing a new logic. He disparaged Aristotle in the tone of one who had made a discovery. He inveighed against the Schoolmen in the tone of one who was first to take the field against them. He declared in the most impressive tone that science and art were in sore plight; that science had stood still for twenty centuries; that nothing was advancing; that observations must be made, instruments must be used, experiments recurred to; that new principles must be adopted; that he himself had found a remedy to the evil and a key to a new era.

Had there been a standstill? Was the remedy he offered new? Readers will find ample answers to these two questions in "Progress of Science." Suffice it to say for the present that twenty-three Greek scientists had appeared since Aristotle, and they had made no less than eighty discoveries. When it is remembered that Archimedes, Aristarchus, Eratosthenes,and Hipparchus are included among the Greek alluded to, and that the precession of the equinoxes, the law of hydrostatics, are among their discoveries, we can well wonder at Bacon's assertion. Next to the Greeks came forty Arabian scientists—among them Giaber, Al Hazen, Avicenna, and Averroes—whose discoveries in chemistry, physics, medicines, &c., amount to a total of 98. Next to them came 64 medieval men of science whose discoveries amount to 137. So that since Aristotle's time there had appeared 126 scientific men, and there had been 315 discoveries made. Every science was founded—founded on experience be it noted—and all our modern branches descend from those great men and their discoveries without a break. It was at such a time that Francis Bacon stepped on the scene and proclaimed himself the herald of science "Our only hope," he said (Nov. Org., I., 97) "is in the regeneration of sciences by regularly raising them on the foundation of experience, and building them anew, which I think none can venture to affirm to have been already done or even thought of."

We see the value of his assertion; we see the error of his biographers, when they assure us that Bacon appeared at a time of profound darkness and brought light to illumine the world of science. We see the great mistake they make by asserting, as they generally and roundly do, that progress set in only after him, and is mainly due to his action on his contemporaries and on subsequent generations.

Passing now to the question of method, we see the worthlessness of Bacon's. We have to turn to antiquity to find the origin of the scientific process. Aristotle originated that process. Aristotle starting from observation of particular facts arrived at a universal law. That method of Aristotle is the scientific process. There can be no other. After observation the great Greek philosopher would say:—

All sheets of salt water are seas,
The Caspian is salt;
therefore,
The Caspian is a sea.

This is the famous syllogism, which stands as a rule of scientific reasoning. It is sound and scientific because it is founded on strict observation and fact. The Schoolmen never used that matter-of-fact syllogism; they used the syllogistic method—a very different process. They tried to solve all propositions, all problems, whether physical or moral, by imagination. In dread of incurring the censure of the Church, which feared science because it savoured of free inquiry, and free inquiry sapped authority, the Schoolmen put examination of facts aside, and reasoned from imagination in this manner:—

All black-feathered birds are ravens,
This bird is black-feathered,
therefore,
This bird is a raven.

As the premise of this syllogism is erroneous, the conclusion is false. The Schoolmen, by this process, which was erroneously identified with Aristotle's—because they invoked Aristotle as their authority—discredited both Aristotle and his syllogism among the scientific men of the Revival. But the outcry was an unjust one. It ought to have been addressed to the Schoolmen alone. The condemnation and contempt was deserved by those who had turned an excellent instrument to a wrong use. It was as unreasonable and unfounded as if we despised Stephenson and his engine because boilers now and then explode through mismanagement But Aristotle's is, and will always remain, the scientific method, because it is based upon observation, experiment, and induction. Nothing is more explicit and clear than Aristotle's injunctions about those three elements of the scientific process.

After Aristotle, the philosopher who started afresh in Medieval Europe, the scientific method was Roger Bacon, the founder of the experimental school (see "Progress of Science"), Leonardo followed Roger Bacon on the same line. He too, was amasterly advocate of observation and experiment. The road opened by Aristotle, Roger, and Leonardo had been followed by a host of men for generations when Bacon came forward and had the boldness to expound his own logic in opposition to the Greek logic. And what sort of logic was the so-called Baconian logic? It is based on rejection, on the rejection, that is, of all the causes which can be pronounced imagination—and when these imaginary causes have been rejected, the one cause that remains is the true cause of phenomena. Imagination, in Bacon's logical process of rejection, plays the chief part in it. Imagination collects *fanciful* phenomena having a fanciful bearing on the inquiry at issue, and after no other verification of their value than what *fancy* itself suggests or dictates, it rejects most of these phenomena and retains the rest; finally, imagination, finding one particular quality shared in common by the phenomena thus arbitrarily selected, declares that quality to be the "form" (law or essence) of heat, light, sound, &c. Of all processes ever devised Bacon's is the most inane and shadowy.

And this is the unanimous verdict of his adverse critics, but the verdict of his greatest admirers. Such was the famous method.

And what was his judgment upon the great discoveries of the sixteenth century?

An observer, advocating observation at all times, would hasten to acknowledge and admire sterling observations. Now Copernicus, a genius of the highest order, achieves a series of observations of supreme importance—Bacon sneered at the observer and his teaching. Likewise, an experimenter would recognize and value sterling experiments. Now Galileo—one of the greatest of mankind—makes sterling experiments which at once lead him to the discovery of scientific laws—and Bacon ridicules the prince of science and his scientific results. Again, an advocate of instruments would not fail to understand the value of sterling instruments—and Bacon disparages the telescope and microscope, and pooh-poohs the discoveries made by their use! Can anyone after these feats of blindness and ignorance call Bacon a scientific man, or aver as his admirers do, that he was governed by scientific spirit?

But if he did not believe in Copernicus, in Galileo, in the planetary system, in the telescope—that is in the revolutionary discoveries of the age—what did he believe in? He believed in magic, spirits, witchcraft, talismans, astrology, and alchemy. This contrast is of capital importance—because it shows most forcibly that Bacon, instead of heading the scientific movements, instead of being at least in the forefront of progress, *was behind* his age altogether. Then, if he did not follow the track of Copernicus and other great scientists, his predecessors, whom did he follow? He followed the Schoolmen he denounced! And, following the Schoolmen as he did, he necessarily endorsed a thousand errors; but when he was left without their limited guidance, he was irretrievably wrong—his own method notwithstanding! Witness what his disciples take to be his most marvellous proof of scientific genius and most succesful inquiry, viz., his investigation into the nature of heat. Here, in his greatest feat, we find, as Lewes—one of his staunch admirers—is compelled to own, a total misconception of the scientific process!

In the Novum Organum we have Bacon's system—a system recognised absolutely unworkable and unscientific—in his Natural History we have Bacon's knowledge of phenomena. To this Natural History Bacon attached the utmost importance. He meant this work to stand as a sort of storehouse rich in scientific lore, a collection of *facts* from which inquirers would draw their raw material for all manners of researches. It is the one substantial support, and the substantial illustration of the Novum Organum in its theory and practice; a kind of revelation to men of science how to handle phenomena and draw conclusions from the handling; it contains some five thousand phenomena at least. And Bacon assures the reader that he has in this great work freed himself from all prejudices and prepossessions; that nature is his only book; that he despises all authorities ancient and medieval; that he never takes facts but after due examination; that he has gone straight into nature and its mysteries; that he has proved by laborious experiments the hollowness of theories and the validity of his facts. After such professions we are prepared to take his facts as obtained from direct observation, direct manipulation, and direct evidence. What do we find in the Natural History? How many of the facts therein recorded were obtained at first hand? Not five hundred, not one hundred, neither fifty, nor twenty—*not one*!

He gleaned his so-called facts from sources especially pointed at by himself as utterly unreliable and contemptible, namely, from the ancients, and from the Schoolmen, from gossip, and from hearsay!

After giving over a hundred examples of Bacon's ignorance on questions of *capital importance*, Mr. Marmery wound up with the laudatory verdict of Baconian biographers—in contrast to which he quoted the estimation in which Bacon was held by great *scientific* men—not mere literary men as the panegyrists were. The greatest men of science and philosophy—those best qualified to speak with authority on the history of science—Descartes, Spinoza, Göthe, Humboldt, Liebig, Brewster, Draper—are unanimous in pronouncing Bacon a scientific and philosophical charlatan, whose aim was to delude ordinary mortals in the belief that he was the sole imperial mind of all times, and he succeeded in making *literary* minds believe in him, by the solemn assurance he displayed, by the majesty of his style, and by the contempt he poured on the men and discoveries that preceded him, whereas in reality he was not even a tiro in science and was steeped in medieval ignorance. Finally, the lecturer asked the audience: "Which verdict carries weight, the verdict of literary men who follow the bent of national prejudice, or the verdict of great scientific men, everyone of whom commands the highest authority on the subject by their competence, their labours, and their judgment?"

WEDNESDAY, DECEMBER 11TH, 1895.

DISCUSSION ON MR. MARMERY'S PAPER ON BACON.

WEDNESDAY, JANUARY 8TH, 1896.

"AN ARRANGEMENT IN HORNS AND HOOFS."

MISS AGNES CRANE.

AND

"AN INDIAN PUZZLE."

MR. J. LEWIS, F.S.A.

It is related of the great Cuvier that in his student days, pursuing his studies late at night, he was suddenly interrupted by the appearance of the nameless one "in his habit as he lived," *i.e.*, with horns and hoofs, who said he had come to devour him. The philosophic student calmly scrutinized his strange visitor and then ejaculated, "Horns, and"—with a downward glance—"cloven hoofs, humph! a harmless grass-eating animal!" Having duly classified among the Bovidæ, the terrible apparition, Cuvier presumed his investigations, much to the discomfiture of his masquerading fellow students who had hoped to raise a laugh against their more industrious comrade.

The great group of *Ungulata*, "animals with hoofs," is subdivided into the "odd-toed" ungulates (*perissodactyla*), or those, for instance, such as the elephant, rhinoceros, and horse, having five, three, or one toe on each fore-foot, and the "even-toed" (*artiodactyla*), which have an equal number of toes, two or four, like the cloven-hoofed pigs, hippopotami, camels, deer, oxen, and sheep. Some of these even-toed cloven-hoofs chew the cud, and these ruminants are, therefore, again separable from the non-ruminantia. There was evidently a time in the chequered history of the hoofed mammals when "To ruminate or not to ruminate, that was the question"; and it is impossible to determine absolutely to which group some of the earlier fossil forms should be referred. For this depends on a physiological character. The proverbial Alderman might well envy the digestive capacities of the ruminants; they have never less than three, and generally four, stomachs. It is to the oldest type, the "odd-toed," or perissodactyl, division that the six-horned Dinocerata belong, although they possess some features of each family and tend to unite them, as was long-ago predicted of the earlier fossil forms of Mammalia. The wonderful type genus *Dinoceras mirabile,* "in his habit as he lived" clothed in skin, muscles, and flesh, stood over six feet high, measured three feet across the loins, fourteen feet from snout to tail, and is said to have weighed not less than six thousand pounds, or nearly three tons.

A detailed account of the six-horned Dinocerata was given. They may be briefly described as animals with strong solid leg bones, large limbs, and padded five-toed feet, very like those of the elephant, to which they bore a strong resemblance when walking, although having a neck much longer and more flexible than that animal; the long prehensile nose or trunk was not developed. Abundant remains of these great beasts have been found in the picturesque wilds of the "Bad Lands" of Western Wyoming, and have been brilliantly described and illustrated by Professor O. C. Marsh.

These bulky and sluggish animals had their day, and it was evidently a long one. At the close of the middle Eocene they died out, leaving no direct descendants. The great changes of climate ensuing on the elevation and drainage of the region they frequented, and the hardening of the soil consequent thereon, led to their extinction, as their slow movements, small brain power, and fixed characters rendered them unfitted for survival under less favourable conditions and surroundings. The Dinocerata were the ancient representatives of a type of hoofed mammals, possibly still continued by the existing elephants and rhinoceroses now found chiefly in the vicinity of tropical jungles, river courses, forests, and swampy ground. Both these races are doomed to speedy extinction, and it seems probable that the horse and its allies, the most changed and modified of all the ungulates, so far as the structure of the feet and teeth are concerned, will evidently be the only linear representatives of the older and once dominant line of "odd-toed" ungulates. The oldest and ancestral type of this ancient order is that singular five-toed creature named by Cope *Phenacodus,* of which two species are known from the Wasatch Eocene, North Wyoming. This genus is allied to the early proboscidians, and by Sir W. Flower it is considered as an early ancestor of the horse, whether represented by the swift pace of a Ladas or the remarkable by-the-hour gait of that noble animal, the Brighton cabhorse.

To-day the "even-toed," or artiodactyla, greatly predominate. The distinction between these two sub-orders, differentiated at the base of the Eocene, really rests, not upon the number of toes in each foot, but upon the position of the axis of the limb, which in the older perissodactyl types was central, the weight of the body resting on the longer and larger middle, or third, toe or finger, whether there were two or four others present fully developed or not. In these "odd-toes," or mesaxonia, as Marsh prefers to term them, the first and fifth toes were the first to lose touch of ground, to dwindle gradually away and become finally absorbed. In the next stage the second and fourth toes were similarly affected, as in the case of the modern horse, the North American Indian's "beast with one finger nail," adapted for rapid "tip-toe" progression on hardest ground.

In the "even-toes," or artiodactyl type, on the contrary, the axis of the limb was shifted from the central toe to the space between the third and fourth toes, which thus became equally developed in the cloven foot. As the weight of the body was thrown more on them they both increased in size and strength, also at the expense of the two outsiders, which, therefore, dwindled away until at last they became lost entirely in the various stages of structural modification, which resulted in the numerous forms of adaption from slow, flat-footed locomotion on swampy soil, to dainty, swift, "tiptoe" progression on hard ground. In other words, the mesaxonia have one big toe in the centre of the foot, while the paraxonia, better off, have two equally divided.

The structure of the extinct Dinocerata throws much light on the interesting question of the coming into being of the great group of hoofed quadrupeds which have played, and may still continue to play, so far as the even-toed paraxonian line is concerned, such an important part in the economy of nature. The discovery of so many varied and well-defined forms of ungulates and other mammalia in the Eocene deposits necessarily antedates the first appearance of the class upon earth. Unfortunately, the land areas or shores of the extensive Cretaceous oceans in America have not yet been developed, but a group of small-brained, hornless, flat-footed ungulates, with five fully-developed toes on each foot, the axis being central, probably existed at that epoch.

The proto-ungulata, or "first hoofs," Marsh considers to be directly represented to-day by the existing coney (*Hyrax*) of Scripture, which must not be confounded with the rabbit, though well described as "small but exceeding wise." They differ so much from all their contemporaries that the majority of naturalists have agreed to leave them in a group by themselves (*Hyraxcoidea*). Many divergent lines sprang from the Cretaceous first ungulates, of which, however, only three main off-shoots, the proboscidian, the odd-toed, and the even-toed ungulates "remain unto this day," the last and most modern being now the prevailing type. The general ancestors of these primeval hoofs (*protungulata*) must be sought at least as far back as the Permian in a group called by Huxley *Hypotheria*, or "the animals beneath." These root mammals possessed vertebræ concave at both ends, like those of fishes. They were small animals with little brain power, and five free toes on each foot.

Not so very long ago mammalian life was thought to begin in the lower Tertiaries, or, at the earliest, in the Purbeck strata. Now there are quite a number of known Triassic and Jurassic mammals. Professor Marsh has the remains of a large number of species chiefly from the American Jurassic beds in his collections at Yale. They are for the most part of small size, and are believed to belong to the insect-feeding group of mammals. The complete elucidation of their structure will form another interesting volume of that history of the evolution of vertebrate life on the American continent to which Leidy, Cope, Marsh, Scott, and Osborn have made successive contributions. Verily these American scientists and explorers follow worthily in the footsteps of Cuvier, of Owen, of Huxley, and Falconer, in thus making "these dry bones live." I would express in conclusion (said Miss Crane) a fervent hope that such as these may ever be the sole "bones of contention" between the English and American peoples.

AN INDIAN PUZZLE,

BY

MR. J. LEWIS, F.S.A.

Mr. Lewis called attention to a large drawing of a piece of wrought iron, somewhat of the shape of a flattened Roman amphora, which he had prepared in illustration of the subject of his paper.

The weight of this enormous mass of iron was just one ton. Its dimensions: height, 4ft. 1in.; width at shoulders, 2ft. 7in., tapering down to 18in. at base; thickness at shoulders, 9in., at base, $8\frac{1}{4}$in.

The manner in which he was led to the discovery of this strange relic of past times might he thought be of interest to members of the Society. A large mound existed many years ago to the north of Adelaide Crescent at Hove. Over this as a boy he used to run. For generations it had been merely a grass-covered excrescence on an otherwise level plain, but coming home on leave in 1862 the author was surprised to learn that this mound had been opened and objects of great antiquarian value been disinterred from it. These are now in the Brighton Museum. On returning to India his work took him to the Semroul River, about 90 miles south of Allahabad. Here a large mound attracted his attention, and recalled to him the one on which he had so often played near far-away Brighton. Although much larger its form was the same. He longed much to open it, but "that eternal want of pence," which Tennyson says, "vexes public men," blocked the way. The contractors, however, who were then making the Jubbulpore railway, which now crosses the river just where the mound stood, were in want of ballast. The author had noticed loose bricks lying among the vegetation which covered the mound. He induced the contractor's engineer to open the mound, and no less than 250,000 cubic feet of well-burned ancient bricks were taken from it. Carved and plainly dressed stone work was also unearthed, and finally this huge piece of wrought iron. Among the debris coins of the Kushan dynasty, minted between the years A.D. 30 and 120, were also brought to light.

Various were the explanations offered as to the use and purpose of this strange mass or vessel of iron. The natives said it was a god, a brother engineer said it was a striker for coining money. An account of it was printed in the Journal of the Asiatic Society for May, 1865, but none of its members had propounded a solution of the puzzle. As far as the author could learn no other similar piece of iron had been found in India. No iron work of any description besides this was found among the ruins, although iron abounds in the neighbourhood. A celt made from the black or magnetic oxide of iron was found not very far from the mound. Prof. Valentine Ball says this is the only chipped implement known made from that substance. It is now in the Asiatic Society's Museum in Calcutta. Stone implements had also been found in the district, two specimens of which the author had given to the Brighton Museum. Some others were also exhibited by him at the meeting.

Mr. Lewis hoped that by bringing this interesting find to the notice of members he might receive some help towards the solution of the problems which it involved.

WEDNESDAY, FEBRUARY 12TH.

NOTES ON A JOURNEY FROM TANGIER TO FEZ,

WITH LANTERN ILLUSTRATIONS.

MR. W. CLARKSON WALLIS.

The interest of Morocco centres almost entirely in the fact that it is a land with a great past, and also no doubt with a prosperous future, but of its present position and influence amongst the nations of the world there is but little to be said.

The history of the country dates back to mythological times, and many of the exploits of Hercules are connected with this region, whilst the Garden of the Hesperides has recently been localized within its limits by a French Archæologist.

Safer ground is reached with Roman times, and the vast ruins of ancient cities which are to be seen throughout North Africa testify to the importance of this province of the Imperial City.

Then followed the Arab invasion which effaced the Roman and Christian civilization and established the Moorish power, under whose successive dynasties in Spain and the North-west of Africa there commenced and continued for centuries the great period of national prosperity and splendour. During this glorious period the Moors were in advance even of European nations in the matter of arts and wealth.

To-day the cities of Morocco only testify of departed grandeur.

That Morocco is destined for future prosperity as soon as a settled government is established there can be but little doubt.

The resources of the country are boundless as to production, whilst the mineral wealth in the mountains is probably enormous, but every effort in the direction of progress and improvement is checked and baffled by one of the most corrupt governments on the face of the earth.

The geographical position of Morocco is all in its favour, except that the extreme importance of it, in its relation to the possessions of other countries, renders it impossible that any civilized power can take the development of the country in hand without incurring the jealousy of others.

Mr. Wallis alluded to several of the questions which relate to the present condition of the country, including the slave trade, the absence of the administration of justice, and the barbarity in the treatment of criminals.

The lecture was illustrated by a number of lantern slides from original photographs, and which included views of Tangier, Larache, Meknes, Fez, and the country districts, and it was explained that the fanaticism and bigotry of the people is such as to make the pastime of the photographer somewhat difficult and in some cases even risky.

WEDNESDAY, MARCH 11TH.

CURIOUS DWELLERS ON OUR SHORES

MR. W. H. SHRUBSOLE, F.G.S.

It is a matter of common knowledge that the sea contains a great variety of quaint and curious forms of life, of which the least familiar are those which are very small and also simple in structure. Yet, notwithstanding their minuteness and simplicity, they are important links in the chain of life, and many of them—inasmuch as they are true plants—are essential to the existence of animal life in the sea. Samples of these microscopic organisms can be obtained by the simple expedient of filling a bottle with sea water and transferring it contents to a glass jar. Then, if this be spread to the light, certain of the little things which have been thus captured will go to the bottom, and others to the surface of the water, and at the side which is nearest to the source of light. From either of these positions they can be removed for examination by means of a pipette.

When it is desired to obtain a larger supply of microsoa from the open sea, it is needful to use a naturalist's tow-net, which is simply a bag of any fine textile material attached to a metal ring. So long as it will allow water to pass, the texture of the material can hardly be too fine or close, when very minute life is being sought.

But a prolific source of embryonic and other stages of low life is the slimy ooze in the tortuous water courses of the marshy areas bordering creeks and rivers. This soft unctuous substance constitutes a very comfortable resting place for myriads of forms which are at once small, curious, and beautiful. In such places near the confluence of the Thames and the Medway, and probably in all our rivers, Infusoria, Rhizopods, and Annelids, may be found in all stages of development.

As this marine mud has not received much attention in the past, it is not surprising that several forms, new to science, have recently been found, some of which have been described, while others still await investigation.

But by far the most numerous of the minute objects found in the salt marsh rills are Diatoms. These tint the mud surface with pleasant shades of colour ranging from golden yellow to dark brown: the intensity being in direct proportion to the abundance of the little plants. Looking down into a shallow rill, it is highly interesting to see silvery looking globules of oxygen continually rising all along the field of view, thus giving evidence that Diatoms in such places not only hide the unlovely aspect of the mud but also purify it and the superfluent water. When the tide has ebbed sufficiently an enormous quantity of Diatoms and other living microscopic objects can be secured by lightly skimming off some of the coloured film from the mud surface. On getting home with the semi-fluid mud it is usual to put it into a clean jar and liquefy it still more with sea water, and let it stand where it will be fully exposed to light. In the course of a few hours mud and water separate, and the Diatoms once more congregate in a thicker and therefore darker layer on the mud, as well as on the side of the jar which happens to be the most brightly illuminated. They are then easily accessible, and can be studied at convenience. Various genera are peculiar to such localities, and are not often found elsewhere. Of these, the most abundant, as well as the the largest is Pleurosigma. *P. angulatum* ($\frac{1}{120}$ of an inch long to $\frac{1}{650}$ of an inch wide) is a very prominent species, and is often found in groups by itself. In the living state, this Diatom appears to be very active on the microscope stage. This is due to the motion as well as the form being magnified. Its actual rate of movement is something like $\frac{3}{4}$ of an inch per hour. Still, the apparent great activity of these tiny plants as they glide to and fro unceasingly, pushing and jostling each other, is a very remarkable sight.

To be able to see the so-called "striæ" of the diatom-valve, it is needful to remove the protoplasm and chlorophyll by acid, or other suitably severe treatment. Then the sculphured lines, of which in *P. angulatum* there 52,000 to the inch, are faintly visible with a good $\frac{1}{4}$ of an inch objective. With higher powers the lines are seen to be rows of circular markings which have been considered to be elevations by some, depressions by others, but which are undoubtedly apertures. (Photomicrographs of *P. angulatum*, magnified 100, 400, 2,000, and 7,700 diameter, were shown in illustration.)

From very selfish motives, Amœba and other Rhizopods, generally seek to associate with Diatoms. This jelly-like, almost structureless animal, Amœba, although devoid of parts or appendages, is very well able to look after its own interests. It glides about among the little plants in an innocent manner, and when it feels hungry it imprisons one or two of them within itself, and assimilates whatever is digestible. When it has finished a meal, it moves away, leaving the empty plates, or valves, behind.

Other Rhizopods found in company with the Diatoms are Lieberkuchnia, Gromia, and several species of Foraminifira, all of which spread out slimy threads of their body substance, so as to be able to catch unwary animals and wandering plants much in the same way that spiders catch flies.

A gradation can be observed in the manner in which the body is hidden from sight by all these simple organisms, except Amœba, which is content to remain uncovered.

The first advance in this direction is made by Lieberkuchnia, which forms a temporary covering by merely holding mud particles over and around any portion of itself which otherwise would be exposed to view. This ambush is cast away, renewed, or altered as circumstances may determine.

Gromia is much larger than the preceeding, being about $\frac{1}{50}$ of an inch in its longest diameter, and it improves upon the habits of its less enlightened relative by felting particles together so as to form a permanent wrapping itself.

Some specimens vary from the type in having a zone of oval apertures around the usual single circular one. These do not seem to have been met with by other observers, although they are plentiful in the localities indicated.

Shepheardella fusiformis (Shrubsole) is also a new species. It forms a spindle shaped tube of mud having an opening for business purposes at both ends. It has probably escaped notice till recently, by its habit of not lifting itself out of the mud when in a bottle or jar, as the others do.

All the foregoing animals employ mud as the clothing material. The Foraminifera greatly improve upon this plan by making use of the lime which the sea water holds in solution for the construction of their beautiful and protective habitations. Naturally they are influenced by their environment, and therefore it is not surprising that those of this order which live in muddy rills should not be able to avoid impurities which are manifested by the dingy aspect of their shells. Other members of this class, the Radiolaria, disregarding both mud and lime as building materials, make use of silica in the construction of their basket-like abodes. These are not abundant in British waters. The one which occasionally appears in the estuary of the Thames and along the South Coast has been pronounced by Hæckel to be a new form.

In order to get anything like a proper idea of their life, it is needful to leave the marshes and ramble along the beach, or better still follow the ebbing tide as far as possible. There, in the rock pools and attached to stones or rocks, will be seen Tertularia and other representatives of the Hydrozoa, which, because of their somewhat plant-like form, the majority of seaside visitors believe to be seaweeds.

Examination shows each frond-like expansion to be a self-supporting colony, most of the units of which gather and prepare food for the benefit of the whole. They provide sufficient for themselves; for the growth of the colony by budding; and for the sustenance of those individuals which assume the form and functions, together with the limitations, of ovarian capsules.

From these capsules, the ova are emitted when mature in the form of active ciliated oval bodies known as planules, which, in time, and if able to steer clear of accidents, settle down and form new colonies.

Other Hydroid Zoophytes found on our shores present many points of great interest and beauty. (Figures of various genera were shown in illustration.) Singular indeed is the arrangement whereby the reproduction elements of Syncarne, for instance, assume the form of jelly fishes which in due time are detached from the polypites and move through the water in gracefull pulsations. A more complete contrast to the stationary Zoophyte in form and in habit cannot be imagined, than these medusiform zorids thus sent forth laden with the seed of new commonwealths.

Frail and delicate as most of these Zoophytes appear to be, yet have the considerable advantage over some other and larger animals. For their tentacles and some other parts are armed with a large number of specialized cells from which threads carrying a poisonous fluid are emitted, so as to wound and paralyze creatures which otherwise would avoid capture.

Scattered on the sands, especially after a gale, will be seen strange-looking, tough, gelatinous masses of yellowish colour, which fishermen call "pipe weed," although they are really colonies of *Alcyonidium gelatinosum*—one of the Polyzoa, and therefore much higher in the scale of being than any of the Hydrozoa.

A colony, founded by a single individual, increases by budding, and at first forms a more or less cylindrical extension from the point of attachment. Then short lobate processes appear, and sometimes longer straggling branches.

An old writer says of Alcyonidium, then known by the name of "Sea Ragged Staff":—"It is of a dark yellowish colour, and buncheth forth on everie side with many unequal tuberorities or knots." It only appears uncouth when out of its proper element. Put a piece into an aquarium and it will soon be covered by a delicate hairy film due to the protrusion of the tentacular wreaths of thousands of polypites which are closely packed together in the common dermal system, and under these conditions it presents a very different appearance. When viewed with a hand lens or a microscope, many interesting details are discovered. The polypides are highly sensitive, and instantly withdraw their tentacles when alarmed. Attention is drawn to Alcyonidium because it differs in general aspect from the majority of the Polyzoa, and because, at certain times, it is a very common object of the sea shore.

When strolling on any shingly beach, shells and pebbles may often be found pitted with numerous perforations. When these are seen to be roughly arranged in pairs, there is no doubt that they have been made by a curious little worm about ½in. long when full-grown, known as *Spio Seticarius*.

Wherever these indications are seen the living animals are not far off. They can generally be found on shells or other hard substances between tide marks. As they burrow with great ease in chalk, it is natural that they should be abundant on the foreshore at Brighton in the projecting boulders and in the chalk floor.

By chipping off a piece of chalk with a cold chisel, a group can easily be removed and transferred to a jar of sea water at home in which their doings can readily be observed. Each one seeks to improve its position for getting a good supply of food by erecting a little turret over one of the entrances to its U shaped tunnel in the stone. Then the tentacles can reach farther for food without the naked body being exposed to possible injury.

It is highly interesting to watch these little creatures feeding. A little finely powdered biscuit dropped into the water will provide the feast. The watchful animals soon see what has been done, and commence excitedly to wave their highly elastic tentacles, as if in glee, but really to secure the food. Any particles of solid matter touching the tentacle are seized and passed to the mouth along a groove on one side of the tentacle by the cilia arranged in pairs thereon.

If the substance be edible it is at once consumed; if not, it is utilized as building material for the enlargement of the turret.

When, as sometimes happens, two animals simultaneously grasp the same crumb, a severe struggle for the possession takes place. Each anchors itself firmly in its burrow, and then tugs away with all its might. The turrets yielding to the strain, bend inward, and the part of each tentacle concerned in the struggle appears perfectly rigid. Then, when the strength of one or other of the contestants is exhausted, the two animals suddenly slip back out of sight and the tubes again become erect.

WEDNESDAY, APRIL 15TH, 1896.

THE MUSICAL NATURE OF SPEECH,

BY

MR. MARTIN L. ROUSE.

Through investigations begun in 1881 (in which year he discovered the whispering scales) Mr. Rouse said that he had first discriminated sixteen simple vowel sounds, of which eight were long, free, or full, and eight short, checked, or slender (each free sound having a checked one closely resembling it) these being heard respectively in the two rows of words

boom, mode, *dawn, pard,* *burn, age, dû* (Fr.), *keen,* and
bush, mot (Fr.), *dot,* *patte* (Fr.), *but,* *etch, dut* (Fr.), *kit.*

But criticisms made when he read a paper on the subject before the Philological Society in 1889, have led him to see that the vowels of the first series may be shortened or checked, and those of the second series lengthened or set free, without making the first series identical with the second. If a sharp consonant be written after the sounded vowels in every word of the first row, we find every free vowel sound checked, without becoming the same as the corresponding sound in the second series; and if a flat consonant be written after the vowels in every word of the second row, we find every checked sound set free, without changing into the cognate sound of the first series, or into the cognate sound as modified by the reverse process.

Thus we get four series of vowels as heard in the four following rows of English and French words (those in italics being the French ones) ;—

I.	$\bar{1}$ Shude	$\bar{2}$ mode	$\bar{3}$ gnawed	$\bar{4}$ large	$\bar{5}$ curd	$\bar{6}$ laid	$\bar{7}$ *dû*	$\bar{8}$ heed
II.	$\breve{2}$ Shoot	$\breve{2}$ mote	$\breve{3}$ naught	$\breve{4}$ larch	$\breve{5}$ curt	$\breve{6}$ late	$\breve{7}$ *dût*	$\breve{8}$ heat
III.	$\underline{\bar{3}}$ Should	$\underline{\bar{2}}$ *mode*	$\underline{\bar{3}}$ nod	$\underline{\bar{4}}$ *plage*	$\underline{\bar{5}}$ cud	$\underline{\bar{6}}$ led	$\underline{\bar{7}}$ sud	$\underline{\bar{8}}$ hid
IV.	$\underline{\breve{4}}$ Soot	$\underline{\breve{2}}$ *mot*	$\underline{\breve{3}}$ not	$\underline{\breve{4}}$ *place*	$\underline{\breve{5}}$ cut	$\underline{\breve{6}}$ let	$\underline{\breve{7}}$ *sut*	$\underline{\breve{8}}$ hit

And we may distinguish these series as the free full, the checked full, the free slender, and the checked slender, respectively. In all French monosyllables wherein *e* is the only written vowel and bears no written accent (as in *de, se,* and *que* for instance) it has the checked full sound $\breve{5}$, and when the English word *dog* is uttered contemptuously, its slender vowel is often set free and prolonged without its turning into the *au* sound of *naught* or of *gnawed.*

The 32 vowels may each be nasalized by throwing the breath down the nose instead of down the mouth, as is done with eight in French—witness the words:
Onde, containing $\underline{3}$ nasalized, *houte* $\breve{\underline{3}}$, *emblée* $\underline{4}$, *emploi* $\breve{\underline{4}}$, *humble* $\bar{5}$,
punch $\breve{5}$, *symbole*, a diphthong = $\underline{6}$ + $\bar{5}$, and *simple* $\underline{6}$ + $\breve{\underline{5}}$.

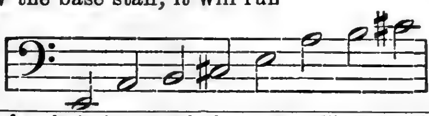
There are no other simple vowels (using the word in its ordinary sense) than the 32 we have exemplified in English, French, German, or Italian, or, we venture to think, in any language of man. The sounds given to *è*, *ê*, and *i* in the French words *grève*, *tête*, and *pique* are not simple, but are true drawls; that is to say in each case the checked full form of a vowel is followed by a slender one ($\breve{6}$ by $\breve{\underline{6}}$, $\breve{6}$ by $\breve{\underline{6}}$, and $\breve{8}$ by $\breve{\underline{8}}$), so that the words might be written in English

gray-ev, tay-et, and *pee-ik.*

A careful analysis of the vowel sounds both simple and compound that occur in the English, French, German, and Italian tongues* (including as many as exist of the four forms of simple vowels, and the corresponding forms of drawls and dipthongs), shows German to have 50 oral sounds, English 34, French 33 oral ones and 8 of the less pleasing nasal ones, and Italian only 30 altogether. But the copious melody of English and German is somewhat marred by the frequency of sibilants and by the harsh meeting of consonants between words; which latter defect is often avoided in French by *liaison*, and always in Italian by every words ending with a vowel, or *l*, or *n*.

Now, besides the more obvious differences of quality in vowels and the cadence of emphasis, they have an inherent music that can be gauged by regular tones and semitones. Let the following words, whereof the first eight contain the vowels of the first series, be whispered in order without letting the voice drop, or pausing till the ninth is reached, thus: *Boom, moan, dawn, hard, curve, age, dû, keen,*† *loud.*

A scale of eight notes will be heard rising from *boom* as a key-note to the fourth, fifth, sixth, octave, and fourth, fifth, and sixth above the octave: thus, starting in the speaker's own voice from *e* below the base staff, it will run



* An unrevised analysis shown at the lecture gave like proportionate results, as did three marked stanzas of choice English, German, and French poetry.

† This word is added to prevent the voice from being dropped at *keen*, as is usually done at the last word of a list.

At the same time, though much more faintly, a secondary descending scale will be heard proceeding concurrently with the ascending one and exactly reversing it.

Again, if the same nine words be spoken aloud in order without dropping the voice till the last word is reached, the first eight will form a chromatic scale, which in the same voice ascends from the *e* below the base staff, thus

One person should read the sounds, another listen; as the reader finds it hard to listen to himself,* and when the words have been read a few times, their vowel sounds, as just represented, should be read in the same way, which will yield still clearer results.

Lastly, whether whispered or spoken aloud, each of the other series makes a scale similar to that of the free full vowels series, each starting in turn a semi-tone above the series preceding it.

To obtain these results, the reader must be careful to lay no stress upon any word. But the rising or falling of a stress simply takes us into another key, and if the same stress were given to the words that follow, they would be at the same musical interval from each other as before.

The following syllables, if the voice be dropt only at the last in each line, will make a tune.

doo, daw, dur, day, dee, dow.
dee, dur, day, daw, do, dow.

The discovery of the first two scales led the speaker to reflect whether consonants might be classified in a way similar to musical instruments, and he perceived the following considerable analogy. (The aspirated consonants set down in the table are each derived from the unaspirated on their left by dropping the lower organ of speech, whether tongue or lip, downward and forward, and so allowing more air to pass over it, as is best seen by comparing the *r* of *azure* with the *z* of *zeal*, or *sh* in *shine* with *s* in *sine*.)

* At his demonstration Mr. Rouse had the words read over by the Secretary, and after some trials, nearly everyone in the audience testified to hearing the two chief scales.

CONSONANTS.

	Flat.		Sharp.		Nasal.
	Unaspirated.	Aspirated.	Unaspirated.	Aspirated.	
Mutes—					
Labials	b	v	p	f	m
Dentals	d	^{c}d	t	^{c}t	n
Back Palatals	g	^{c}g	k	^{c}k	$\overset{\frown}{ng}$
Pharyngeal	h				
Spirants—					
Semi-Vowels	ü=	w	e=	y	
Liquids	r	$\overset{c}{r}$	l	^{c}l	
Sibilants.................	z	$\overset{c}{z}$	s	$\overset{c}{s}$	

NOTE.—^{c}d=*th* in *thine*; ^{c}t=*th* in *thin*; $\overset{c}{g}$=*gh* in *lough* (Ir.); ^{c}k=*ch* in *ich* (Ger.); $\overset{c}{r}$=Italian rolled *r*; ^{c}l=Irish *l* heard in *help* or French *l* in *celle*; z=z in *azure*; s=*sh* in *shine*; $\overset{\frown}{ng}$=*ng* in *ring*; u=*u* in *huit* (Fr.); e=*j* in *ja* (Ger.) uttered ponderingly.

INSTRUMENTS.

	Full-Toned.	Slender-Toned.	Reed.
Beaten—			
Wood.	Wood upon wood. *Xylophone.*	Metal upon wood. *Saw.*	Wooden. *Clarionet, &c.*
Metal.	Wood upon metal. *Harmonicon.*	Metal upon metal. *Musical Box.**	Metal. *Harmonium, &c.*
String.	Hand upon string.‡ *Harp, Guitar, &c.*	String upon string. *Violin, &c.*	String. (No instance.)
Membrane	*Drum.*		
Blown—			
Wood.	Blown from the side *Flute, &c.*	Blown from the top. *Flageolet.*	
Metal.	Blown from the side *Organ.*	Blown from the top. *Trumpet, &c.*	
String.	Blown from the side *Æolian Harp.*	Blown from the end. (No instance.)	

* Without a case or in a metal one. ‡ Or leather-padded hammer as in the Piano.

Aspiration perhaps finds its counterpart in the use of the loud pedal or organ swell.

But may not our speech also be uttered in the rhythm of music. It is, if, in reading aloud or other speaking, just after we have taken a breath anywhere we let our hand fall at the first accented syllable, and again at the second, we shall find the third coinciding with the third beat, and the fourth (if there be one *ere we breathe again*) coinciding with the fourth beat; the number of intervening unaccented syllables neither hastening nor hindering the occurence of the accented.

Thus in the following extract from a newspaper article, breathing naturally at the double lines and accenting the syllables that just follow, we perceive by beating time between our breaths that the accents all fall at even intervals of time.

" || The | Grèeks have a dis | tínct nátional | cáuse ||- cléar and | práctical | nátional | claims. || The | cáuse and the | claíms are | récognised* and ac | cépted || by | áll the Greek | péople alíke." ||†

And these equal measures from accent to accent are here instinctively preserved, although in the first breathing period of the above passage, for example, there come four syllables belonging to the accent on Greeks ere the next is heard, one belonging to the accent on "tinct" and four to the accent on "na."

These discoveries show that vowels are really musical notes, with diphthongs as their chords; that consonants impart to these notes when preceding them diverse characters which are with much reason likened to those of the various musical instruments, and that our sentences are cut up into rhythmical periods. Thus is that means which God has given to us men for conveying to each other our every feeling, reflection, and judgment, replete with tune, and most varied music pouring forth, in spite of much degeneracy, delightful symphonies from mouth to ear.

* Some might breathe here. † Daily News, 31st October, 1890.

THURSDAY, MAY 14TH, 1896.

ELECTRICAL DISCHARGE,

BY

MR. W. R. BOWER, A R.C.S.,

FOLLOWED BY A DEMONSTRATION BY

MR. E. CLUTTERBUCK, Ph.D., B.Sc.,

ON

THE PHOTOGRAPHIC PROPERTIES OF THE X RAYS.

The phenomena connected with electrical discharge have been the subject perhaps of more zealous and patient research than those belonging to any other branch of physical science. The discovery in 1745 of the Leyden Jar soon attained world-wide notoriety. Sir Humphrey Davy says: "No single philosophical discovery ever excited so much popular and scientific attention." Among those who studied it was the celebrated Benjamin Franklin, and it is to him we owe an intelligent theory of electrification as a result of his experiments. Poor Richard was able to announce in his almanac for 1753 that "It has pleased God in His goodness to mankind, at length to discover to them the means of securing their habitations and other buildings from mischief by thunder and lightning."

It was Franklin's discovery of the efficacy of POINTS in bringing about electrical discharge which gave us the lightning rod.

Nicholson and Carlisle in 1800 made the next great step. They found that when a continuous discharge is made through acidulated water the water is broken up, decomposed into its constituent gases. Sir Humphrey Davy soon took advantage of the discovery, and by the electric current decomposed the fixed alkalies and obtained the metals sodium and potassium.

If two metallic balls form the poles of an electrical machine and they be set near together we may get a short thick spark through the air; place them a little further apart and the spark branches in a zig-zag fashion; separate the balls a little more, and we get only a spreading brush of blueish light. If this disruptive discharge from metallic balls be examined by the spectroscope, we find 1st, faint lines due to the gas through which the discharge has passed; 2nd, bright lines due to the incandescent vapour of the metallic bodies between which the discharge takes place; and 3rd, a faint continuous spectrum.

We learn, therefore, that in the discharge there was a decomposition of the gas separating the electrodes, and a disintegration of the substance of the electrodes. It is believed that the complete molecules of any gaseous medium are incapable of receiving an electrical charge. If a discharge takes place through a quantity of gas it is because of the dissociation of its molecules or of its molecular aggregates. Chemical decomposition is not an accidental attendant, but an essential feature of the discharge, without which it could not occur.

If we lessen the density of the gas between the electrodes very interesting features of the discharge are observed. When the density of the air between them is diminished to $\frac{1}{25}$ of its normal state, the discharge assumes the form of a band of light. If the air in the tube be diminished to $\frac{1}{40}$ the tube is filled with a luminous haze, together with a dark space near THE NEGATIVE ELECTRODE OR KATHODE. Carrying the exhaustion still further until the air is only $\frac{1}{180}$ of the original quantity, the discharge proceeding from the positive electrode breaks into bright patches of light separated by dark spaces, but still round the kathode we have Faraday's dark space. Further exhausting the tube we get starting from the anode—the positive electrode: 1st, a stratified column; 2nd, Faraday's dark space; 3rd, the negative glow; 4th, a second dark space round the kathode—this is called Crooke's dark space. Exhausting the tube still further the Crooke's space grows larger, glow and stratification disappear and the kathode becomes the seat of action.

When the Crooke's dark space occupies the whole bulb remarkable phenomena are observed. The glass of the bulb glows with a characteristic fluorescence. With high exhaustion the particles of gas which remain in the tube have necessarily greater freedom of motion. They do not clash with other atoms and, therefore, impinge with full force on the glass walls of the tube. Hence in the glass vibrations are set up as a consequence of this bombardment which reveal themselves by a beautiful fluorescence. This explanation of Crooke's is a part of his theory that the phenomena exhibited by the tube is caused by the rectilineal motion of the atoms of residual gas, charged with negative electricity from the kathode. Dr. Lenard, a pupil of the celebrated physicist Hertz, constructed a Crooke's tube partly of glass and partly of aluminium. He then found that the kathode radiation would pass through the aluminium window and would then excite fluorescence in certain substances such as the platino-cyanide of potassium, and moreover act upon a photographic plate. According to modern views as we have said chemical decomposition and electrical discharge invariably accompany one another. The atoms of the substance between the anode and kathode undergo some change of position or grouping; some going to the one pole and some to the other. In the electric arc lamps, now so familiar to us, the positive electrode is quite the hottest place on earth. Gold, platinum, and carbon are vaporized at it. The temperature is probably about 3,500° C. As the arc of light can deflected by a magnet it is assumed that the discharge is partly carried by particles torn off the electrodes and partly by the conducting carbon vapour.

Dr. Clutterbuck, at the conclusion of Mr. Bower's paper, described the process of making the tube or bulk in which the Röntgen rays are generated, and by means of a large coil exhibited them. He also showed how they passed through opaque subjects such as wood, and since they passed through the fleshy parts of the hand but were obstructed by the bones, a photographic plate placed beneath the hand was affected in some parts and not in others. Hence a shadow of the bones was obtained, which could by the methods ordinarily followed by the photographer be FIXED, and a permanent impression of them be thus obtained.

ANNUAL GENERAL MEETING.

WEDNESDAY, JUNE 10TH, 1896.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 10TH, 1896.

The Ordinary Monthly Meetings of the Society which have been held during the past year have been on the whole well attended.

Among those which have more particularly drawn large audiences may be mentioned the Lecture given by Mr. Shrubsole on "Curious Dwellers on our Shores," at the Athenæum Hall; and that by Messrs. Bower and Clutterbuck, at the School of Science and Art, on "Electrical Discharge" and on "The Röntgen Rays." Your Council has under consideration the advisability of making its programme more attractive by having occasionally during the Session a lecture by some professional lecturer, on a subject of scientific interest, which would, by the popular manner in which it was given or by its illustrations or demonstrations, appeal to larger audiences than are accustomed to assemble in this room.

It will be seen by the Report of the Photographic Section how successful was the Exhibition of the Photographs held under the auspices of the Society in the Picture Gallery in this building. The thanks of the Society are due to the Corporation of Brighton and to the Fine Arts Sub-Committe for so cordially granting the Society the use of the Gallery.

In an Appendix to the Report of the Botanical Section, Mr. T. Hilton gives a valuable list of rare Sussex Plants found by him and Mr. Farr, of Uckfield, during the past year. It is mainly through the labours of these two gentlemen that the number of Sussex Plants in the Society's herbarium now amounts 900. The Council would wish to put on record its high appreciation of the labours of Mr. Hilton in mounting these, and of his and Mr. Farr's assiduity in collecting them.

A Congress of "The Natural History and Scientific Societies of the South-Eastern District of England" was commenced at Tunbridge Wells by the Natural History Society of that town on April 25th. By a resolution of the Council Mr. Pankhurst was deputed to attend as a delegate from this Society. He reports that "The South-Eastern Union of Scientific Societies was duly constituted, the aim of which is to aid in bringing about the co-operation of the different Societies in the furtherance of scientific knowledge and work."

During the past year the Society has lost by death and resignation twenty members, and has acquired ten new ones.

The papers read before the Society during the past year have been as follows:—

1895.	Oct. 9th.	Address by the PRESIDENT on the Foundations of Scientific Progress.
	Nov. 13th.	Francis Bacon's place in the History of Science—A Criticism and an Indictment: J. VILLIN MARMERY.
	Dec. 11th.	Discussion on Mr. Marmery's paper on Bacon.
1896.	Jan. 1th.	An Arrangement in Horns and Hoofs: Miss AGNES CRANE.
		An Indian Puzzle: Mr. J. LEWIS, F.S.A.
	Feb. 12th.	Notes on a Journey from Tangier to Fez.
	Mar. 11th.	Curious Dwellers on our Shores: Mr. W. H. SHRUBSOLE, F.G.S.
	April 16th.	The Musical Nature of Speech: Mr. MARTIN L. ROUSE.
	May 14th.	Electrical Discharge: Mr. W. R. BOWER, A.R.C.S.
		The Photographic Properties of the X Rays: Mr. E. Clutterbuck, Ph.D., B.Sc.
	June 10th.	Annual General Meeting.

The Excursions during the past year have been as follows:

6th July, 1895.	NEWICK, Rock Garden, by kind permission of J. H. Sclater, Esq.
20th ,, ,,	LEWES, meet Croydon Society.
18th April, 1896.	GRAVETYE, by kind permission of W. Robinson, Esq.
16th May, ,,	HENFIELD, Barrow Hill, by kind permission of J. Eardley Hall, Esq.
13th June, ,,	COWFOLD.
18th July, ,,	LEONARDSLEE, Park and Grounds, by kind permission of Sir E. G. Loder.

LIBRARIAN'S REPORT.

During the past year the principal event as regards the Society's Library has been the printing of the new catalogue. In preparation of this, Pascoe's "Zoological Classification" proved of great assistance. The issue of the catalogue has been welcomed by the members generally, but has not led to an increased use of the library. The total of books and periodicals borrowed during the year has been 136; in addition the library had been much used for reference purposes by the general public. There have been no further purchases since the catalogue was printed. Mr. Henry Willett has continued his kind gift of the Quarterly Journal of the Geological Society.

H. DAVEY, Jun.,
Hon. Librarian.

Brighton and Sussex Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 10TH JUNE, 1896.

Dr.

1896.	£	s.	d.
By Balance in the hands of the Treasurer, 19th June, 1895 ...	21	4	10
,, Annual Subscriptions and arrears to 1st October, 1895...	3	10	0
,, Annual Subscriptions to 1st October, 1896 ...	64	10	0
,, Entrance Fees ...	3	0	0
,, Dividends on £100, 2¾ per cent. Consolidated Stock, one year to April, 1896...	2	15	0
	£94	19	10

Balance in the hands of the Treasurer, 10th June, 1896...	8	4	5

Cr.

1896.	£	s.	d.
To Books and Periodicals ...	13	0	4
,, Bookbinding ...	2	4	2
,, Printing Annual Report and Abstract of Proceedings ...	12	13	0
,, Printing Library Catalogue...	8	0	0
,, Printing and Stationery ...	7	10	1
,, Postages, &c.,...	10	18	9
,, Scientific Secretary, Honorarium for the current year...	10	0	0
,, Subscriptions to Societies ...	2	9	6
,, Clerk's salary (E. P. Golding) ...	2	2	0
,, Commission to Collector ...	2	16	0
,, Gratuities to Assistants at Museum ...	3	10	0
,, Expenses of Meetings ...	6	19	2
,, Botanical Section expenses...	2	1	11
,, Photographic Section expenses ...	1	12	6
,, Fire Insurance Premium on Books ...	0	18	0
,, Balance in the hands of the Treasurer, 10th June, 1896 ...	8	4	5
	£94	19	10

Audited with books and vouchers and found correct.

F. G. CLARK, F.C.A., *Hon. Auditor.*

June, 1896.

PHOTOGRAPHIC SECTION.

ANNUAL REPORT, 1895-6.

OFFICERS.

Chairman : MR. W. CLARKSON WALLIS.

Committee : MESSRS. DOUGLAS E. CAUSH, G. FOXALL, W. HARRISON, W. W. MITCHELL, W. H. PAYNE, C. BERRINGTON STONER, A. H. WEBLING, E. ELGEE, and G. F. ATTREE.

Hon. Secretary : MR. R. CHAPPEL RYAN, 43, Compton Avenue.

Your Committee have to report that during the past season four Sectional Meetings have been held, the attendance at which has been fairly satisfactory. Of these meetings three have been devoted to the exhibition of lantern slides, and one to a demonstration of the capabilities and method of treating "Platino-Bromide Paper," the lecturer being Mr. Nahum Luboschez, of the Eastman Company. On the lantern evenings there have been exhibited a set of local geological slides collected by the Tunbridge Wells Society, the series being rendered extremely instructive and valuable in being accompanied by complete descriptive notes. A set of slides from photographs taken by Mr. Clarkson Wallis during a tour in Morocco was also shown the same evening.

On another occasion the "Photography" Prize Competition sets of slides were exhibited, in which one member of the Section was successful in obtaining a Certificate.

The Society has also been favoured by a visit from Dr. Fabgood, President of the Eastbourne Photographic Society, who delivered an interesting lecture on "Moorish Archæology in Spain," illustrated by a large number of excellent views; his visit deing returned by Mr. D. E. Caush, who has also given lectures on "Photo-Micrography" at Eastbourne and Lewes.

Excursions have been made to Bosham and Cuckfield, the latter occasion having been by the kind invitation of the past Chairman, Mr. J. P. Slingsby Roberts, who entertained the members of the Society to tea, after which the inaugural meeting of the Session was held, at which Mr. Clarkson Wallis was installed as Chairman for the year.

A competition for lantern slides and prints was held in March, and was instituted specially for the purpose of obtaining additions to the Survey Collection. Six sets of four slides and three sets of prints were sent in, a response somewhat disappointing as regards quantity, the quality of the prints being below competition standard the Bronze Medal was withheld. The small number of competitors *i.e.* four, may be partly accounted for by the fact of members being engaged in preparing work for the Exhibition arranged to open on March 23rd.

The most important engagement upon which the Committee has entered during the year has been the promoting and arrangement of a Non-Competitive Exhibition, which was held in the Corporation Picture Gallery, kindly placed at the disposal of the Committee for the purpose by the Mayor and Corporation of Brighton.

The Exhibition was opened by the Mayor on March 23rd, and remained open to the public for two months. The Committee have every reason to be well satisfied with the success of their first venture in this direction, both the quantity and the average quality of the work contributed exceeding their most sanguine expectations.

There were about 20 exhibitors and 200 exhibits, and during the two months in which the Exhibition remained open 8,149 visitors have entered the doors.

As regards future work, the Committee have in view the more systematic carrying out of the long-projected photographic survey of the county.

The thanks of the Society are due to the judges who kindly adjudicated in the competition; to Mr. J. E. Haselwood who generously presented a medal; and to Mr. D. E. Caush for providing and working the lantern on several occasions.

They are also much indebted to the Rev. R. M. Hawkins and the Trustees of Christ Church Schoolroom for the use of that building on two or three occasions for meetings of the Section.

R. C. RYAN,

Hon. Secretary Photo. Section.

REPORT OF THE BOTANICAL SECTION.

Chairman : MR. J. LEWIS.

Committee : MESSRS. TREUTLER, EDMONDS, LOMAX, AND MISS CAMERON.

Secretary : MR. T. HILTON, 16, Kensington Place.

The meetings of the Section have not been very largely attended, but good work has been done and interesting papers have been read. There have been a few Excursions of the Section, but they have been very poorly attended. Special thanks are due to Mr. Hilton and Mr. Farr for the numerous and valuable additions they have made to the Society's Herbarium of Sussex Plants. Subjoined is a Report of Botanical finds during 1895 and early in 1896, which Mr. Hilton has drawn up for the Committee.

The Papers read before the Section have been as follows :—

1895.	Oct.	31st.	The Botanical Finds of the year : Mr. T. HILTON.
1896.	Jan.	23rd.	Wind-Fertilized Plants : Mr. HENRY EDMONDS, B.Sc.
"	Feb.	27th.	British Ferns : MR. J. LEWIS.
"	March	26th.	Botanical Writings of Theophrastus : Mr. SALMON.
"	April	23rd.	Primulas : Mr. SHRUBSOLE.
"	May	20th.	Mosses : Mr. NICHOLSON.

BOTANICAL FINDS DURING THE YEAR.

Since last year's report the plants in the Society's Herbarium have very much increased in number, there being over 900 specimens mounted and named. To Mr. Farr, of Uckfield, our thanks are especially due for contributing many specimens from the forest region of Sussex, which are not likely to be found by occasional visitors. Among them are several brambles that have not been reported from Sussex before. Habenaria Albida (White Habenaria) only found in one place in Sussex at intervals of years. Also Osmunda Regalis (Flowering Fern) now nearly exterminated, although at one time abundant in places. The following are some of the other rare plants added:

Helleborus viridis (Green Hellebore).

Carex Montana (Mountain Sedge), first found in Sussex by Mr. Mitten, of Hurst; it was growing plentifully on Chailey Common this year.

Brassica Cheiranthus (Wallflower Cabbage), found occasionally at Southwick.

Fumarià Densiflora (Close-flowered Fumitory).

Mercurelis annua (ambigua).

Carex lœvigata (Smooth-stalked Sedge).

Genista pilosa (Hairy Greenweed), Ashdown Forest.

Rosa Sepium (agrestis) (Small-leaved Sweetbriars), this rare plant was first found (in Sussex) by Mr. Jenner, of Lewes, a member of our Society.

Rosa-tomentosa (Downy Rose).

Dianthus Armeria (Deptford Pink), Henfield; probably introduced by the late W. Borrer, Esq. (reported also from Rustall Common).

Luzula maxima (Great Wood-rush).

Astragalus glycyphyllus (Sweet Milk-Vetch), from Bury Hill, where it grows abundantly.

Epipactis latifolia (Broad-leaved Helleborine).

Utricularia minor (Lesser Bladderwort).

Rapistrum rugosum. On cultivated land by the Dyke Road, a native of the South of Europe.

Stachys annua (Annual Woundwort). On cultivated land; very rare.

Gnaphaleum sylvaticum (Upright Cudweed). Wood, near Freshfield.

Euphorbia platyphyllos (Broad-leaved Warted Spurge).

Drosera intermedia (Long-leaved Sundew).

Rhyncospora alba (White Beak Rush).

Onopordon Acanthium (Scotch Thistle), rare in this district; although commonly called the Scotch Thistle, it is said by Babington not to be a native of Scotland.

Cetarah Officinarum (Scaly Hart's-tongue).

Ranunculus intermedius (Three-leaved Water Crowfoot), although a rare plant it grows abundantly on Mylton Hyde Common, near Berwick Station.

Ophrys aranifera (Early Spider Orchis).

Adonis autumnalis (Pheasants Eye), from beyond Rottingdean, where it has grown for many years.

Verbascum Lychnitis (White Mullein).

Convallaria majalis (Lily-of-the-Valley), St. Leonards Forest.

Silene conica (Striated Catchfly), Clymping Sands, Littlehampton.

Teucrium Chamœdrys (Wall Germander), Camber Castle.

" Plentiful in Sherard's time (Smith) now rare, Blomfield."—Arnold's Flora.

Epipactis palustris (Marsh Helleborne).

T. HILTON, *Hon. Sec.*

REPORT OF THE MICROSCOPICAL SECTION.

Chairman : Dr. Newsholme.

Committee : Mr. D. E. Caush, Mr. Lewis, and Mr. Elgee.

Secretary : Mr. W. W. Mitchell.

Owing to the long illness of the Chairman and other circumstances no meetings were held by this Section.

W. W. MITCHELL, *Hon. Sec.*

THE METEOROLOGY OF BRIGHTON, 1895-6.

The weather in the twelve months, July, 1895—June, 1896, presented some exceptional features. The rainfall for the whole period was only 25·19 inches, the average for the 18 years 1877-1894 being 30·30 inches. The summer months, July—September, 1895, were hot and deficient in rainfall, and the temperature of the soil at a depth of 4 feet was over 56° Fahr., from the 9th June to 22nd October, 1895. An earth-temperature above this point is known to be specially favourable to the prevalence of summer diarrhœa, etc.

The early months of 1896 were remarkable in contrast to the corresponding months of 1895, and apart from this because of the unusual combination, in the winter, of very mild weather with comparatively slight rainfall. Thus although the mean temperature in January was 42·1° as compared with an average for 18 years of 39·1°, and in February was 41·4° as compared with an average of 41·3°, the rainfall in January was only 1·12 inches as compared with an average for 18 years of 2·86 inches, and in February was only 0·26 as compared with an average of 2·15 inches. In April and May comparative drought recurred.

Record of possible and actual sunshine in Brighton.

Month.	Possible sunshine.	Actual sunshine.	Actual sunshine per cent. of possible duration	Average sunshine in the 6 years 1890-95.	Sunless days.	
					Average for 6 yrs. 1890-95.	Year 1895-96.
July, 1895 ...	491·0	196·39	40	205·99	1	2
August ...	440·9	242·48	55	203·90	1	1
September ...	373·8	254·21	68	171·99	2	0
October ...	328·4	128·13	39	119·12	6	8
November ...	259·0	57·82	22	67·73	10	9
December ...	233·8	42·13	18	56·82	13	16
January, 1896 ...	257·3	48·91	19	62·64	10	16
February ...	289·2	78·06	27	97·13	6	8
March ..	358·9	104·06	29	151·63	4	8
April ...	414·4	140·92	34	193·80	3	3
May ...	481·0	274·08	57	242·26	1	1
June ...	486·9	287·27	59	223·66	1	2
Entire year ...	4,414·6	1,854·46	39	1,796·67	58	74

ARTHUR NEWSHOLME, M.D.,

Medical Officer of Health.

Observations taken at the Municipal Meteorological Station, Old Steine, from July, 1895—June, 1896.

Month.		Temperature of Air during Month.				Mean temperature of Air.	Mean degree of Humidity Saturation = 100.	Wind. Number of days of									Rainfall.	
		Highest.	Lowest.	Mean of All highest.	Mean of All lowest.			N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	No. of days on which Rainfell.	Amount collected in inches.
July	1895	72·4	47·8	67·5	56·1	61·8	76	2	2	1	1	2	15	1	6	1	14	2·39
August	,,	75·0	49·2	68·0	56·9	62·4	81	1	0	0	4	5	14	4	1	2	16	1·89
September	,,	83·2	47·4	72·3	55·5	63·9	71	3	11	1	3	1	7	1	3	0	4	1·07
October	,,	69·2	30·6	55·7	42·8	49·2	84	6	6	1	0	3	3	4	4	4	17	4·68
November	,,	61·8	35·0	54·4	45·9	50·1	89	1	2	4	5	6	5	4	2	1	23	4·36
December	,,	53·4	30·0	46·7	38·0	42·3	92	3	3	4	2	1	2	5	8	3	20	3·29
January	1896	51·2	31·0	45·7	38·5	42·1	89	7	6	2	0	2	3	3	3	5	13	1·12
February	,,	58·0	26·0	46·1	36·8	41·4	87	4	3	6	3	1	2	3	2	5	7	0·26
March	,,	63·0	33·6	51·2	41·9	46·5	85	2	2	1	2	4	2	12	3	3	24	2·92
April	,,	60·8	33·6	56·4	43·1	49·7	75	7	3	1	1	1	5	5	5	2	10	0·55
May	,,	75·0	35·4	64·7	45·5	55·1	66	5	15	0	1	2	2	1	2	3	4	0·32
June	,,	80·4	45·0	69·7	54·7	62·2	75	6	2	1	2	4	6	5	0	4	11	2·34
Entire Year		83·2	26·0	58·2	46·3	52·2	80	47	55	22	24	32	66	48	39	33	163	25·19

ARTHUR NEWSHOLME, M.D.,
Medical Officer of Health.

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Mr. LEWIS, seconded by Mr. RYAN, and resolved—

> "That the Report of the Council, the Treasurer's statement, the Librarian's Report, and the Reports of the Committees of the several Sections now brought in be received, adopted, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Sir J. Ewart, F.R.C.P., Mr. J. E. Haselwood, Mr. G. de Paris, Dr. W. A. Hollis, F.R.C.P., Dr. A. Newsholme, Mr. D. E. Caush, and Mr. E. J. Petitfourt, B.A."

And that in pursuance of Rule 42 the Council had appointed the following gentleman to be Honorary Auditor—

> "Mr. F. G. Clark, F.C.A."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, be members of the Council—

> "*Photographic Section:* Mr. W. C. Wallis; *Microscopical Section:* Dr. A. Newsholme; *Botanical Section:* Mr. J. Lewis; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be members of the Council:—*Photographic Section:* Mr. R. C. Ryan; *Microscopical Section:* Mr. W. W. Mitchell; *Botanical Section:* Mr. T. Hilton.

It was proposed by Mr. PANKHURST, seconded by Mr. LEWIS, and resolved—

> "That the following gentlemen be officers of the Society for the ensuing year:—*President:* Mr. J. P. Slingsby Roberts; *Ordinary members of Council:* Mr. E. A. T. Breed, Mr. W. Harrison, D.M.D., Mr. G. Foxall, Mr. W. J. Stephens, L.R.C.P., Dr. Richardson, M.A., and Dr. Treutler; *Honorary Treasurer:* Dr. E. McKellar, J.P.; *Honorary Librarian:* Mr. H. Davey, jun.; *Honorary Curator*: Mr. B. Lomax, F.L.S.; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 12, Clifton Road, Mr. J. Colbatch Clark, 64, Middle Street; *Assistant Honorary Secretary:* Mr. H. Cane."

It was proposed by Mr. Mitchell, seconded by Mr. Payne, and resolved—

> "That the sincere thanks of the Society be given to the Vice-Presidents, Council, Honorary Librariau, Honorary Treasurer, Honorary Auditors, Honorary Curator, and Honorary Secretaries for their services during the past year."

It was proposed by Mr. Caush, seconded by Mr. Breed, and resolved—

"That the sincere thanks of the Society be given to Mr. Petitfourt for his attention to the interests of the Society as its President during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* members of the Society :—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical and Natural History Club.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
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Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Sussex Natural History and Philosophical Society.

1896.

N.B.—Members are particularly requested to notify any change of address at once to Mr. J. C. Clark, 64, Middle Street, Brighton.

When not otherwise stated in the following List the address is in Brighton.

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Brighton and Sussex Natural History and Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH THE

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FOR THE

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SESSION 1896-97.

WEDNESDAY, OCTOBER 14th, 1896.

INAUGURAL ADDRESS

BY

MR. J. P. SLINGSBY ROBERTS

(PRESIDENT).

SOME RECENT ACHIEVEMENTS IN PRACTICAL SCIENCE.

In choosing the subject of my address, I had in my mind the thought that it is well from time to time to review the progress made in those branches of science which are within the purview of this Society. I attempt no more than this, and shall glance therefore at some of the more notable results obtained in the chief departments of science in language as little technical as possible.

One of the most characteristic features of the latter half of the nineteenth century is the manner in which the forces of nature have been bent by man to practical uses. Nowhere is this more markedly evident than in the domains of electricity, of chemistry, and of biology. The man who, when Faraday first obtained an electric current by the insertion and withdrawal of a magnet in and out of a coil of wire, had prophesied the development of the modern dynamo-generator or dynamo-motor would have been regarded as an amiable enthusiast. Yet to-day, new branches of knowledge are opening out on every hand, thanks to the means of producing electricity which have sprung from Faraday's historical discovery. It is not only in the production of light and in the production of power that electricity threatens to revolutionize the world. In the production of heat also valuable results have already been obtained. The electric furnace enables us to subject considerable masses of matter to the highest temperatures yet reached. Some of the most interesting of the results thus obtained have been by compounds of carbon with various elements. These carbides are most of them new to chemistry and have furnished some interesting as well as useful reactions. Thus the carbide of calcium formed by fusing together lime and carbon in the electric furnace is decomposed (as are many of these carbides) by contact with water and yields acetylene. Acetylene, as you doubtless know, is a highly inflammable gas having considerably greater illuminating power than coal gas. Five cubic feet of acetylene burnt in one hour are said to give a light equivalent to that of 240 candles. One ton of calcic carbide will yield about 11,000 cubic feet of acetylene at a cost of about £4. Acetylene can either be burnt alone, or be used for enriching coal gas. Though very explosive under certain conditions there would seem to be no difficulty in rendering its use reasonably free from danger. It has been brought already into practical use—as the train by which the President of the French Republic lately travelled, was lighted by it. Certain carbides of metals are found to produce, when decomposed by water, some of the true liquid petroleums, a circumstance which renders probable the suggestion made many years ago by Mendeleef that the petroleum deposits at Baku in the neighbourhood of the Caspian Sea were derived from the decomposition by water of metallic carbides deeply situated under the surface of the earth.

Another result of the electric furnace is the synthetic production of alcohol directly from its elements. Acetylene made from calcic carbide is transformed into ethylene and the ethylene being absorbed by concentrated sulphuric acid gives sulphovinic acid and this diluted with water and boiled gives chemically pure alcohol.

Electricity has been brought into the service of the engineer by the new art of electric welding and there is perhaps no branch of electrical work which possesses greater possibilities at present. The ease and convenience of manipulation are as yet but little known in this country, but Messrs. Lloyd, of Birmingham; Messrs. Spencer, of Newburn; and The Electric Welding Company, of Pimlico; are doing much to introduce it to the wider notice it deserves. The system of electric welding is due to Professor Elihu Thomson, and may concisely be described as sending a current of electricity through the metal to be welded and thus heating it and then forcing the heated parts together by mechanical pressure. The Thomson process is highly popular in America, and Mr. Dobson of Messrs. Dobson and Barlow, who were probably the first to use the process in this country, states in a paper read before the Institution of Mechanical Engineers that not one defective weld is found in 500. It is said also that the welds thus made are considerably stronger than the ordinary brazed joint, the breaking strain being over 20% greater for the electric weld than for that of a hand brazed wire joint.

I cannot leave the subject of electricity without referring to the works recently erected for the utilization of the force of the Falls of Niagara. These, the largest works for the production of the electrical current yet constructed, are situated in the city of Niagara Falls and mark an epoch in the history of the production of electricity for commercial purposes.

The cost of the electricity to the Aluminium Company which has its works close to the Falls is $\frac{1}{8}$th of a penny per unit. The lowest charge in England, is, I believe, 3d. per unit. You will notice the immense difference. It will suggest to you the great part which water is destined to play in the supply of energy to the works and manufactories of the future. While recognizing the great utility of waterfalls one cannot but lament the invasion of some of the most beautiful scenery by the works necessary for the transformation of their power.

The X Rays or Röntgen Rays, as they are more generally called, have been so much discussed that I hesitate to do more than mention them to you.

Professor Lenard was the actual discoverer of these rays, and Röntgen merely brought the subject more popularly forward and showed that they could penetrate various substances impermeable to ordinary light, and that they rendered fluorescent certain chemical substances.

The actual nature of these rays is at present uncertain, but whatever they may be some most wonderful results have been produced by them : results closely and directly aiding the surgeon's art and benefiting humanity. It is very seldom that a discovery is so soon seized upon and practically applied. Without the necessity of going through the process of impressing a permanent image upon a sensitive plate—the effect of these rays upon a fluorescent screen is modified by an interposed substance—so that at any moment portions of internal structure hitherto invisible may be inspected. Doubtless we are on the threshold of something far greater than we can at present conceive. What has already been accomplished, however, teaches us that there are more things in Heaven and Earth than can be appreciated by us, caged as we are within the limits of our senses and of those comparatively small aids which science has as yet been able to call in as supplements to them.

Let us hope that science will not advance so far as to lay bare our thoughts by registering the molecular changes in the brain. It would add a new terror to life and the very idea would seem to fortify the arguments in favour of cremation.

From time to time we hear that one thing long desired by many has been done, and that the production of a coloured photograph has been accomplished. Hitherto their hopes have been dashed as soon as raised. M. Becqurel succeeded in obtaining coloured impressions by converting the surface of a Dagerreotype plate into violet sub-chloride of silver. But this coloured image cannot be fixed, so that when exposed to the light it vanishes. I pass over M. Joly's process since it includes the painting of the positives with pigment—an idea foreign to what is meant by a coloured photograph. But a real step forward has now been made by M. Lippmann who has succeeded to a certain degree, by placing a mirror in the shutter behind the negative glass. The rays of light are thereby stopped in their career and thrown back on the ray following them—otherwise the incident rays. The effect is that parallel to the surface of the plate a series of strata is formed which strata vary according to the intensity of the energy of the rays which have met on its surface. Two necessaries were wanting—firstly, a transparent film to admit the the rays of light to the mirror—and secondly, a close and immediate contact between the mirror and the film. The first requisite was after considerable trouble conquered by increasing the amount of the organic substratum of gelatine or albumen. The second requisite—viz., a mirror in perfect contact was found by pouring mercury into a reservoir behind the plate—so that the film being reversed (as would of course be necessary) it is in immediate touch with the mercury.

This plate is exposed, developed, and fixed in the usual way, but the colours so produced can only be seen at the angle of specular reflection. They are so far permanent that they can be called up at any moment. Wet the surface of the plate and they disappear, to come forward again as the plate gradually dries.

Another achievement is the discovery of Argon. In his paper on the theory of Phlogiston, published in the Philosophical Transactions in 1784, Cavendish showed that he suspected the nitrogen of the atmosphere to be not all of one quality, and since the time of that great scientist the question remained unanswered until now, when two of our leading men, Lord Rayleigh and Professor Ramsay, working at first independently, have solved the problem and have produced a gas which from its inertness has been named

"Argon." They proceeded, not with the object of solving Cavendish's doubts, but for the purpose of ascertaining the exact weight of nitrogen gas, and it was found that the nitrogen obtained by one method—namely by passing atmospheric air through liquid ammonia and then through a red hot tube and so converting the oxygen into water—differed in weight from the nitrogen produced by absorbing the oxygen by red hot copper, the nitrogen produced by the latter method being 1000th part heavier than that obtained by the former process. That this was due to something in the atmospheric nitrogen was proved by weighing pure nitrogen obtained from ammonia, pure oxygen being used in the first of the processes I have mentioned in place of atmospheric air. The difference in weight between the gases so obtained was about half per cent.

The method employed by Lord Rayleigh for isolating the argon was the same as that used by Cavendish, with the advantage of greater electric power than he had at his command.

A U tube is filled with mercury and inverted. A mixture of air and oxygen in equal proportions is passed up the tube which takes its place at the junction and so separates the two mercurial columns. When a current of electricity is sent from one column to the other the nitrogen combines with the oxygen and a residue is left amounting to about $\frac{1}{120}$th part of the nitrogen. This residue is argon, and is found to be free from nitrogen except to about $1\frac{1}{2}$ per cent.

Whether argon is an element is still undecided, but that it is so is I understand considered highly probable.

During his experiments on nitrogen the attention of Professor Ramsay was called to a means of producing it from uraninite acted on by sulphuric acid. The Professor tried this, but the conditions under which he worked being somewhat different it was found by the spectroscope that the gas produced was not nitrogen (although there was a slight quantity), but that the gas produced a yellow spectrum answering to the yellow band in the solar spectrum which had been named helium as representing a metal in the sun, but unknown to us. It was then found that helium existed in the spectra of nebula and stars, and in a degree varying with their temperature.

While on these subjects I should like to devote a few moments to air in its liquid state.

Pictet, in Geneva, and Cailletet, in France, solved the problem of the liquefaction of the permanent gases—as they were called, but it was reserved for Dewar to bring this feat into practical use and to obtain liquid air, liquid oxygen, and liquid ethylene in such quantities as admitted of experimental research with them.

Into the earlier methods of production employed by Dewar it is not necessary to enter, but the later methods are so applicable to the economical production of large quantities of liquid gases as to lead to the belief that liquid air may play an important part in commerce both as a refrigerating agent and as a source of oxygen gas, while its scientific use is to give facilities for studying the properties of matter at very low temperatures.

As is well known, if a gas is compressed heat is evolved; and when the compressed gas is liberated and allowed to expand it absorbs heat from surrounding bodies and itself in the process. This method is familiar to you in the production of solid carbonic acid. In the apparatus now used by Professor Dewar this principle is made use of.

Liquid air thus obtained is a very pale blue fluid which as the nitrogen evaporates becomes deeper in colour, for since nitrogen boils at a lower temperature than oxygen, liquid air becomes gradually richer in the latter by the evaporation of the former.

For the preservation of the liquid air Professor Dewar uses vessels of glass constructed of double walls, the interval between the two being converted into a very high vacum. So perfect is the insulation from heat thus afforded that several pints of liquid air have travelled from London to Oxford in these vessels, under the ordinary pressure of the atmosphere.

Further, Professor Dewar has converted this liquid air into a solid transparent jelly-like mass.

Extraordinary results have been obtained by submitting different substances to the intense cold of this liquid air. The property which in their ordinary state metals possess of conducting electricity is greatly diminished. On the other hand their tenacity is increased. Ivory, horn, india-rubber, and other substances undergo remarkable changes. Among others they become phosphorescent when exposed to the electric light.

By means of the intense heat generated by a powerful current of electricity, many metals hitherto almost impossible to obtain, have been separated from their oxides—chromium and manganese for example. It is by this means that aluminium is now so largely manufactured and at so cheap a rate.

The rarer metals which are fused with difficulty are found to be useful in giving strength to the metals used in the industrial arts. This power of obtaining the rare metals in an absolutely pure state has greatly helped us in producing a compound metal both for shot and for the armour plate made to resist it. Aluminium is found to be usefully alloyable by copper. A boat built of plate from $\frac{1}{6}$th to $\frac{1}{10}$th of an inch in thickness is 50% lighter and runs $3\frac{1}{2}$ knots faster than a similar boat of steel.

And another result of these wonderful processes—one that is perhaps destined one day to work a great change in the commercial world, is the manufacture of diamonds. Nothing approaching the size of the Koh-i-noor has as yet been obtained, but although those which M. Moissan has made in his electric furnace are small, very small in fact, yet he has doubtless shown us how the Koh-i-noor was made in the laboratory of nature.

Now I turn to another branch.

No subject has made greater progress than that of Bacteriology. It is now so generally practised, that in mostly if not in all of the large hospitals a room is set apart for the breeding of bacteria. Many diseases, the origin of which was obscure have been traced to the presence of micro-organisms, and now we may hope to bring near a curative system founded on our knowledge of these creatures. No disease has baffled the medical profession more than diphtheria which threatened to become a scourge. I refrain from giving statistics from a belief that it would be impossible in the time at my disposal to present figures which would not be fallacious, but I may say shortly that since the introduction of the anti-toxic treatment the rate of mortality from diphtheria—when the treatment has been tried—has been greatly reduced. The horse has, after repeated experiments been found the most suitable instrument for the production of the curative fluid. The horse is to a great degree proof against the action of the diphtheritic bacillus, and the serum of a horse's blood when injected into human veins produces little or no effect. It is as well that it should be known that beyond a slight local swelling accompanied by a rise of one or two degrees in temperature the animal suffers nothing in health.

The horse thus being made immune, the blood is drawn off and cooled until a clot is formed, and the serum, in which are the anti-toxic properties, is separated. This serum is distributed in different strengths, and is found not only to modify existing diphtheritic disease, but (and this is worthy of especial attention) to act as a preventive when no disease exists.

A powerful anti-toxin has been prepared by electrolysing diphtheria bouillon cultures, but nothing definite in this direction has yet been reached.

Closely connected with this subject are the results obtained by Fraser from his enquiries into snake poison and its remedies.

It has long been known that many savage tribes obtain immunity from such poison by swallowing the poison bags of the animal. Experiments have proved that by a method similar to that used for the bacillus of diphtheria, a certain degree of protection from snake poison can be obtained and that the animal who is made the medium can receive without injury in gradual doses far more than what would be a lethal dose if given at one time. How far the poison of one sort of snake produces immunity from the poison of another is under investigation, but it is known that the cobra poison does so act.

There has been no opportunity to try the effect of this treatment upon human beings, though as 20,000 deaths occur annually in India from snake bites, such an opportunity cannot be long delayed.

The step from the above subject to the component parts of the blood is not a long one, and the researches made have materially advanced our knowledge of the white corpuscles. They are protoplasmic, and have what may be called a vital force self-contained. They pass more easily through the enveloping tissues than the red corpuscles and thus by a process of filtration become separated. In this condition they are shown to have the power of throwing out radiating arms which seize upon and digest morbid tissues and so aid the process of reintegration. This force does not desert them when they are artificially withdrawn from the blood and are placed under a microscope. This power of digestion has been treated of by the Russian Metchinkoff. It is now stated (although this and indeed the whole subject of phagocytes awaits further development) that the microbes of infectious diseases are amenable to the attacks of the white corpuscles, so that nature which produces the disease has at the same time provided a remedy.

To a speculative, and therefore an unscientific mind, this war of lives going on within the body of another living being opens up a field of thought, upon which in a philosophic society such as this it would be manifestly out of place to dwell for a moment.

Other great advances have been made in this branch of science, notably the work of Ferrier and Victor Horsley on the brain. Already they have done much to relieve the ills to which flesh is heir.

In this review of some recent achievements of practical science I am painfully conscious of many omissions made.

But there is still a triumph of another kind achieved by science which I have reserved to the last and to which I cannot but refer as worthy to be mentioned here. Only the other day at the Church Congress a large-hearted Bishop uttered in Darwin's own town of Shrewsbury a warm panegyric on his work, acknowledging the greater breadth which that illustrious naturalist had given to our ideas of nature and nature's God. When we find a responsible dignitary of the Church not fearing to avow such sentiments on such an occasion, scientists and theologians may well join hands in thankfulness to the Great First Cause and agree that knowledge is a great power, and a power for the good of mankind and of the world.

WEDNESDAY, NOVEMBER 11TH, 1896.

CHRONICLES OF A CLAY CLIFF

(ILLUSTRATED BY LANTERN SLIDES)

BY

MR. W. H. SHRUBSOLE, F.G.S.,

At the Athenæum Hall.

WEDNESDAY, DECEMBER 9TH.

MOSSES.

BY

MR. W. E. NICHOLSON.

The true mosses form the highest division of the cellular cryptogams, and they are separated from the higher cryptogams by the absence of vessels, and from the lower, such as the algæ, by the greater differentiation of their parts and the possession of a definite stem and leaves. As thus defined they would include the greater number of the Hepaticæ or scale-mosses, but those members of this group, which have a definite stem and leaves, are distinguished from the true mosses by the presence of elaters or spiral threads mixed with the spores, from nearly all mosses by their distichous (two-ranked) nerveless leaves, and by their valvular capsule.

In common with most other cryptogams mosses present the phenomenon known as alternation of generation. In their case the spore produces, by the intervention of a branching filamentous stage, known as the protonema, the sexual moss plant,which eventually produces the oosphere or egg-cell, from which on fertilization the sporogonium or capsule, the second and asexual generation of the moss is developed. The capsule contains the spores from which the cycle of life is again commenced. It is generally small in proportion to the vegetative and sexual plant which forms the moss as we recognize it. The arrangement forms a striking contrast with the alternation of generation presented by the ferns, in which the asexual or spore-bearing generation is by far the more important.

The stem in the higher mosses consists of a firm central portion called the central string, and which, although its functions are very imperfect is regarded by Rabenhorst as the rudiment of of the fibro-vascular bundles, which play such an important part in the higher plants. It is surrounded by the parenchymatous cells of the ground tissue which are generally rich in chlorophyll, and outside this there are often one or more layers of colourless cortical cells, which are well developed in the genus Sphagnum. The lower part of the stem of all mosses, except Sphagnum, is clothed with rootlets or rhizoids whose principal function is to fix the plant to the substratum on which it grows, though it has recently been proved that they to some extent possess the functions of true roots and can derive nutriment from the subtratum. In the leaves of mosses a wonderful variety of form is found based on a very simple plan. The leaf is never compound and never possesses a leaf-stalk as in the higher plants. It usually consists of a single layer of cells which are very variable in form and it never has stomata. In shape every intermediate is found between the narrow linear leaves as exhibited by campylopus and the almost spherical leaves of Mnium subglobosum. Leaves sometimes occur which merely consist of a thin layer of cells of similar shape throughout as in *Pterygophyllum lucens*, but more often they possess a central midrib or nerve which offers every gradation of development from the short ill-defined nerve of many species of Hypnum to that of the genus Lencobryum where it occupies practically the whole leaf. Owing to the comparatively large size of the cells and of the chlorophyll granules the formation of starch under the influence of light can be more readily observed in some mosses than in the higher plants. As the blade of a leaf offers a comparatively small surface for assimilation, the interchange of gases only taking place through the outer cell wall, since there are no stomata, it is sometimes supplemented by appendages to the nerve as in Polytrichum, the nerve of which is thickly studded with lamellæ which are rich in chlorophyll and must enormously increase the assimilative power of the leaf. The mosses of this genus form an almost woody stem, so stiff that they are sometimes used for making brooms, so that the quantity of material assimilated, as compared with other mosses, must be very great.

The leafy moss of the first generation eventually bears the sexual organs, which are known as antheridia and archegonia. These are best observed in those mosses, such as Funaria, many species of Bryum, &c., in which they are produced on separate plants, when the moss is said to be diœcious. The antheridia are to be found in small rosettes generally of a yellowish colour and surrounded by modified leaves called the perigonial leaves. They consist of oblong sausage shaped bodies and are surrounded by curious filaments known as paraphyses, the functions of which are unknown, though they probably in some way regulate the evaporation of water which plays so important a part in the life of a moss. The antheridia when mature open at the apex and the antherozoids or male fertilizing elements escape. These can only live in water in which they swim about by means of a cilia. Their movements may be readily observed by examining a ripe antheridium in water under the microscope.

The archegonia or female flowers are flask-shaped bodies some what similar in shape to the pistils of phanerogams. Like the antheridia they are surrounded by modified leaves, known in this case as the perichætial leaves, and they have paraphyses growing with them. The upper part of an archegonium consists of a hollow neck down which the antherozoid travels to fertilize the öosphere. The first generation of the moss is completed on the fertilization of the öosphere which now starts on a new career of its own. It grows slowly, downwards into the substance of the moss-stem at the expense of which it is nourished, and upwards when it shortly ruptures the swollen archegonium, the upper part of which is borne on its growing point and forms the calyptra. This is often a very beautiful object and under its protection of the growing point soon develops into the more or less cylindrical capsule. In the more highly organized mosses the capsule dehisces by means of a lid to permit of the escape of the spores, which are formed round the central axis or columella of the capsule by free cell division, with the intervention of a mother-cell, in the same way as the pollen grains of the flowering plants. The most beautiful part of the capsule is perhaps the peristome, which becomes visible on the fall of the lid and surrounds the mouth of the capsule regulating the dispersion of the spores. In its complete form it consists of an inner and an outer row of teeth, the outer row being rather stouter, darker coloured, and entire, while the inner row is more delicate and is frequently supplemented by fine cilia. The long twisted peristome of Barbula is a very beautiful object and readily observed as one species, Barbula muralis, is abundant on walls everywhere.

Interesting peristomes are also found in the Genera Bryum, Polytrichum, and Fontinalis and their examination is often of great value for purposes of classification. Although the capsule is generally parasitic on the moss plant, it occasionally contains abundant chlorophyll and is provided with stomata which never occur in the leaves. The assimilative functions are generally carried on at the base of the capsule known as the apophysis, which reaches an extraordinary development in the genus Splachnum, where it consists of a large spherical or pear-shaped mass of tissue provided with numerous stomata which might be mistaken for the true capsule, which is very small.

Besides the normal method of reproduction by spores, mosses are also frequently reproduced directly from the moss-plant of the first generation by means of variously shaped reproductive bodies known as gemmæ, which are produced on various parts of the plant and are often very characteristic of different species; Tetraphis pellucida, which is very abundant on the Sussex sand-rocks, affords a very interesting example of this method of reproduction.

Nearly 600 species of the true mosses are found in the British Isles of which upwards of 300 have been recorded for Sussex, which, with the varied conditions it affords, is an excellent county for mosses.

The theory of an alternation of generation in the life history of a moss has been referred to so it is perhaps only just to observe that it has recently been called in question, at least in its extreme form. A question at present interesting botanists in connection with it being, whether the spore-bearing plant or capsule and the öophyte or sexual moss-plant are homologous with one another or whether the capsule is an entirely new formation intercalated in the life history, or, as it is called, antithetic to the sexual plant. According to the antithetic view all the vegetative parts of the capsule have arizen from the sterilization of tissue which might have produced spores, e.g. the wall of the capsule, the apophysis, where present, the seta, peristome, etc., have been produced by the metamorphosis of spore-forming cells.

In connection with this view the capsule of **Nanomitrium,** one of the lowest forms of the true mosses known to us, merely consists of a mass of spores surrounded by a single cell wall, which ruptures irregularly having no differentation into mouth operculnm, columella, or spore-sac. It is however open to us to regard these characters as degenerate. If on the other hand the capsule or spore-bearing generation is merely regarded as a new part of an existing organism or homologous to the sexual moss plant the diffulty of accounting for such an extensive differentiation of spore-producing tissue is avoided, and it is easier to trace a connection between the mosses and the ferns which certain facts in the life history of the lowest family of ferns, the Hymenophyllaceæ, seem to indicate. This question was made the subject of an address to the botanical section of the British Association by Dr. Scott last autumn, and may be regarded as still *sub judice*.

WEDNESDAY, JANUARY 13TH, 1897.

AN EVENING FOR CONVERSATION AND THE EXHIBITION OF SPECIMENS.

WEDNESDAY, FEBRUARY 10TH.

THE ORIGIN OF DOUBLE FLOWERS.

BY

MR. E. H. FARR, F.C.S.

The Author commenced by describing the constituent parts of normal flowers and their modes of arrangement in different classes of plants, illustrating the extremes by means of the floral diagrams of Ranunculaceæ and Liliaceæ respectively, drawn on the blackboard.

He then proceeded to demonstrate the modes in which various double flowers were evolved from their single representatives by means of a quantity of selected fresh and dried specimens, which showed clearly the various stages in the transition.

He showed that flowers were composed of two classes of organs, the outer ones, consisting of the sepals and the petals, having chiefly protective functions to perform; whilst the inner ones, consisting of the stamens and carpels, were designed for the reproduction of the plant.

The decorative value of any plant depended as a rule upon the form and colour of the protective organs, more particularly the petals as the sepals forming the outside row of organs were as a rule green and inconspicuous.

Taking the diagram of the Liliaceœ (Lily tribe) in the first place and comparing it with that of the Ranunculaceæ (Buttercup tribe), he explained how it was that the plants of the former type were generally so much less double than those of the latter having so stamens as compared with the latter.

There were two ways in which the extra petals which constituted the double flower were derived; in the first place by a kind of doubling of the existing petals, and in the second by the conversion of stamens into petals. In some cases only the latter mode was concerned in the formation of the extra petals, but in the more double ones, both of the modes operated in producing the final product. When the extra petals were produced by the doubling of the whorls of petals the resulting products were in no way distinguishable from the original petals, but on the other hand petals which had been evolved from stamens, nearly always showed more or less evident traces of their origin in the form of parts of the anther growing on the edge or in the centre of such petal. These portions of anther might or might not contain any pollen grains.

On dissection of any of our double flowers it was easy to pick out examples showing the gradual transition from perfect stamen to more or less perfect petal, and the lecturer then proceeded to show a complete series of such forms taken from such familiar old friends as Geraniums, Primulas, Azalias, and Daffodils, with many others. These forms were described and passed round whilst the subject was further illustrated by blackboard sketches of a series of the extra petals from Azalia with a normal stamen showing the various steps generally to be found in double flowers.

In many of these part only of the stamen was concerned in the change, that part being the filament, whilst in the extreme cases their position only afforded evidence as to their origin.

WEDNESDAY, MARCH 10TH.

SOME INHABITANTS OF OUR PONDS AND STREAMS.

(WITH LANTERN ILLUSTRATIONS)

BY

MR. D. E. CAUSH, L.D.S.

WEDNESDAY, APRIL 14TH.

THE LOWER FORMS OF ANIMAL AND VEGETABLE LIFE.

(MICROSCOPICAL DEMONSTRATION)

BY

MESSRS. D. E. CAUSH, ELGEE, HAINES, MUSTON, MITCHELL, NICHOLSON, THOMS, AND PANKHURST.

WEDNESDAY, MAY 5TH.

ON THE GROWTH OF HAIR UPON THE HUMAN EAR,

AND ITS TESTIMONY TO THE SHAPE, SIZE, AND POSITION OF THE ORGAN IN PAST TIMES.

BY

MR. H. M. WALLIS.

In 1871, Darwin called attention to the cusp sometimes seen upon the folded edge of the human ear and suggested that this feature was a survival of the pointed tip which terminated the ear of our remote ancestor.

The hypothesis was ingenious, but less convincing than many of the bold and splendid deductions of our great philosopher.

Support from corroborative phenomena was needed, but none was forthcoming. Indeed, had this identification stood alone, it would hardly have commanded acceptance; but making its appearance in good company amidst a phalanx of marshalled facts, which there was no gainsaying, it obtained an amount of credence which was scarcely deserved.

In Germany, Ludwig Meyer and, more recently, C. Langer, have thrown doubt upon Darwin's interpretation of the cusp in question. But although this cusp is sometimes triple, frequently double, and still more frequently absent altogether—variations which, to say the least, do not uphold Darwin's view—the current of intellectual opinion has borne the Theory of Natural Selection into favour and this item has travelled with the rest.

Although for nearly a generation no fresh light has been thrown upon this particular question, yet for years past the cusp has been labelled "Darwin's Point" upon diagrams and museum preparations; the correctness of his identification has been generally assumed and the matter treated as settled.

This, however, was not Darwin's opinion.

In July, 1879, my attention was drawn to the ears of a new-born child. He was of a dark complexion and hirsute; the edges of his little ears were fringed with black hairs showing conspicuously upon the delicate skin of infancy.

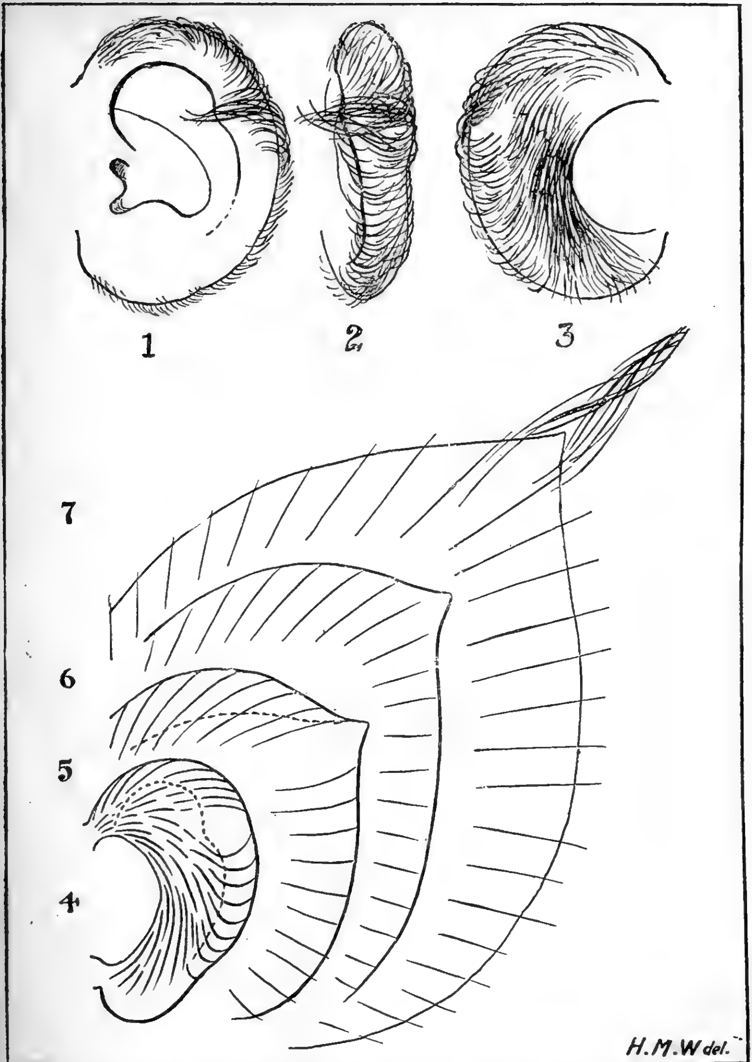
The direction, or set, of these hairs surprised me. Instead of radiating from the margin of the ear like the cogs of a wheel, or overlapping one another around its edge like the teeth of a ratchet, two streams of hairs approached each other from almost opposite directions until their points crossed and interlaced (see Fig. 2).

The part of the *helix* at which the points of the hairs met was that part of the infolded outer rim which is normally somewhat thickened, and where a little white nodule is frequently present, the nodule which in later life commonly develops into Darwin's Point. I communicated my discovery to Mr. Darwin, and received from him several letters on the subject.

Encouraged by Mr. Darwin, I have for the past 16 years observed the ears of infants and induced others to do so.

I proceed now to describe some observations which prove that the hairs upon an infant's ear are arranged upon a definite plan and have different directions in different parts of the organ.

To begin with, the back of the ear at birth is frequently clothed with a regular growth of hair. The possible significance of this will be dealt with later. For the moment, however, I merely draw attention to the peculiarities of the growth, its



1, 2, 3.—Front, edge, and back aspects of left ear of child six weeks after birth. Such a well-marked example is rare, the hairs being usually pale, small, almost invisible, or locally absent. *When present* they seem to conform to the plan here figured.

4.—Lines of growth followed by the hair upon the back of the human ear, as sometimes observable in men when past middle life. The dotted line shows the course of the folded margin and atrophied "point."

5, 6.—Outlines of ears of low-grade quadrumana, representing stages of degradation analogous to those through which the human ear may have passed.

7.—Suggestive outline of primæval ear.

constant adherence to certain lines—both on the back of the *concha,* where the hairs are directed backwards and downwards (as may be seen by reference to Fig. 3); and upon the back of the *helix* and *anti-helix,* where the lines of growth followed by the hair, though in my experience constant (when hair is present at all), are apparently capricious, a question to be dealt with presently.

Fig. 3 shows the back of an infant's ear enlarged. The tract immediately around Darwin's Point, or where Darwin's Point is to be expected (for it is not always present), is bare. Those parts of the *helix* which are above the bare tract are clothed back and front with hairs directed towards Darwin's Point, whilst the hairs upon the back of the *anti-helix* separate themselves from those upon the back of the *concha,* which are directed downwards towards the lobe, and executing a countermarch, as one might say, come curving round the infolded rim of the *helix* below Darwin's Point, directing their growth towards it until their tips meet and touch those of the hairs approaching from above.

The significance of this countermarch or reversal of direction it is proposed to discuss later in this paper.

The opposing growths of hairs do not approach one another from directly opposite directions; they cross one another's paths diagonally, as though seeking something which was once there, but which no longer exists.

On many infant ears Darwin's Point is not sufficiently pronounced to unable its precise locality to be determined. Its position varies much in my experience, and the tract around it, or its presumed site, is very frequently bare, as already remarked. In short, the external infant ear is a very variable organ, but whenever hair is present it seems to follow the above-described lines, although it may be almost invisible and need a dark card to be placed between the ear and head and the use of a lens to discover the hairs.

I have observed a case where an infant's ear shewed Darwin's Point well, and the small white tubercle beneath the skin was marked by a minute tuft of down. The ear drawn in fig. 1 was so noticeable that the child's mother, a woman in humble circumstances, was struck by its appearance and sent for me to see it. Where the two streams of hairs met the hairs were longest, a distinct tuft of hairs twisted upon one another came partly from behind the ear and partly from the fold of the *helix* and projected laterally at right angles to the median line of the body from one-eighth to one-quarter of an inch. The *spina helicis* was thickly clothed with hairs pointing towards this tuft. The child was a fair-skinned infant with very dark brown hair.

My observations of fœtal ears have so far been inconclusive. Of some the epidermis seems imperfectly developed and is hairless. In no case are very small hairs easily observed whilst the subject is immersed, and when removed from the spirit the *lanugo* clings to moist skin and it is difficult to determine the direction of its natural growth.

The Darwin's Point was not well marked, or indeed determinable, upon most of the fœtal ears which I have examined; but no stress need be laid upon this, as this feature is very variable and frequently absent, as is well-known. One fœtal ear was remarkable for having Darwin's Point directed backwards (the *helix* being unfolded as in Monkeys), and this point was tufted with small pale yellow hairs. This is a specimen in spirit in the Oxford University Museum.

In life this infantile growth is soon shed, but in later middle age, a hairy covering sometimes reappears and may be noticed in black-haired men of coarse skin and hirsute habit of body more frequently than in others, although I have recently observed the ears of a man of about forty, fresh complexioned, dark red moustache, pale red hair, which exhibited almost all the phenomena I have described. The hairs, which were straw-coloured and very numerous, grew thickly upon the backs of the ears, fringed the edges of the *helix*, and had well-marked lines of growth.

The majority of ears, whether of adults or of children other than infants, show no hairs, or where a weak and straggling growth has persisted in spite of constant friction and depilatory influences, there is seldom any visible direction or "set" traceable.

In the hope of discovering the law of growth followed by these hairs the ears of various Apes and Monkeys have been examined.

Troglodytes niger.—The ears of young Chimpanzees in the Zoological Gardens, have no indications of any point, a very few small hairs upon the upper fold and a few more upon the lower edge directed towards one another as is usual. Backs almost hairless.

An ear in spirit in the Oxford University Museum showed no rudimentary point and bore a few fine airs upon the upper fold only; direction as usual. I could not examine the back.

The ears of a gorilla in the same museum showed some faint indication of a point towards which the small hairs were directed. In the immediate neighbourhood of what I took to be the rudimentary point the hairs were fewest and their direction most indefinite. The hairs upon the folded margin of the *helix* curled inwards as in the human ear and the few stronger and darker hairs upon the back of the upper ear pointed towards the edge.

Cynocephalus albigularis.—Is bluntly pointed and plentifully fringed; the hairs cross tips at the point. Back of ear nude.

C. petaurista.—Distinct, sharp, nude point; fringe of hairs directed to it. Short curving hairs upon the back, such as one finds upon the back of a baby's ear.

C. lalandii, Juv.—Less hairy, same general characters. Tiny tuft of darker hairs at the tip, and a few on back of ear point towards the tip.

Monkey, sp.?—Ear fringed with converging growths. Point definite and tufted with slightly longer hair.

Aye-Aye (*Cheiromys*).—A simple bestial ear, not quadrumanous in character, almost naked, sparsely clothed inside with fine black hair directed to the tip,outside coarser and fewer black hairs tipped with white are similarly directed. No fringe or tuft; no point. Root of ear (*concha*?) thickly clothed with divergent hairs pointing fanwise towards the circumference of the ear.

Whilst contemplating a series of forms such as these it is possible to follow in imagination the progressive degradation of the external ear from a condition in which it was mobile and of the utmost importance to its possessor to a state in which it ceases to be functional.

The presumably conspicuous leaf-shaped organ of some common ancestor of the Aye-Aye, the Lemurs, and ourselves has dwindled to a mere crumpled excrescence in the Gibbon, sans lobe, sans point, sans hair, sans everything!

An ordinary human ear occupies an intermediate position, although variations in the direction of a simian type may be found in which the *helix,* or lobe, or both are wanting, whilst others show a pithecine cusp directed laterally or even backwards.

The testimony of the convergent hairs to the origin of the cusp is so confirmatory of the view enunciated by Darwin that from henceforth the fact of our ancestors having had pointed ears may be regarded as established.

Is it possible from the phenomena under discussion to deduce anything as to the shape, position, and movements of the ancestral ear?

As to shape, it seems unlikely that the ear was obtusely pointed as in *Loris* and *Cynocephalus,* for had not the point been originally at least as sharp as it is in *Macacus* it would hardly have persisted until now.

As to position and mobility: was the ear pressed as closely to the head as in most living Apes, and had it as little mobility as theirs?

Darwin ascertained that neither the Orang nor the Chimpanzee ever erects or moves its ears. I have seen *Macacus maurus* move its ear slightly, and some men retain this power, although it is questionable whether this movement is due to the extrinsic muscles of the organ, as Darwin appears to have believed, or to the contraction of the scalp. It is certain that beyond the power possessed by many persons of moving both their ears simultaneously with their eyebrows and the skin of the nape, some few can move the whole ear quite independently of the scalp; and I have observed a case in which the upper half of the ear could be vibrated at will, either rapidly or slowly, whilst the lobe and lower half of the same organ, the eyebrows, and scalp remained motionless.

Whether these movements are due to the muscles of the ear or no, such muscles exist in Man, and their existence argues past use in our ancestral form. As a matter of fact, the external ear in both Man and the Quadrumana is an atrophied organ in several respects, mobility for one. But evidence of mobility is foreign to the present enquiry except as affording concurrent testimony as to the conditions of the ancestral ear, which almost certainly moved freely. A freely moving ear must needs project, and a projecting ear is exposed and seems to require (and usually possesses) a special hairy covering of its own. To-day the normal human ear is almost hairless, frequently indeed quite nude. It is practically sessile. Whether at one time it projected laterally seems a fair subject for investigation, and to this question the existence of hairs upon its back affords a clue.

Where the ear is pressed closely to the head as in most of the Quadrumana, its back is almost naked: it was quite bare in the Gibbon which I examined. An ear thus placed is obviously protected from weather either by the fur in which it is embedded, as in the Gibbon, or by the long tresses which fall over it from the sides of the head in the Orang and Chimpanzee. Even the thick short bristly hair of the Gorilla affords an efficient protection, and it is not easy to get sight of the back of its ears, even when the ear is handled. A special hairy covering for an ear so placed is needless, a tuft in the orifice to exclude rain being all that is needed and usually all that exists. Except a very few weak hairs in Gorilla, the Anthropoids have lost the hair upon the back of the ear so far as my observations extend, which is not far, for Anthropoid Apes are neither abundant nor easy to examine. Their ears seem subject to much variation.

Man alone exhibits in infancy and reproduces in later life the ancestral hairy coat of the ear—a fact from which we may perhaps infer that at one time his ears had sufficient lateral projection to need other and more constant protection from the weather than the hair of the scalp afforded.

The shape of the head of our ancestor who had pointed ears is not known, but it is highly improbable that his skull was of the lofty, domed Caucasian type. If it were long and low, somewhat after the style of the Eocene *Adapis,* the ears would be set much higher in the head than ours, and would get no protection from any hair growing upon the scalp.

Several contributary pieces of evidence suggest that the external ear is an organ diminished by disuse. Thus, it is no longer functional; it varies extremely and constantly in shape and size and in other particulars. It is by its position exposed to sunburn, frost-bite, and injuries of all kinds, yet it is ill-supplied with nerves of sensation and has a poor supply of blood. Consequently it heals slowly when cut. One might compare our external ear to an outpost once important, but now no longer essential, from which the garrison is withdrawing.

But evidences of degeneration are, for the purposes of this enquiry, negative testimony; let us seek for something positive as a clue to ancestral shape and size.

The most puzzling feature seems to be the abrupt countermarch of the hairs upon the back of the *helix.* No anthropoid or other quadrumanous animal, so far as my limited observations extend, shows anything analogous. The arrangement is useless, is not ornamental, but is so persistent that one is driven to believe that its history, if decipherable, would throw light upon the condition of the organ in past times.

The theory which I propound upon this growth is submitted with extreme diffidence.

This countermarch is in its incipience simply a divergence or radiation of the lines of growth of the hair, such as is found upon all funnel-shaped hairy ears where the diameter increases outwards from a short tubular *concha* to a larger expansion. This radiation is found among the hairs on the back of the human ear, the growth starting spirally at the junction of the head and *concha,* and diverging outwards, some to the one side of Darwin's Point, some to the other.

The divergence is easily explained, but the subsequent convergence requires consideration. The convergence of the hairs, as the curl in the *helix* is reached, suggests (as other phenomena have already suggested) that this infolded rim is an atrophied feature, the most degenerate part of a degenerate organ. It would seem that this fold is all that survives of a subdiscoidal or funnel-shaped organ of considerable size and projection.

As in the course of ages this extension contracted and became folded back upon itself into the *helix* which we now know, the once divergent lines of growth upon its back would be crowded together as the lines of longitude upon a globe draw together after passing the equator. Or, taking the wrist to represent the *concha* and the extended thumb and fingers the lines of growth of the hairs upon the ancestral ear, partial closure of the hand bringing the five finger-tips into proximity will roughly illustrate the supposed phenomena of distortion.

That the distortion is greatest below Darwin's Point suggests that the ear has sustained its greatest loss of surface on that side; and this interpretation is in some sort supported by the fact that all, or most, Monkeys which have pointed ears show the point higher than we show our rudiment.

The great size of the ancestral ear may be inferred from the still considerable dimensions of its atrophied successor; and if the above explanation of the countermarching hairs is correct, the amount of their convergence argues a very considerable extent of ear at one time protruding beyond the present limits of the *helix*.

It has, I believe, been generally suspected that the line of of human descent runs somewhat wide of any living anthropoid, and in this view the phenomena of the ear agree.

WEDNESDAY, JUNE 9TH.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 9TH, 1897.

During the past year the usual ordinary meetings of the Society have been held, and have been well attended. The Photographic Section have met six times, The Council regrets to have to report that the Botanical and Microscopical Sections have not received that support which it was hoped members would give them. No officials of the Microscopical Section have therefore this year been nominated.

A communication has recently been received from the British Association saying that this Society has been admitted as one of its corresponding Societies. It is cousequently entitled to send a Delegate to the meetings of the Association, which Delegate becomes a member of the General Committee.

Notices of the more important papers published in our own Report will therefore be able to find a place in the Annual Report of the British Association; and will thus be brought to the notice "of other corresponding Societies and of members of the Association, and of workers in science throughout the world."

It is to be hoped that this may be an incentive to our members and others to prepare papers which may be worthy of such recognition

At the Annual Corgress of the S. E. Union of Scientific Societies, held at Tunbridge Wells on the 21st and 22nd of May, this Society was represented by the President Mr. J. P. Slingsby Roberts, Messrs D. E. Caush, E. T. Breed, and Edward Alloway Pankhurst.

One advantage that it is to be hoped may spring from this Union is the exchange of papers and lecturers between the different Societies affiliated.

In pursuance of this idea Mr. Pankhurst lectured before the Eastbourne Natural History Society on the 28th ult.

During the past year the Society has lost twelve members by death and resignation and has acquired nine new ones.

The record of the Excursions is as follows—

13th June, 1896,	Cowfold.
18th July, ,,	Leonardslee Park and Grounds, by kind permission of Sir E. G. Loder, Bart.
12th May, 1897,	Wivelsfield and Ditchling Common.

Brighton and Sussex Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 9TH JUNE, 1897.

Dr.

1897.	£	s.	d.
By Balance in the hands of the Treasurer, 14th June, 1896..	8	4	5
,, Annual Subscriptions and arrears to 1st October, 1896...	10	10	0
,, Annual Subscriptions to 1st October, 1897 ...	64	5	0
,, Entrance Fees..	3	0	0
,, Dividends on £100 $2\frac{3}{4}$ per cent. Consolidated Stock, one year to April, 1897...	2	15	0
	£88	14	5

	£	s.	d.
Balance in the hands of the Treasurer, 9th June, 1897..	7	12	1

There is a sum of £100 invested in $2\frac{3}{4}$ per cent. Consols in the names of the Treasurer and Secretaries as Trustees for the Society.

Cr.

1897.	£	s.	d.
To Books and Periodicals.	7	4	11
,, Bookbinding	1	0	0
,, Printing Annual Report and Abstract of Proceedings	13	10	0
,, Printing and Stationery, General	8	0	3
,, Postages, &c., General	7	10	10
,, Scientific Secretary, Honorarium for the current year...	10	0	0
,, Subscriptions to Societies	3	9	7
,, Clerk's salary (E. P. Golding)	2	2	0
,, Commission to Collector	2	17	9
,, Gratuities to Assistants at Museum	3	0	0
,, Expenses of Meetings	5	15	5
,, Botanical Section, Printing, Postage, and Incidental Expenses	1	11	11
,, Photographic Section, Stationery, Printing, Postage, and Exhibition Expenses	12	19	0
,, Fire Insurance Premium on Books.		18	0
,, Cheque Book		2	6
,, Expenses of Excursion and Secretaries' incidental expenses...	1	0	2
,, Balance in the hands of the Treasurer, 9th June, 1897	7	12	1
	£88	14	5

Audited with books and vouchers and found correct.

F. G. CLARK, F.C.A., *Hon. Auditor.*

June, 1897.

LIBRARIAN'S REPORT.

During the past year 162 books and periodicals have been borrowed from the Library. No purchases have been made, as the regular increase from exchanges and subscriptions to periodicals is beginning to crowd the shelves. The alteration of the premises cannot be expected to be complete in less than two years.

H. DAVEY, Jun.,
Honorary Librarian.

PHOTOGRAPHIC SECTION.

ANNUAL REPORT.

Chairman : Mr. W. Clarkson Wallis.

Committee : Messrs. J. P. Slingsby Roberts, Douglas E. Caush, W. W. Mitchell, W. H. Payne, E. J. Elgee, and C. B. Stoner.

Hon. Secretary : Mr. R. Chappel Ryan, 43, Compton Avenue.

Your Committee have to report that during the past year six sectional meetings have been held and the attendance has been fairly satisfactory. Of these two have been devoted to the Exhibition of Lantern Slides, viz. : the prize slides of "The Amateur Photographer" and "Photography" respectively. The remaining four comprised a meeting for discussion and mutual criticism of members' prints, a paper by Mr. A. Brooker Hastings P.S., on Lantern Slide Making; and Demonstrations of "Bromide Enlargements," by Dr. Manwaring Hooe, C.C.; "Development of Films," by Mr. W. Clarkson Wallis; and "Photomicrography," by Mr. D. E. Caush.

The past year has not been marked by any particular event besides the usual meetings and excursions. No competitions have been held, but one has been arranged for the coming session.

With regard to the "Photographic Survey," the Committee regret that no further progress has been made. The Sussex Archoloægical Society have been approached in the matter and the co-operation of the Section offered, the Committee believe, however, that there is a prospect of some more definite particulars in detail being shortly furnished, by which the work can proceed in uniformity with that carried on by other counties.

The thanks of the Society are due to the following gentlemen who have presented medals to be offered in competition, viz.: Messrs. J. E. Haslewood, J. Colbatch Clark (who jointly present a silver medal), J. P. Slingsby Roberts, D. E. Caush, W. W. Mitchell, W. H. Payne, and W. Clarkson Wallis (bronze medals).

R. C. RYAN,

Hon. Secretary Photo. Section.

MICROSCOPICAL SECTION.

ANNUAL REPORT.

The Section held one Committee Meeting on October 12th, at the Chairman's residence.

Owing to the difficulty in getting papers or lectures on any subject connected with Microscopy, the Section held no meetings, but supplied the Microscopes at the meeting of the Society held on April 17th.

W. W. MITCHELL, *Hon. Secretary.*

BOTANICAL SECTION.

ANNUAL REPORT.

Chairman : Mr. J. Lewis.

Committee : Messrs. H. Edmonds, B.Sc., B. Lomax, F.L.S., E. F. Salmon, and J. H. A. Jenner.

Secretary : Mr. T. Hilton.

Little has been done by this Section since the last Report, the only Excursion of a Botanical character was that of the

Society to Ditchling Common in the spring, which was well attended and appeared to give satisfaction to the Members.

The Herbarium has made considerable progress, the number of specimens having increased from about 900 to over 1,000 all mounted and named. Most of the common plants having now been collected, the number added each year will show a constant diminution. We have again a considerable contribution sent by Mr. Farr of plants from the Uckfield district—mostly Rubi—several of them being new records for Sussex. Among those added since last Report are the following :—

Fumaria confusa.
Silene conica (Striated Catchfly), Clymping Sands.
Sagina, ciliata, Chalk Downs.
Potamogeton acutifolius, Pevensey Level.
Scirpus carinatus, Amberley.
Carex extensa, Fishbourne.
Hypopithys multiflora, Stanmer Park.
Spartina stricta, Chichester Channel.
Spartina alterniflora, Chichester Channel.
Polypogon monspeliensis, Thorney Island.
Geranium Robertianum, b. modestum, Clymping Sands.
Erodium moschatum (Musky Storkbill).
Vicia, Bithynica.
Lathyrus, Aphaca.
Statice rariflora, Chichester Channel.

Mentha Puleguim, (Penny-royal) Chenopodium hybridum, Salicornia radicans, Rumex maritimus (Golden Dock), Rumex palustris, Southease.

Polygala ciliata, var. dunensis, of this plant Mr. Baker wrote in the Journal of Botany.

" Polygala ciliata, Lebel Forma.—A short time ago Mr. Hilton brought to the Natural History Museum, South Kensington, a very interesting Polygala which he had gathered on the Downs, near Brighton. The sepals are strongly ciliate, more so than in some specimens we have of the Gogmagog plant, but it does not quite agree with Lebel's original description (in Grenier and Godron, Fl. de France, i 195) of his P. ciliata. Two points of difference being, the racemes are often lateral ; (b.) the sepals taken as a whole (I say taken as a whole, because they are not always quite the same shape). We are fortunate in having in the Herbarium specimens from Lebel of his P. ciliata, and I notice the point he so emphasizes in his description, ' les grappes terminales et jamais laterales' is not quite borne out by his specimens, the racemes of which, though generally terminal, are not invariably so. The sepals of the Brighton plant are narrower than in the Lebel specimens—an important point—as he says, 'la largeur, des ailes l'en distinguent parfaitement,' so I think it must be referred to P. ciliata as a form. I notice P. ciliata, Lebel, non Linn, is the P. blepharoptera, of Borbas (Oest. Bot. Zeit. 1890, 177), which has got changed to ptepharoptera in Hallier and Wolfarth's edition Koch's Synopsis, 251, and that M. M. Rouy and Foucaud in their recently published work follow M. Cobiere in reducing *ciliata* to a variety of P. dunensis Dumortier. Since writing the above, I have received the following from Professor Chodat, who has kindly examined the plant: — 'This is a form of Polygala ciliata, auct. (P. vulgaris var. intermedia. ciliata mihi). The true P. ciliata, Lebel, has much broader wings and more slender shoots, but some forms, as P. dunensis, Dum. and P. dunensis Corbiere, agree in all parts with your plant. The characters however, shown by these varieties are but slight, and due only to the station, so you may call your plant, if you will hold P. ciliata, as a species, P. ciliata, Lebel, var. dunensis (Dum.) For me this plant is only one of the numerous varieties of P. vulgaris, its name would be (P. vulgaris var. intermedia) ciliata, forma alis acutis, caulibus minus, tenuioribus, etc. (vide Monogr. Polyg. 452, 82 (tab xxxiii. fig. 4)."

It may interest the Members who have not already been informed to know that the Brighton Museum has been enriched by a very large collection of plants gathered by the late Mr. Roper, F.L.S., of Eastbourne, and bequeathed by him to the Corporation. Many rare Sussex plants are well represented. Of course they are open for inspection and reference to any inhabitant.

METEOROLOGICAL REPORT.

Table I.—Record of Possible and Actual Sunshine in Brighton.

Month.	Possible Sunshine.	Actual Sunshine.	Actual Sunshine percentage of possible duration	Average Sunshine in the years 1890-95.	Sunless Days.	
					Average for six years 1890-95.	Year 1896-97.
July, 1896	489·8	254·67	52	205·99	1	1
August	442·1	185·68	42	203·90	1	2
September	376·7	116·83	31	171·99	2	5
October	326·3	133·82	41	119·12	6	5
November	262·9	107·77	41	67·73	10	8
December	233·3	41·99	18	56·82	13	10
January, 1897 ...	262·5	52·50	20	62·64	10	14
February	281·5	36·58	13	97·13	6	15
March	366·1	131·89	36	151·63	4	1
April	408·1	155·09	38	193·80	3	6
May	480·2	266·91	55	242·26	1	0
June	482·4	198·33	41	223·66	1	1
Total for the Year	4411·9	1682·06	35	1796·67	58	68

TABLE II.

Summary of Meteorological Observations at the Corporation Station in the Old Steine.

Month.		Temperature of Air during Month. Highest.	Lowest.	Mean.	Relative Humidity Saturation=100.	Wind. Number of days of N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	Rainfall. No. of days on which Rain fell	Amount collected in inches.
July,	1896	78·0	48·4	63·3	72	4	2	0	3	5	8	4	4	1	7	1·26
	1877-96	85·0	45·0	61·5		1·5	3·4	0·7	2·1	1·9	12·6	4·2	4·1	0·3	13	2·61
August,	1896	77·6	46·0	61·2	72	6	5	2	0	2	6	3	4	3	17	1·21
	1877-96	82·2	44·3	61·6		2·3	4·3	1·4	2·1	1·2	9·8	5·0	4·2	0·6	13	2·52
September,	1896	72·0	42·0	59·2	78	2	3	0	0	3	6	5	8	3	23	6·43
	1877-96	83·2	35·9	58·0		3·5	6·8	1·1	1·9	1·4	6·8	3·0	4·7	0·6	12	2·70
October,	1896	65·0	33·6	49·6	80	5	8	0	0	0	7	2	4	5	22	5·03
	1877-96	73·0	29·5	51·1		4·1	7·0	1·4	1·8	1·5	6·4	2·8	5·1	0·8	16	4·24
November,	1896	60·2	30·2	42·7	80	5	8	4	0	1	0	2	3	7	9	1·57
	1877 96	63·5	17·9	45 8		3·0	6·0	1·5	1·5	2·6	6·8	3·2	4·5	0·8	16	3·40
December,	1896	50·0	26·0	41·3	87	6	4	1	1	3	7	2	3	4	22	4·83
	1877-96	69·4	17·6	41·4		3·7	6·1	1·2	1·6	1·8	7·4	3 6	5·1	0·5	15	2·64
January,	1897	50·0	23·0	38·2	87	8	9	1	2	2	3	0	5	1	21	2·97
	1877-96	63·6	12·0	39·1		3·7	6·1	1·8	2·5	2·2	6·6	2·5	5·1	0·3	16	2·75
February,	1897	57·6	30·2	44·0	90	3	1	6	1	1	3	4	4	5	17	3·10
	1877-96	58·0	17·4	40·8		2·8	5 7	2·0	2·4	1·8	5·2	3·5	4·0	0·5	13	1·96
March,	1897	56·4	32 0	46·0	82	0	2	1	3	5	4	10	3	3	20	4·39
	1877-96	65·0	20·2	42·2		2·8	7·7	1·8	2·1	1·3	6·3	3·2	5·0	0 7	13	1·81
April,	1897	65·8	31·8	47·7	75	5	4	3	3	4	4	3	2	2	16	2·17
	1877 96	75·4	28·0	46·7		2·7	10·3	1·6	2·4	1·6	5·8	2·3	2·9	0·2	11	1·81
May,	1897	74·6	35·0	53·2	68	7	7	0	0	2	8	0	3	4	12	1·89
	1877-96	78·1	30·0	53·1		3·0	8·6	1·1	3·1	2·3	7·9	1·5	3 0	0·2	10	1·64
June,	1897	78·2	46·0	60·8	78	2	6	1	4	2	5	5	1	4	11	3·33
	1877 96	85·0	37·0	59·3		2·8	6·5	1·2	2·3	1·6	9·3	2·6	3·2	0·4	11	1·79

TABLE III.

Month.		Temperature of Air during Month. Highest.	Lowest.	Mean.	Mean relative Humidity. Saturation=100.	Wind. Number of days of N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	Rainfall. No. of days on which Rainfell.	Amount collected in inches.
January,	Brighton	51·2	31·0	42·1	89	7	6	2	0	2	3	3	3	5	13	1·12
	Crowborough ...	47·5	30·0	38·6	87	5	3	6	4	1	3	0	9	0	12	1·64
February,	Brighton	58·0	26·0	41·4	87	4	3	6	3	1	2	3	2	5	7	0·26
	Crowborough ...	54·0	23·8	38·9	88	0	11	2	2	0	7	3	4	0	7	0·36
March,	Brighton	63·0	33·6	46·5	85	2	2	1	2	4	2	12	3	3	24	2·92
	Crowborough ...	65·0	31·4	44·1	82	3	2	1	3	0	12	3	7	0	20	3·24
April,	Brighton	60·8	33·6	49·7	75	7	3	1	1	1	5	5	5	2	10	0·55
	Crowborough ...	61·0	30·0	46·9	72	6	3	1	0	0	4	2	14	0	9	0·92
May,	Brighton	75·0	35·4	55·1	66	0	15	5	1	2	2	1	2	3	4	0·32
	Crowborough ..	74·4	33·0	52·4	66	0	25	1	1	0	0	0	4	0	4	0·39
June,	Brighton	80·4	45·0	62·2	75	6	2	1	2	4	6	5	0	4	11	2·34
	Crowborough ...	79·9	47·2	60·3	63	2	6	0	4	3	6	4	5	0	8	3·45
July,	Brighton	78·0	48·4	63·3	72	4	2	0	3	5	8	4	4	1	7	1·26
	Crowborough ...	82·8	46·2	62·3	65	3	2	2	2	7	7	5	3	0	7	1·11
August,	Brighton	77·6	46·0	61·2	72	6	5	2	0	2	6	4	4	3	17	1·21
	Crowborough ...	72·0	43·0	58·0	76	5	9	2	0	1	6	1	7	0	14	2·11
September,	Brighton	72·0	42·0	59·2	78	2	3	0	0	3	6	5	8	3	23	6·43
	Crowborough ...	71·1	42·0	55·4	85	1	2	0	1	3	13	4	6	0	24	8·01
October,	Brighton	65·0	33·6	49·6	80	5	8	0	0	0	7	2	4	5	22	5·03
	Crowborough ...	63·5	32·8	45·5	84	3	6	1	0	1	10	4	6	0	22	5·64
November,	Brighton	60·2	30·2	42·7	80	5	8	4	0	1	0	2	3	7	9	1·57
	Crowborough ...	50·0	25·6	39·3	84	5	9	8	0	0	2	2	4	0	9	1·73
December,	Brighton	50·0	26·0	41·3	87	6	4	1	1	3	7	2	3	4	22	4·83
	Crowborough ...	47·7	22·8	37·9	91	7	3	0	5	1	9	2	4	0	22	4·95
Entire Year,	Brighton	80·4	26·0	51·2	78	59	61	18	13	28	54	47	41	45	169	27·84
	Crowborough ...	82·8	22·8	48·3	78	40	81	24	22	17	79	30	73	—	158	33·55

Table I. gives the amount of sunshine in Brighton for each month, the total amount being 35 per cent. of that possible, somewhat lower than the average of the previous six years.

Table II. gives the chief meteorological data for each month, July, 1896—June, 1897, compared with the corresponding averages for the nineteen years, 1877-96. July was drier and on the whole warmer than the average. August again showed deficient rainfall, its temperature being about the average. September had 6·43 inches of rainfall, as compared with an average of 2·70 inches. In October the temperature was lower and the rainfall rather higher than usual. November was colder and drier than the average, while in December the temperature was an average one, and the rainfall excessive. The first six months of the present year have all been characterized by excessive rainfall, the excess being greatest in March, in which month 4·39 inches fell. About this time a "Bourne" appeared in the Lewes Road valley near the bottom of the slope leading from Falmer to Newmarket Inn. This stretched across the road forming a lake on its south-eastern side and then a stream running several hundred yards. The occurrence of these "Bournes" is of importance as indicating an overcharged condition of the neighbouring Downs. They only occur after very protracted rains. In former years similar "Bournes" have occurred in the Patcham valley, the water running down it towards Preston. Similar "Bournes" are recorded this spring in the Caterham valley.

The relationship between weather and health is a close and intimate one. Speaking broadly a mild winter and a cool summer mean an immense saving of life, or perhaps to speak more accurately, one should say postponement of death. The object of medicine, preventive and curative, is to postpone death, and its efforts are frequently frustrated by unfavourable meteorological conditions. The statement that a mild winter means a great saving of life is contradictory to the old proverb that "a green Yule-tide means a fat churchyard." It is true, notwithstanding this. A regular study of the obituary column of *The Times,* demonstrates its truth, but exact statistical evidence could be adduced if necessary. It is none the less true because the excessive deaths very often coincide with the thaw following on protracted frost.

A wet cool summer, means in towns, a very marked reduction in the annual death toll demanded by infantile diarrhœa. The deaths from this disease occur chiefly in infants under one year of age. They occur almost solely in hand-fed children. It is reasonable to assume, therefore, that bad methods of feeding have much to do with this excessive mortality from diarrhœa in all towns. On this supposition, in Brighton, we distribute each summer about 10,000 circulars, stating the precautionary measures as to food, etc., which are desirable. But it remains true, that with identical conditions as to food, if the summer is cool and wet, the diarrhœa mortality is trifling, while if the temperature of the air and soil is excessive, the diarrhœa mortality rapidly becomes serious. So far as the soil temperature is concerned, the critical point appears to be 56° F at a depth of 4 feet. When this point is passed, diarrhœa becomes prevalent. The same rule does not hold good in rural districts, and if as is probable the micro-organism causing Epidemic Diarrhœa has its home in the soil, it follows that the soil of towns is more favourable to its multiplication than that of rural districts.

Table III. gives an interesting comparison of the chief weather conditions, month by month, during 1896, in Brighton and Crowborough. It will be noted that the relative humidity of the air was greater in Brighton during five out of the seven first months in the year, but markedly less than in Crowborough during the last five months of the year. The mean temperature was higher in Brighton during each month, the mean temperature for the whole year being 2·9 higher in Brighton than in Crowborough. The extremes were also less violent in Brighton, the absolute minima being 26·0 and 22·8, and the absolute maxima 80·4 and 82·8 in Brighton and Crowborough respectively. In respect of wind, it will be noticed that a calm occurred on 45 days in Brighton, whereas this heading does not appear in the Crowborough returns. Rain fell (*i.e.*, an amount equal to or exceeding ·01 inch) on more days in Brighton than in Crowborough, but the total amount collected was greater in Crowborough than in Brighton by 5·71 inches.

ARTHUR NEWSHOLME, M.R.C.P.,

Medical Officer of Health for Brighton.

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Dr. HARRISON, seconded by Dr. MORGAN, and resolved—

> "That the Report of the Council, the Treasurer's statement, the Librarian's Report, and the Reports of the Committees of the several Sections now brought in be received, adopted, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Sir J. Ewart, F.R.C.P., Mr. J. E. Haselwood, Mr. G. de Paris, Dr. W. A. Hollis, F.R.C.P., Dr. A. Newsholme, Mr. D. E. Caush, and Mr. E. J. Petitfourt, B.A., F.C.P."

And that in pursuance of Rule 42 the Council had appointed the following gentleman to be Honorary Auditor—

> "Mr. F. G. Clark, F.C.A."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, be members of the Council—

> "*Photographic Section :* Mr. W. C. Wallis ; *Botanical Section :* Mr. J. Lewis ; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be members of the Council :—*Photographic Section* : Mr. R. C. Ryan ; *Botanical Section* : Mr. T. Hilton."

It was proposed by Mr. HASELWOOD, seconded by Dr. HARRISON, and resolved—

> "That the following gentlemen be officers of the Society for the ensuing year :—*President :* Mr. J. P. Slingsby Roberts ; *Ordinary members of Council* : Dr. R. Black, Mr. E. A. T. Breed, Mr. W. W. Mitchell, Dr. Morgan, Mr. Payne, and Mr. W. J. Stephens, L.R.C.P., *Honorary Treasurer* : Dr. E. McKellar, J.P. ; *Honorary Librarian* : Mr. H. Davey, jun. ; *Honorary Curator :* Mr. B. Lomax, F.L.S. *Honorary Secretaries* : Mr. Edward Alloway Pankhurst, 12, Clifton Road, Mr. J. Colbatch Clark, 64, Middle Street ; ***Assistant Honorary Secretary*** : Mr. H. Cane."

It was proposed by Mr. Iles, seconded by Dr. Harrison and resolved—

"That the sincere thanks of the Society be given to the Vice-Presidents, Council, Honorary Librarian, Honorary Treasurer, Honorary Auditors, Honorary Curator, and Honorary Secretaries for their services during the past year."

It was proposed by Mr. Petitfourt, seconded by Mr. Haselwood, and resolved—

"That the sincere thanks of the Society be given to Mr. Petitfourt for his attention to the interests of the Society as itsPresident during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* members of the Society : —

British Association, Burlington House, Piccadilly.
Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical and Natural History Club.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club and Archæological Society.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institute, Washington, U.S.A.
South-Eastern Union of Scientific Societies.
South London Microscopical and Natural History Club.
Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Sussex Natural History and Philosophical Society.

1897.

N.B.—Members are particularly requested to notify any change of address at once to Mr. J. C. Clark, 64, Middle Street, Brighton.

When not otherwise stated in the following List the address is in Brighton.

ORDINARY MEMBERS.

Attree, G. F., 8, Hanover Crescent.
Ashton, C. S., 27, Clifton Terrace.
Abbey, Henry, Fair Lee Villa, Kemp Town.

Burchell, E., L.R.C.P., 5, Waterloo Place.
Brown, J. H., 6, Cambridge Road, Hove.
Badcock, Lewis C., M.D., M.R.C.S., 10, Buckingham Place.
Boxall, W. Percival, J.P., Belle Vue Hall, Kemp Town.
Balean, H., 15, Alexandra Villas.
Booth, E., 70, East Street.
Baber, E. C., M.B., L.R.C.P., 97, Western Road.
Burrows, W. Seymour, B.A., M.R.C.S., 62, Old Steine.
Billing, T., 86, King's Road.
Bedford, E. J., Eastbourne.
Black, R., M.D., 16, Pavilion Parade.
Bevan, Bertrand, Withdean.
Breed, E. A. T., 72, Grand Parade.

Clark, John Colbatch, 64, Middle Street.
Cox, A. H., J.P., 35, Wellington Road.
Cane, H., 64, Middle Street.
Cowley, E. R. Palace Place.
Catt, B. W., 44, Church Street.
Caush, D. E., L.D.S., 63, Grand Parade.
Clark, F. G., 56, Ship Street.
Cowell, Samuel, 143, North Street.
Couchman, J. E., Down House, Hurstpierpoint.

Davidson, Capt., 1, Mills' Terrace, Hove.
Davey, Henry, J.P., 82, Grand Parade.
Day, Rev. H. G., M.A., 55, Denmark Villas, Hove.
Denman, Samuel, 26, Queen's Road.
Dodd, A. H., L.R.C.P., M.R.C.S., 14, Goldstone Villas, Hove.
Davey, Henry, Junr., 82, Grand Parade.
Deedes, Rev. Canon, 2, Clifton Terrace.
Douglas, F., B.Sc., 14, Clifton Terrace.

Edmonds, H., B.Sc., Municipal School of Art, Grand Parade.
Ewart, Sir J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Montpelier Hall.
Earp, F., 37, Upper Rock Gardens.
Elgee, E., Mountjoy, Preston Road.

Fletcher, W. H. B., Fair Lawn House, Worthing.

Glaisyer, Thos., 96, London Road.
Grove, Edmund, Norlington, Preston.
Griffith, Arthur, 15, Buckingham Place.

Haselwood, J. E., 3, Richmond Terrace.
Hurst, H., Ship Street.
Hobbs, James, 62, North Street.
Hack, D., Fir Croft, Withdean.
Hollis, W. Ainslie, M.D., F.R.C.P., 8, Cambridge Road, Hove.
Holder, J. J., 8, Lorne Villas.
Haynes, J. L., 49, Shaftesbury Road.
Henriques, A. G., F.G.S., 9, Adelaide Crescent, Hove.
Harrison, Walter, D.M.D., 6, Brunswick Place, Hove.
Hodgson, G. G., M.R.C.S., 35, Montpelier Road.
Howlett, J. W., 4, Brunswick Place, Hove.
Harding, N., Wynnstay, Stanford Avenue.
Horniman, F. J., M.P., Surrey Mansion, Eastern Terrace.
Hardcastle, S. B., 71, East Street.
Hilton, Thomas, 16, Kensington Place.
Haines, W. H., 24, Hampton Place.

Iles, R. P., 8, Goldsmid Road.
Infield, H. J., 130, North Street.
Isaac, T. W. Player, 114, Marine Parade.

Johnson, J., 24, Norfolk Square.
Jennings, A. O., LL.B., 50, Brunswick Place, Hove.
Jenner, J. H. A., East Street, Lewes.
Johnston, J., 12, Bond Street.

Kilmister, Charles, F.R.H.S., 56, Buckingham Road.
Knight, John J., 33, Duke Street.

Lomax, Benjamin, F.L.S., C.E., Public Library.
Langton, Herbert, M.R.C.S., 11, Marlborough Place.
Loder, Gerald W. E., M.P., Abinger House, Brighton, and 48, Cadogan Square, London.
Lewis, J., 37, Preston Road.
Law, J., The Wallands, Lewes.
Lewis, J., C.E., F.S.A., Cromwell Road, Hove.
Lamsback, L. P., 66, Grand Parade.

Merrifield, F., 24, Vernon Terrace.
Mitchell, W. W., 66, Preston Road.
McKellar, Edward, M.D., J.P., Woodleigh, Preston.
Morgan, G., L.R.C.P., M.R.C.S., 45, Old Steine.
Martin, C., 42, York Road, Hove.
Maguire, E. C., 41, Grand Parade.
Muston, S. H., 54, Western Road.

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Norris, G. L., 3, Cambridge Road, Hove.
Newmarch, Major-General, 6, Norfolk Terrace.
Nicholson, W. E., Lewes.

Pankhurst, E. A., 12, Clifton Road.
Puttick, W., The Ferns, Woodlands Road, Hassocks.
Petitfourt, E. J., B.A., F.C.P., 8, Sudeley Street.
Paris, George de, 5, Denmark Terrace.
Prince, H., 146, North Street.
Pears, H. Kilby, Junr., 16, Western Road, Hove.
Pugh, Rev. Charles, 107, Marine Parade.
Payne, W. H., 6, Springfield Road.
Penney, S. R., Highcroft, Dyke Road.
Perry, Aylett W., Annesly Hall, Dyke Road.

Rutter, J., M.D., M.R.C.S., 142, Western Road.
Ross, Douglas M., M.B., M.R.C.S., 9, Pavilion Parade.
Rose, T., Clarence Hotel, North Street.
Roberts, J. P. Slingsby, 3, Powis Villas.
Rodgers, J. C., 7, Leune Strasse, Coblenz.
Read, S., 12, Old Steine.
Redman, J. H., 61, Old Steine.
Ryan, R. C., 43, Compton Avenue.

Smith, T., 85, Church Road, Hove.
Smith, W., 6, Powis Grove.
Savage, W. W., 109, St. James's Street.
Stephens, W. J., L.R.C.P., 9, Old Steine.
Salmon, E. F., 30, Western Road, Hove.
Stoner, C. Berrington, D.D.S., Philadelph., L.D.S., Rio Lodge, 55, Western Road, Hove.
Sloman, F., 18, Montpelier Road.
Skey, Edward, 4, Hampton Terrace.
Stoner, Harold, L.D.S., 18, Regency Square.

Thomas, J., 28, Old Steine.
Treutler, W. J., M.D., 8, Goldstone Villas, Hove.
Tanner, J. Slingsby, 104b, Mount Street, Berkeley Square, London.
Talbot, Hugo, 82, Buckingham Road.

Uhthoff, J. C., M.D., F.R.C.S., M.R.C.P., Wavertree House, Furze Hill.
Upton, Alfred, L.R.C.P., M.R.C.S., Rio Lodge, 55, Western Road, Hove.

Verrall, Henry, 26, Gloucester Place.

Willett, Henry, F.G.S., Arnold House, Montpelier Terrace.
Winter, J. N., M.R.C.S., 28, Montpelier Road.
Wood, J., 21, Old Steine.
Williams, H. M., LL.B., 17, Middle Street.
Wallis, W. C., 15, Market Street.
Wilkinson, T., 170, North Street.
Wood, Frederick, 12, Lewes Crescent, Kemp Town.
Walter, John, 13a, Dyke Road.
Whittle, E. G., M.D., F.R.C.S., 9, Regency Square.
Wells, Isaac, 4, North Street.
Woodruff, G. B., 24, Second Avenue, Hove.
Whytock, E., 36, Western Road.
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Webling, A. H., Trinity House, Hampstead Road, Preston Park.
Wightman, G. J., Wallands Park, Lewes.
Wedd, H., St. Valerie, Port Hall Road, Prestonville.
Weston, S. J., 24, Church Road, Hove.
Williams, A. Stanley, 17, Middle Street.

Associate.

Thoms, H. S., Museum, Church Street.

LADY MEMBERS.

Brinton, Mrs. Hannah, 40, King's Road.
Bagley, Miss, Heidelberg House, 38, Medina Villas, Hove.

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Cameron, Miss E., 25, Victoria Street.

Graham, Miss, 42, Tisbury Road, Hove.

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Rich, Miss, 34, Sussex Square.

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Farr, E. H., Uckfield.

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Mitten, W., Hurstpierpoint, Sussex.

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