THURSDAY, APRIL 12, 1894.

THE FUTURE OF CIVILISATION.

Social Evolution. By Benjamin Kidd. (London: Macmillan and Co., 1894.)

THIS is a very remarkable book; and one which must have a good effect in preparing students of sociology for the inevitable changes which are rapidly coming upon us. It is thoroughly scientific in its methods, inasmuch as it is based upon the theory of evolution; yet it is altogether original in its treatment of the subject, and gives us a theory of social progress which is in many respects very different from that generally accepted by evolutionists. This theory appears on the whole to be a sound one, although the author has fallen into certain errors which will be pointed out. These, however, do not materially affect the general theory.

In his first chapter, "The Outlook," the author gives a sketch of the progress of opinion during the present century, showing that the old political parties, whose watchwords are almost confined to the completion of the programme of political equality, find that the world is rapidly moving beyond them. As he well puts it:—

"One of the most striking and significant signs of the times is the spectacle of Demos, with these new battle-cries ringing in his ears, gradually emerging from the long silence of social and political serfdom. Not now does he come with the violence of revolution foredoomed to failure, but with the slow majestic progress which marks a natural evolution. He is no longer unwashed and illiterate, for we have universal education. He is no longer muzzled and without political power, for we have universal suffrage. With his advent socialism has ceased to be a philanthropic sentiment merely. . . . The advent of Demos is the natural result of a long series of concessions, beginning in England with the passing of the Factory Acts, and the legislation of combination, and leading gradually up to the avowedly socialistic legislation for which the times appear to be ripening."

A forcible sketch is given of the growing power of capitalism on the one side, and of socialism on the other; and then we come to what forms the keynote of the work, in the declaration that religion is not, as the scientific urge, a mere system of superstition and error, a clog on the wheels of progress, the enemy of science and enlightenment, and, as Grant Allen has described it, a mere "grotesque fungoid growth"; but, on the contrary, that it has been one of the most important agencies in social development, and is closely bound up with that portion of our nature to which all recent social advance is due, and which will inevitably decide the course of our future progress. Of course this has nothing to do with dogmatic religion, but only with those great ethical principles which have always formed part of religious teaching, and whose influence is in great part due to it.

The conditions of human progress form the subject of the next chapter, and it is laid down that no progress is possible without some form of selection.

"It may appear strange, but it is strictly true, that if each of us were allowed by the conditions of life to follow his own inclinations, the average of one generation would have no tendency whatever to rise beyond the average of the preceding one."

But the author goes further than this. He fully accepts Weismann's view of the non-inheritance of acquired characters, and is under the mistaken impression that the theory of *panmixia* leads to continuous and unlimited degeneration. Many writers have pointed out that this is an error. The amount of the degeneration thus produced would be limited to that of the average of those *born* during the preceding generations in place of the average of those that had *survived*. As Prof. Lloyd Morgan puts it, the survival-mean would fall back to the birth-mean. This error is of especial importance because it is used as an argument against the possibility of any form of socialism which removes the individual struggle for existence.

The chapter which follows bears the startling heading—"There is no Rational Sanction for the Conditions of Progress"; by which is meant that at any moment the great bulk of the people have no interest in preserving the conditions that are essential to it, but rather, in altering them. The author urges that, in our existing societies, where we base on the fabric of political equality the most obvious social and material inequality, the lower classes of our population have no sanction from their reason for maintaining existing conditions. In a question of this kind reason has nothing to do with any existence but the present, which, it insists, it is our duty to ourselves to make the most of.

"The prevailing conditions of existence can, therefore, have no such sanction for large masses of the people in societies where life is a long onerous rivalry, where in the nature of things it is impossible for all to attain to success, and where the many work and suffer and only the few have leisure and ease. Regard it how we may, the conclusion seems inevitable, that, to the great masses of the people, the so-called lower classes, in the advanced civilisations of to-day, the conditions under which they live and work are still without any rational sanction."

We now come to the question of the causes of the evolution of society and of modern civilisation, which are found, not in the growth of intellect and of science, but in the continuous action of religious beliefs. The argument by which this conclusion is reached is ingenious, elaborate, and I think quite sound, but is difficult to condense. Societies and civilisations have prevailed in the struggle for existence in proportion as they have been efficiently organised, and this organisation has always rested on some form of religious sanction. The doctrines of caste, of class, of the divine right of kings, of subjection to popes and bishops, have been powerful in welding together tribes and peoples, have checked the supremacy of brute force, and have been the most efficient agency in that subordination of the many to the few which was essential to the production and accumulation of wealth, to the growth of the arts, and to the firm establishment of that national unity which is the most important factor in the growth of civilisation.

This was its function in the early development of European civilisation, but during the last two or three centuries its influence has been exerted in a different manner, which has had even more important results. As nations became more advanced

in education and the arts, and a considerable middle class arose whose interests were opposed to those of the warrior caste and to constant war and bloodshed, the ethical side of all religious teaching began to have more influence, and ideas of justice and mercy, and of the inherent rights of man independent of class or caste, obtained for the first time some real effect throughout all ranks of society. Hence arose that gradual amelioration in our punishments, that recognition of human rights in even the lowest classes, that love of equal justice for all men, which has, little by little, permeated all civilised nations; and which has culminated during the present century in the abolition of slavery and of class and religious privileges; in general education, and in the grant of almost universal suffrage. This long process of social evolution is thus briefly summarised by our author:—

"Throughout the history of the Western peoples there is one central fact which underlies all the shifting scenes which move across the pages of the historian. The political history of the centuries so far may be summed up in a single sentence: it is the story of the political and social enfranchisement of the masses of the people hitherto universally excluded from participation in the rivalry of existence on terms of equality. This change, it is seen, is being accomplished against the most prolonged and determined resistance at many points and under innumerable forms, of the power-holding classes which obtained under an earlier constitution of society the influence which they have hitherto, to a large extent, although in gradually diminishing measure, continued to enjoy. The point at which the process tends to culminate is a condition of society in which the whole mass of the excluded people will be at last brought into the rivalry of existence on a footing of equality of opportunity."

He points out the immense significance of this process of development, which is absolutely unique in the history of the race; and that its whole tendency is, not to suspend the rivalry of life, but to raise it to the highest possible degree of efficiency as a cause of progress. This progress towards equalisation of the conditions of life is in no sense due to an intellectual movement. From the point of view of the power-holding classes the conception of the native equality of men is essentially irrational, besides being wholly opposed to what they have always conceived to be their interests. As classes they have always opposed any concessions to the masses as being destructive of society, and had not the softening of character due to ethical teaching and impulse permeated their own organisation, thus taking heart and unanimity out of their opposition, each successive concession would never have been made. The whole movement is therefore due to the all-pervading influence in our civilisation of that ever-growing fund of altruism, that development of humanitarian feelings, that deepening sense of justice, which, in the author's opinion, is "the direct and peculiar product of the religious system on which our civilisation is founded."

There is one difficulty here with which the author fails to grapple. His fundamental doctrine is that all human progress is due to selection in the struggle for existence, whether that struggle acts most severely upon individuals or upon communities. But it is not shown *how* the rude struggles of the two thousand years terminating in the sixteenth century could have had any tendency to increase and develop these altruistic and ethical sentiments. During the ages when might was right, when violence, cruelty, and rapine held sway over Europe, how were the mild, the true, the humane and the just so constantly preserved in the struggle, as to steadily increase and ultimately permeate all society as they do now? It is pointed out that neither in Greece nor in Rome, at the period of their greatest intellectual splendour, was there any such development of these altruistic and higher ethical sentiments. The mere *teaching* of their principles could not have created the sentiments themselves without selection, and selection in this case seems altogether absent. The natural possessors of such sentiments were usually buried in religious houses, and, as a rule, left no descendants. All selection seems rather to have tended to the extermination of the possessors of humane and altruistic sentiments, not to their continuous preservation and increase. Yet nothing is more certain than that they *do* now prevail to an extent never before known, and if they have not been developed by selection they must have been inherent in the race, developed perhaps at some earlier period, and have lain dormant till a more peaceful and more intellectual epoch called for their manifestation.

Though not a socialist, Mr. Kidd goes so far that, by the upholders of the present system, he will be thought hardly less dangerous an innovator. The whole drift and burthen of his work is, that we are inevitably moving towards a system of society in which, not only will all men be politically equal, but all will exist under conditions of *equal social opportunities*. Again and again he recurs to this point. He speaks of "the movement which is tending to ultimately bring all the people into the rivalry of life on conditions of equality." He recognises that this means that the position of the lower classes will be raised "*at the expense of the wealthier classes*," and that this is "a *conditio sine quâ non* of any measure that carries us a step forward in our social development." And again, in his concluding chapter, he thus speaks of this inevitable social movement:—

"The practical consequence is of great significance. It is, that the development in which the excluded masses of the people are being brought into the competition of life on a footing of equality of opportunity is proceeding, and will apparently continue to proceed in Great Britain, not by the violent stages of revolution, but as a gradual and orderly process of social change. The power-holding classes are in retreat before the people; but the retreat on the one side is orderly and unbroken, while the advance on the other is the steady, unhastening, onward movement of a party conscious of the strength and rectitude of its cause, and in no doubt as to the final issue."

Although thus clear as to the nature and final result of the movement now in progress towards securing for all men "equality of opportunity in the rivalry of life," Mr. Kidd nowhere explains what that term really means, and how complete is the revolution that it implies. It is clear, in the first place, that there can be no equality of opportunity so long as a limited class remains in possession of the land on and by which all must live, and the whole inherent value of which is the creation of society. The resumption of the land of the country by the community is therefore the first essential to "equality of opportunity." Again, hereditary wealth is equally op-

posed to the principle, since it gives to a class the power to live permanently at the expense of the workers. In like manner, those whose parents can give their children a better education, and supply them with the means of a good start in life, have greater opportunities than have the children of the poor. Equality of opportunity demands, therefore, in the first place the same means of education for all, and, afterwards, a sufficient endowment to give every young person an equally good start in life. It will thus be seen that the principle of "equality of opportunity in the rivalry of life" goes very far indeed, and it will be judged by many to involve as drastic, and as much to be dreaded, a change as socialism itself. It differs from socialism, however, inasmuch as it will leave rivalry and competition, not only unchecked but even increased in intensity, and in order to avoid the corresponding increase of some of the evils which result from our comparatively limited competition, society will probably, *pari passu* with this development, so organise itself that every community will form a congeries of co-operative societies by which all will benefit, thus bringing about a form of voluntary municipal socialism.

This great principle of "equality of opportunities," to which Mr. Kidd's inquiry has led him, has been already fully set forth and advocated by a school of Belgian economists, and is worked out in detail by Agathon de Potter in his "Économie Sociale," published at Brussels in 1874. A similar principle obtains in the scheme of Dr. Hertzka, as explained in his interesting work, "Freeland," and now in course of experimental realisation.

Many other points of interest are discussed by Mr. Kidd, and will well repay careful study. Among these is his examination of the general belief as to the great intellectual inferiority of most savages, on which question he arrives at conclusions opposed to the views of most anthropologists. The chapter headed "Human Evolution is not primarily Intellectual" is full of original and interesting views, though mingled with details that are of doubtful accuracy. Sufficient, however, has been said to show that we have here the work of a very able thinker who deals with the fundamental problems of civilisation and progress in a far more hopeful manner than does another recent author, also of great ability—Mr. Pearson. The two following extracts from the concluding paragraph of Mr. Kidd's volume will serve to exhibit the general result of his inquiry:—

"The movement which is uplifting the people—necessarily to a large extent at the expense of those above them—is but the final result of a long process of organic development. All anticipations and forebodings as to the future of the incoming democracy, founded upon comparisons with the past, are unreliable or worthless. For the world has never before witnessed a democracy of the kind that is now slowly assuming supreme power among the Western peoples." . . .

"There are many who speak of the new ruler of nations as if he were the same idle Demos whose ears the dishonest courtiers have tickled from time immemorial. It is not so. Even those who attempt to lead him do not rightly apprehend the nature of his strength. They do not perceive that his arrival is the crowning result of an ethical movement in which qualities and attributes which we have all been taught to regard as the very highest of which human nature is capable, find the highest expression they have ever reached in the history of the race."

Every true reformer, every earnest student of society, every believer in human progress, will cordially welcome such conclusions, founded as they are upon a careful study of history, enlightened by a thorough appreciation of the theory of evolution and the principle of natural selection.

ALFRED R. WALLACE.

ESSAYS IN HISTORICAL CHEMISTRY.

Essays in Historical Chemistry. By T. E. Thorpe, Ph.D., B.Sc., Sc.D., F.R.S. Pp. vii.; 381. (Macmillan and Co., 1894.)

A REVIEWER is not bound to read the whole of the book which he reviews. I opened this book with the half-formed intention of practising the art of judicious skipping; but I have been obliged to read it all. I fancy that most people who take up the book, if they have some little acquaintance with chemistry will not care to put it down till they have read it through; and that those who dip into it, knowing no chemistry, will determine to become more familiar with this, the most fascinating and the most human of the sciences.

"This book consists mainly of lectures and addresses given at various times, and to audiences of very different type, during the last eighteen or twenty years. . . . The book has no pretensions to be considered a history of chemistry, even of the time over which its narratives extend."

These sentences, from the preface, sufficiently define the aim and scope of Prof. Thorpe's essays. Accounts are given of the lives and labours of Boyle, Priestley, Scheele, Cavendish, Lavoisier, Faraday, Graham, Wöhler, Dumas, and Mendeléeff; there is also an essay on "Priestley, Cavendish, Lavoisier, and *La Révolution Chimique*"; and another on "The Rise and Development of Synthetical Chemistry." The form of the book—a collection of essays written at different times—serves admirably to keep before the reader the manifoldness and the diversity of chemistry; for chemistry is a branch of natural science whose immediate object and scope change much from time to time. The characters and careers of the men whose lives are sketched in these essays were nearly as different as are the aspects of the science to which they were all devoted. But as the one aim of chemistry is to bring the mind into actual contact with certain classes of natural occurrences, so the one aim of Boyle, and Priestley, and Faraday, and Lavoisier, and the other students of nature about whom Dr. Thorpe has written, was, as far as in them lay, to "know the soul of nature, and see things as they are." There is Priestley, the brilliant discoverer, the teacher of Latin, Greek, Hebrew, French and Italian, the lecturer on logic, elocution, the theory of languages, oratory and criticism, history and general policy, civil law, and anatomy; and there is Cavendish, the recluse, the measurer of natural quantities, the man who arranged his dinner-parties by a formula, dinner $= \frac{\text{legs of mutton}}{x}$ (x being proportional to the number of guests), the man who, when he felt

death coming, said to his servant, "Mind what I say—I am going to die. When I am dead, but not till then, go to Lord George Cavendish and tell him—go." There are Lavoisier and Dumas, at once men of action in many departments of public life and men of thought, men of the world, and men of science; and there is Faraday, the humblest, the simplest, the most accurate, and the most original, of men.

The book abounds in examples of the dangers, the difficulties, and the triumphs, of the scientific method. We see Priestley on the verge of great discoveries regarding the composition of water and metallic calces, but held back by his devotion to that idol of the theatre, *phlogiston*. We see Boyle meeting the statement of Linus, that the mercury in the Torricellian vacuum is upheld by a kind of internal cord, by measuring the decrease in the volume of a portion of air caused by increasing the pressure on that air, and so arriving at the fundamental statement regarding the relation of gaseous volumes to pressure which is known as *Boyle's law*.

We are able, too, to compare the thoroughness and methodical application of the Germans, as shown in the work and lives of Wöhler and Kopp, with the brilliancy and sweep of the French naturalists Lavoisier and Dumas, and also with the stubborn perseverance and imaginative grasp of such English men of science as Dalton, Graham, Faraday, and Boyle.

The comparison of the two great atomists, Dalton and Graham, made on pp. 225–6, is succinct and suggestive. But I cannot agree with the author in his apparent approval of Henry's statement that imagination had no part in the discoveries of Dalton. I am sure that everyone who has attempted to teach the essentials of the atomic theory must be convinced that without vivid imagination it is impossible to gain any firm hold of this great conception. The whole of Dr. Thorpe's book, indeed, may be taken as a complete refutation of the vulgar mistake that the man of science has no need of imagination.

One may be repelled by the solitary, non-human life of Cavendish; but the character of Faraday, as set forth in Dr. Thorpe's sketch, must attract every reader. The accounts of the first meetings of Wöhler with Berzelius, and Dumas with Humboldt, given in the words of Wöhler and Dumas themselves, show that to men of science too comes sometimes the glow of hero-worship.

Who but a Frenchman would express his joy at a new discovery made in the laboratory by seizing the discoverer and waltzing with him round the benches! This was Gay-Lussac's method. I have been present when the arrival of a few tarry, evil smelling, drops of a long-wished for compound has been hailed with shouts and songs; but the translation of the emotions of a chemist into the poetry of movement is a higher and more inspiring flight.

The criticism given by Dr. Thorpe of the conception that underlies the hypothesis of Prout is one that chemists would do well to remember. In its original form, Prout's hypothesis suggested that the atoms of the elements are collocations of atoms of hydrogen, and that, therefore, the atomic weights of the elements are whole multiples of the atomic weight of hydrogen. Dr. Thorpe very justly remarks of the work of Stas (p. 229):

"It may be that it demolished Prout's hypothesis in its original form, but it has not touched the wider question; indeed it is very doubtful whether the wider question is capable of being reached by direct experiments of the nature of those of Stas, unless the weight of the common atom is some very considerable fraction, say one-half or one-fourth, of that of the hydrogen atom."

It seems to me that chemists have been very ready to forget "the wider question" that underlies the hypothesis of Prout. That wider question is: Are the elementary atoms collocations of different numbers of atoms of one fundamental kind of matter? And Prof. Thorpe does well to point out that this question cannot be answered by measurements of the relative weights of the atoms of the kinds of matter that we call elements. If the best established values for the atomic weights are multiplied by one hundred, all the values will be expressed in whole numbers; it is then only necessary to assume that the atom of the fundamental matter is one hundred times lighter than the atom of hydrogen, and, if the wider question underlying Prout's hypothesis can be answered by measurements of atomic weights, that question is answered. The solution of the world-old enigma of the unity of matter must be sought for by other methods.

On p. 154 the author quotes from Faraday, who, when writing to a scientific man at variance with another, remarked:

"These polemics of the scientific world are very unfortunate things; they form the great stain to which the beautiful edifice of scientific truth is subject. Are they inevitable?"

Would it not have been better had Dr. Thorpe, remembering this wise remark made by Faraday, who was the perfect representative of the true scientific student of nature, omitted from his collected essays that entitled "Priestley, Cavendish, Lavoisier, and *La Révolution Chimique*"? This essay jars somewhat. It is not in harmony with the others; it is not concerned with matters of universal interest; it revives a controversy that surely had better been left in forgetfulness. For is it of much importance to determine whether Lavoisier was or was not wholly indebted to Priestley for the fact that *red precipitate*, when heated, gives off a gas wherein a taper burns brilliantly?

Lavoisier can afford to make full acknowledgment of indebtedness to Priestley. Priestley discovered dephlogisticated air; Lavoisier gave oxygen to science.

M. M. PATTISON MUIR.

THE ORIGIN OF GLACIAL DRIFTS.

The Canadian Ice-Age. By Sir J. William Dawson, C.M.G., F.R.S. (Montreal: William V. Dawson. New York and London: The Scientific Publishing Company, 1893.)

IT is continually brought to the notice of geologists that the most recent period in the long history of the earth is also that which excites the greatest controversy. We can deal complacently with earth-movements, mountain-thrusts, and submergences of half a

continent, so long as the organisms affected by these occurrences are less specialised mammals than ourselves; but we find it hard to believe in great physical or climatic changes within the limits of our own written or unwritten history. Moreover, our knowledge of the post-Pliocene period is burdened with an excess of detail; and broad and sweeping generalisations seem at present out of the question. And, if we go one step further, we may fairly attribute our friendly agreement with regard to the conditions of the older periods to our ignorance rather than to our information.

Sir William Dawson, in the present work, summarises several previous papers of his own, just as M. Gaudry's detailed memoirs were summarised for general use in "Les Ancêtres de nos Animaux." This handy paper-bound volume deals strictly with Canada, and is in no way a "Theory of the Earth." It is moderate in tone, and forms a serious plea for a rational treatment of the glacial epoch. Whatever caused the cold conditions in the northern hemisphere, or in parts of the northern hemisphere, it is pointed out that the land-ice in Canada radiated from two local centres, and not from the hypothetical ice-cap at the pole. Readers of NATURE will remember the evidence brought forward by Dr. G. M. Dawson as to the "Laurentide" centre of glaciation on the east and the "Cordilleran" centre on the west (NATURE, vol. xlii. p. 650). The conditions maintained by Sir W. Dawson as most favourable to the development of glaciers are high masses of land in proximity to cold seas; and, as he properly points out, these conditions still prevail in North America to a greater extent than in North Europe. They prevail, moreover, in Greenland, but not in Grinnell Land, to cite two closely neighbouring areas.

It will be clear, then, that Sir W. Dawson urges that differential earth-movement was the main factor in the production of Canadian glaciation. The evidence of marine shells in the drift, of the bones of whales, of the character of the deposits themselves, all points to the existence of wide areas of submergence. With regard, for example, to the Cordilleran centre in British Columbia, our author writes:—

"The conditions were combined of a high mountain chain with the Pacific on the west, and the then submerged area of the great plains on the east, affording next to Greenland the grandest gathering-ground for snow and ice that the northern hemisphere has seen."

Of recent years it has been far too generally assumed that we have to picture the glaciers of the ice-age moving across the features of the country as we at present know them. The views of Prof. Suess with regard to earth-movements in the historic period are perhaps only fair criticism of somewhat hasty observations; but, in face of the extraordinary evidence of post-Pliocene upheavals, it is at least irrational to believe that these terminated with man's appearance on the globe. Many English "glacialists" accept a recent submergence of their country to a depth of 500 feet, and yet postulate the most catastrophic occurrences to account for marine beds at twice that height above the sea. Yet we now have, in addition to the old Lyellian instances, such as the Astian or even later beds in Sicily, which are elevated some 3000 feet, evidence given us by Prof. Andrew Lawson of a post-Pliocene uplift of the continental coast of California to heights of from 800 to 1500 feet; and Sir W. Dawson's requirements to explain the distribution of the Canadian drift are such as will seem moderate and natural to every rational uniformitarian.

On p. 111 of the present work, the author discusses the possibility of distinguishing striations produced by the "huge ice-islands" in shallow seas from the deeper and firmer markings of true glacier-ice. Granted the submergence, which in itself assists in the formation of snow and ice, the phenomena of the distribution of boulders receive at once their simplest explanation; and in chapter v. the local details of the drifts are taken, area by area, into consideration. Our own British islands must similarly be discussed area by area. Because it seems probable that Scotland in the glacial epoch was a local Greenland, there is no reason why England should also have been lifted above the sea. The evidence accumulating in Ireland goes far in favour of a long submergence of that country, with the production of an archipelago of picturesque and snow-capped islands. Hence it is that we may welcome Sir W. Dawson's summary of results in Canada as a reminder that land-ice and enormous terminal moraines are not to be left in undisputed possession of the field. We can even sympathise with him in his final sense of irritation, when he charges some glacialists with "misunderstanding or misrepresenting the glacial work now going on in the arctic and boreal regions." "These are grave accusations," he continues, "but I find none of the memoirs or other writings of the current school of glacialists free from such errors; and I think it is time that reasonable men should discountenance these misrepresentations, and adopt more moderate and rational views."

Of course Sir W. Dawson cannot resist the temptation of stating as "an inevitable conclusion" (p. 289) "that the origin of specific types is quite distinct from varietal modification"; but this is a cheerful side-thrust, as it were, in a work on quite another subject. On p. 36 the use of "Neozoic" as equivalent to "Tertiary" seems unusual; and on p. 51 there is a sentence on the origin of fiords, quoted from an earlier paper by the author, which describes them as "often evidences of the action of the waves." They may have nothing to do with glacial excavation, but still less can they be regarded as products of marine erosion, unless the author confines himself to the cases that he has specially examined in Nova Scotia.

G. A. J. C.

OUR BOOK SHELF.

Grundzüge einer Entwickelungsgeschichte der Pflanzenwelt Mitteleuropas seit dem Ausgang der Tertiärzeit. Von Dr. August Schulz. (Jena: Gustav Fischer, 1894. 8vo. pp. 206.) (Outlines of a History of the Development of the Flora of Central Europe since the close of the Tertiary Period.)

IN a preliminary note by the author, we are informed that this dissertation is an extract from a more extended essay on the vegetation of Central Europe, which present circumstances prevent him from publishing in full. The title cited above is really that of the first chapter of the work only. A second deals with the

spread of the "thermophytes" in Central Europe since the "fourth ice-period"; and a third with the division of Central Europe into floral districts; followed by some seventy pages of explanatory remarks on the points raised in the preceding chapters. Unfortunately for those who would wish to consult this book, it has neither index nor headings of any kind. There is no attempt whatever to classify the facts and data; no map, no summary, no digest, no general conclusions; indeed, no help at all for the reader desirous of knowing what the writer has arrived at, or is leading up to. He begins with the assumption, that only very few of the plants which now inhabit Europe were already here in Miocene times, and that a large majority of the present vegetable inhabitants consist of immigrants and such as have originated within the territory since the beginning of the Pliocene period. The homes of the migrated species he would seek in Arctic America, but chiefly in Asia; and a very small number he considers have migrated from North Africa. In illustration of migrations the author gives full details of the present distribution of a small selection of plants; but only in words, so that it is a study to trace the areas. Having thus called attention to this work, we must leave it to the reader with leisure to follow the writer through his four ice-periods, and the present distribution of the leading elements of the flora of Central Europe; and we may add, that he will find much interesting matter.

Elementary Metal Work. By G. C. Leland. (Whittaker and Co., 1894.)

THIS book is devoid of scientific or general interest, merely treating of certain kinds of decorative metal work which can be executed by amateurs and children, and which, as a general rule, we would far rather be without. There have been instances, however, in which metal working at home, directed by energetic people of taste and leisure, has been found to greatly benefit working men and their families who are forced to be comparatively idle in winter. In a certain charming spot in the Lake District, where such objects are readily disposed of to tourists, the results have been most satisfactory, and we wish some such home industries could be introduced into parts of Ireland and Scotland frequented by visitors in summer, where the enforced winter idleness produces an amount of poverty painful to think of.

J. S. G.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Earth Currents.

THE Astronomer Royal was kind enough to show me the permanent photographic records of earth currents during the great magnetic storm on February 20–21, and they indicated so unmistakably such rapid and violent alternations, that I supplied our principal relay stations with telephones and with instructions to insert them in circuit whenever they observed indications of disturbances. This happened on March 30–31, during the display of the Aurora Borealis. Mr. Donnithorne, in Llanfair P.G., Anglesea, reports:—"At 2.0 a.m. (Saturday) the telephone receiver was again tried, and then 'twangs' were heard as if a stretched wire had been struck, and a kind of whistling sound. The strength of the earth current was 17·7 milliampères." Mr. Miles, in Lowestoft, reports:—"Noise on 408 (Liverpool-Hamburg) wire seemed like that heard when a fly-wheel is rapidly revolving," and "sounds in telephone appear like heavy carts rumbling in the distance." Mr. Scaife, in Haverfordwest, reports:—"March 31, 2.5 a.m. Earth currents on all wires; wires completely stopped. . . . Peculiar and weird sounds distinctly perceived, some highly-pitched musical notes, others resembling murmur of waves on a distant beach. . . . The musical sounds would very much resemble those emitted by a number of sirens driven at first slowly, then increased until a 'screech' is produced, then again dying away. Duration of each averaged about twenty seconds." These experienced observers, situated at three distant points, and perfectly acquainted with the ordinary inductive disturbances on telephone circuits, simultaneously observed and independently recorded their own impressions of peculiar sounds exerted in telephones by very rapid alternations or pulsations of currents which accompanied or were consequent on sun-spots, earth currents, and the Aurora Borealis.

W. H. PREECE.

G.P.O., April 9.

The Aurora of March 30.

I VENTURE to supplement the reference in NATURE to the Aurora of March 30, by a brief account of an observation made by me at Bristol.

At about 10.30 p.m. I noticed against a dark blue sky a single narrow rose-coloured ray stretching from between α and β Ursa Majoris to the neighbourhood of δ Aurigæ, and slightly beyond it. It was speedily joined by a second and then by a third ray, apparently diverging from a common centre about 5 degrees beyond α and β Ursa Majoris. The three rays gradually became less divergent, and merged into one broad beam, which ultimately faded away: the whole phenomena lasting about 5 or 6 minutes only. At the same time there was a greenish-white luminosity on the N.N.W. horizon, suggestive of a belated and misplaced sunset. I understand that this had endured for a long time, perhaps an hour or more.

J. RYAN.

University College, Bristol, April 9.

Crystalline Schists of Devonian Age.

IN a recent number of NATURE (vol. xlix. p. 435) Prof. Bonney writes:—"Speaking for ourselves we think he (Prof. van Hise) is disposed to . . . . admit on too slight evidence that in 'Silurian, Devonian, and even later times, completely crystalline schists have been produced over large areas'; for in the past this assertion has been so often made, and so often proved erroneous, that on the principle, 'once bit, twice shy,' we are disposed to be a little sceptical."

Mere assertions in geology, as in general science, are scarcely worth the trouble of contradicting; but in one case, at least, the evidence of the existence of completely crystalline "Devonian" schists does not rest on mere assertion.

I published certain microscopic evidence in favour of the Devonian age of the schists of the Start and Bolt district in the *Geological Magazine* in 1892, and as Prof. Bonney would not condescend to weigh the said evidence, but contented himself by attempting to defend his own position by "abusing plaintiff's attorney," I proceeded to dissect his own argument for the Archæan age of the rocks in question in a separate publication.

Until the facts and arguments advanced in support of the "Devonian" age of these crystalline rocks, and the arguments against Prof. Bonney's rival hypothesis, (the latter based on a brief week's investigation of a district which has puzzled geologists for over half a century) are all fairly met, I must deprecate any attempt being made to lead the readers of your journal to believe that the doctrine of the "Devonian" age of the Devonshire schists has been "proved erroneous."

Torquay, March 23. ARTHUR R. HUNT.

P.S.—When the above was written I had not seen the remarks of the Director General of the Geological Survey on the metamorphic area of South Devon, published in your issue of March 22 (NATURE, vol. xlix. p. 497).

William Pengelly.

PROF. BOYD DAWKINS, in his otherwise excellent obituary of Pengelly, refers to the Bovey Tracey beds as a Miocene Lake deposit. They are, however, not lacustrine but fluviatile, consisting of current-bedded coarse grits alternating with lignitic muds, such as are deposited in stretches of still water when the main current cuts itself a new channel. Lithologically these beds are identical with those of Corfe and Bournemouth, and there is no reason to doubt their being the

deposits of one and the same river. Neither are they Miocene, if the evidence of fossils is to be trusted; and we have no other guides in this case but the lithology and palæontology, since the identifiable and most characteristic fossils are also found in the Middle Bagshots of Bournemouth, in a precisely similar matrix, and in the same state of preservation. In determining the age of the deposits, great stress was laid on the supposed identity of the *Sequoia Couttsiæ* of Bovey with that of the Hamstead beds; but by visiting Bovey not long since, and obtaining perfect specimens of the cones, I satisfied myself that the Bovey plant is a true *Sequoia*, with scales growing at right angles from the axis, and with compressed winged seeds; while even more perfect specimens from Hamstead, obtained soon after, showed the scales inserted at the base, and the seeds wingless, falling thus more properly into Athrotaxis. The foliage growth is also entirely different, though the leaves are similar. The point is of some importance, yet the mistake having been made by such "heroes of geology" as Heer and Pengelly, is extremely hard to eradicate. J. STARKIE GARDNER.

A Rejected Address.

CONSCIOUS that the protestant is a weak-kneed *urochs*, I ask permission to protest by implication against a common trivial mistake. How long will people go on writing about "political meteorology" and the like, meaning, by this, haphazard prediction? The meteorologist is as near a cousin to the *local* "weather-prophet" as Helmholtz to the artisan who is making a spectacle-case; or, to use an illustration lent me by a lady, as the astronomer is to the astrologer. NUBES.

April 9.

THE LIMBS OF LEPIDOSIREN PARADOXA.

DR. GÜNTHER, in his valuable work, "The Study of Fishes," says of Natterer's Lepidosiren from the Amazons, "It is one of the greatest desiderata of natural history collections." In fact, only seven years ago the opinion was current that Natterer had been deceived by specimens of Protopterus imported from Africa, or that in some way African specimens had been mixed with his American collections.

I was therefore greatly pleased to obtain recently for the Oxford University Museum, by purchase from a London dealer, specimens of the Lepidosiren of the Amazon well preserved in spirit. I immediately noticed a peculiarity about the pelvic fins, which it is the object of the present note to make known. These fins, whilst more robust than the pectorals, were remarkable for exhibiting upon their dorso-mediad surface a clothing of well-developed "villi," the appearance of which is best gathered from the accompanying sketches (Figs. 2 and 3).

As many as four "villi" were in some cases united at the base, or mounted on a short trunk.

No such "villi" are known in the African Protopterus, nor in Ceratodus.

The specimen figured by Natterer showed no trace of these "villi." This was a female, whilst the specimens recently imported which exhibit the "villi" are males.

I am at present engaged in an examination of the minute structure of these "villi" of the pelvic limbs of Lepidosiren. Whether tactile or respiratory, they form a most remarkable feature, and it seems worth while to place a brief notice of them at once in the hands of naturalists.

Natterer's figure of Lepidosiren (which has often been copied) is not good. It does not give a fair idea of the proportions of the animal. I hope soon to publish a careful drawing of life-size. Lepidosiren is distinctly longer in proportion to breadth than is Protopterus, and there is a greater distance between the pectoral and pelvic fins in Lepidosiren (in proportion to total length) than in Protopterus. The median fin is not so deep in Lepidosiren as in Protopterus.

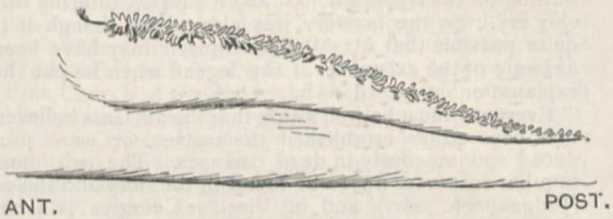


FIG. 2.

The woodcuts are as follows:—

Fig. 1 represents the left pectoral fin and opercular opening.

Fig. 2 shows the left pelvic fin, drawn to the same scale, in its natural position of rest; the long axis nearly parallel with the long axis of the body.

Fig. 3 shows the same pelvic fin turned forward (a position which the animal can give it in life), exposing the dorso-mediad face of the fin with its numerous "villi."

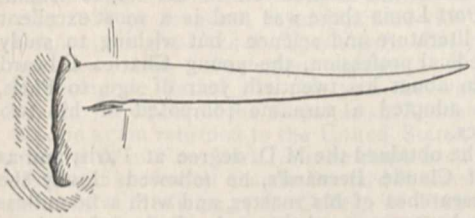


FIG. 1.

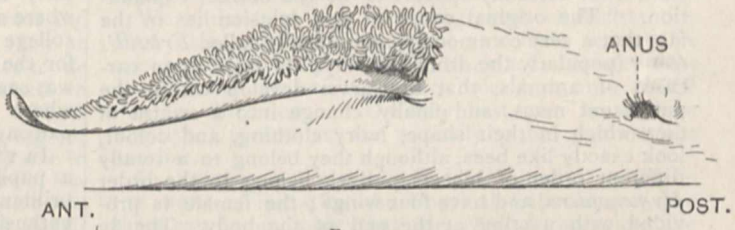


FIG. 3.

The lifting of the fin has also exposed the anus, which lies on the left side of the median line of the body.

E. RAY LANKESTER.

March 20.

BEES AND DEAD CARCASES.[1]

DURING the last two hundred years our knowledge of natural and physical science has advanced by leaps and bounds, until, in most departments, it has risen to a level far exceeding anything which has been recorded during historic times. Hence, in dealing with improbable or impossible statements which have come down to us from classical or mediæval times, we are perhaps too apt to forget the old proverb that "there is no smoke without fire," and to dismiss them at once as vulgar superstitions, instead of seeking for the substratum of truth which will often be found to underlie them. Even so plain and simple a statement as that ants store up food was long discredited; for, as the ants of Northern Europe do not possess this habit, it was supposed to

[1] "On the so-called *Bugonia* of the Ancients, and its Relation to *Eristalis tenax*, a Two-winged Insect." By Baron C. R. Osten-Sacken. Reprinted from the *Bulletino della Societa Entomologica Italiana*, Anno xxv. 1893.

have arisen from their having been seen carrying their pupæ (or, in common talk, "ant-eggs"). But a case which nearer concerns our present subject is that of the distant islands, upon which, as many Arabic writers gravely assured us, grew trees bearing fruit resembling human heads, which cry out "Wák-wák" at sunrise and sunset. What could be made of such a story? One fine day Mr. Wallace landed in the Aru Islands, and found that the Birds of Paradise were in the habit of settling on the trees in flocks, about sunrise, uttering this very cry. So the mystery was cleared up, though it is quite possible that Mr. Wallace himself may have been unaware of the existence of the legend when he put the explanation on record.

Everyone must be well aware that the ancients believed that bees either established themselves, or were produced spontaneously in dead carcases. The two most familiar instances are to be found in the story of Samson (Judges, ch. xiv.), and in Virgil's Georgics iv.; but there are many other references to it in various authors, many of them of good repute, down to a very recent period. But with the dawn of a more scientific age the idea of bees being produced from carcases was rejected; and the Biblical narrative was interpreted to mean that the bees had made their nest in a dried-up carcase or skeleton. As the Septuagint says expressly that Samson found the bees and honey in the *mouth* of the lion, this explanation might not perhaps have appeared so very unreasonable, in default of a better. But several writers suggested that in cases where the spontaneous generation of bees from carcases was positively asserted, flesh-flies may have been mistaken for bees; and in the pamphlet before us, which has suggested our own remarks, Baron Osten-Sacken, the eminent dipterist, has given a long account of the popular idea of "Bugonia," or the production of bees from the carcases of oxen, and puts forth what certainly appears to be the correct explanation. "The original cause of this delusion lies in the fact that a very common fly, scientifically called *Eristalis tenax* (popularly the drone fly), lays its eggs upon carcases of animals, that its larvæ develop within the putrescent mass, and finally change into a swarm of flies which in their shape, hairy clothing, and colour, look exactly like bees, although they belong to a totally different order of insects. Bees belong to the order *Hymenoptera*, and have four wings; the female is provided with a sting at the end of the body. The fly *Eristalis* belongs to the order *Diptera*, has only two wings, and no sting."

This thesis Osten-Sacken works out in great detail, quoting or referring to a large number of authors. Among other interesting points, he calls attention to another classical notion that *wasps* were produced from the carcases of horses. These supposed wasps he identifies with *Helophilus*, a wasp-like genus of flies not far removed from *Eristalis*. Thus the one error illustrates and explains the other in a singularly apposite manner. As regards Samson, Osten-Sacken remarks, "The riddle . . . affords the proof of another fact, that the belief in the *Bugonia* was current among the people at that time, because, without that substratum, the riddle would not have had any meaning."

Osten-Sacken concludes his pamphlet with a detailed account of *Eristalis tenax*. The fly appears to be common in almost all parts of the Old World (and has latterly been introduced into America, also), so that the story of the *Bugonia* could easily have originated spontaneously (even if the bees themselves do not) in any country. Indeed, in all probability the story may have sprung up independently in more than one part of the world.

Baron Osten-Sacken has lived much in America, and is usually in the habit of writing in English to whatever journal he addresses his observations; and his present interesting pamphlet is no exception. It will be seen that he writes not for entomologists only, but for scholars and literary men; and we have not attempted to do more than give a brief sketch of a critical essay which, to be appreciated, must be read in its entirety. But we cannot now do better than quote the Baron's concluding remarks.

"Except the silkworm and the honey-bee, I hardly know of any insect that can show an historical record equal to that of *Eristalis tenax*. The record begins in the dusk of prehistoric times, and continues up to the present date. In its earliest days *E. tenax* appears like a myth, a misunderstood and unnamed being, praised for qualities which it never possessed, a theme for mythology in prose and poetry, later on, the bubble of its glory having burst, it gradually settles into a kind of commensalism with man, it obtains from him 'a local habitation and a name'; it joins the Anglo-Saxon race in its immense colonial development, it vies with it in prodigies of fecundity, and at present renders hitherto unrecognised services in converting 'atrocious stuff' into pure and clean living matter!

"I close this chapter on the *Bugonia*-craze with the moral of it, contained in another sentence from Goethe:—

'Man sieht nur was man weiss.'"

W. F. KIRBY.

CHARLES EDWARD BROWN-SÉQUARD.

THIS distinguished physiologist and physician was born on April 8, 1817, at Port Louis, Mauritius. His father, Edward Brown, of Philadelphia, was of Irish origin, and his mother was of a French family which had been settled for some time at the "Isle of France." His early education was carried on in his native island, where at Port Louis there was and is a most excellent college for literature and science; but wishing to study for the medical profession, the young Charles Edward was sent, in about his twentieth year of age, to Paris, where he adopted a surname composed of his two patronymics.

In 1840 he obtained the M.D. degree at Paris, and as a pupil of Claude Bernard's, he followed closely the brilliant researches of his master, and with a boundless enthusiasm he commenced the study of nerve physiology, which he continued with but brief periods of intermission for the next fifty years of his life. By the accidents of his birth he became from his earliest years equally proficient in both the English and French tongues; but though an Englishman by birth, he always seemed to regard France as his home, and Paris as his resting-place. Owing in part to Brown-Séquard's facility of writing both French and English, his various papers on the functions of the sympathetic nerves and ganglia soon made his views known to a large circle of inquirers, and in 1858 he was invited to deliver a course of six lectures at the Royal College of Surgeons, in Lincoln's-Inn Fields. About this period, also, a number of the younger physicians and surgeons of Dublin persuaded him to come as far west as Dublin, to repeat this course, but at that time no college in the Irish capital was found willing to open its doors to the experimental physiologist, and the lectures were delivered in the back room of a concert hall. For the first ten or twelve years after taking his doctor's degree the struggle for life was somewhat arduous; his line of research was not productive of an income, and the pecuniary rewards for scientific writing or for scientific reports was excessively small. The writer calls to mind a visit paid to Brown-Séquard at his lodgings in Paris; the two rooms occupied by him were just under the sky, and their chief furniture consisted of books, pamphlets, and writing paper.

His first of many visits to the United States was made about 1850, and his work on "Experimental Researches applied to Physiology and Pathology" was published in New York in 1853. In January 1858 the first part appeared of the *Journal de la Physiologie de l'Homme et des Animaux*. It was dedicated to Biot, Rayer, Flourens, and James Paget, as a "hommage de reconnaissance et de respectueuse affection." His experimental researches had already proved of immense importance in their bearings on various pathological conditions, and the results of experiment had not only aided in the diagnosis of disease, but had also furnished means and hints whereby suffering humanity could be relieved, so that it was not very surprising that when, in 1860, the Hospital for the Paralysed and Epileptic was opened in London, Brown-Séquard was selected to be its physician. Arduous as were his new duties, they had a special attraction for him. His labours, however, did not end with his hospital work; a large private practice demanded a great expenditure of his own nerve force, and after a couple of years he talked of it as being overwhelming. A visit paid to him at this time was a contrast to the one at Paris. The large reception-room in his house in Cavendish-square was filled with anxious patients and their friends. A hasty interview on the staircase was all that he could afford; it ended with a "come and have a talk over old times, but come at night for fear of the patients." To those who knew him well it was therefore no surprise that in 1864 he should give up his hospital appointment, his patients, and his house in London, and go to the Harvard University, as Professor of Physiology and Pathology of the Nervous System. The rest at Cambridge did him good, and he recommenced original work; but shortly afterwards his wife died, and in a fit of poignant grief he gave up his appointment and returned once more, with his son, to Europe (February 1885), passing through Dublin on his way to Paris.

In 1868 he founded, in conjunction with Charcot and Vulpian, the *Archives de Physiologie*. Early in 1869 he was nominated "Professeur agrégé à la Faculté de Médecine de Paris." In this year he was elected an honorary member of the Royal Irish Academy. About 1870 he again returned to the United States, staying for some time in New York; but he came back to Paris in 1878, and succeeded Claude Bernard in the chair of Experimental Medicine at the College of France. He was awarded the Baly medal by the Royal College of Physicians of London in 1881, and was elected to Vulpian's place in the French Academy in 1886. He was a F.R.S. as well as a member of many continental and American Societies.

His experimental researches, undertaken in his later days—between 1889 and 1893—to sustain or even to renew the vital powers, it is not necessary for us to particularly mention: dreams allowed to a poet are forbidden to the philosopher, and time will alone tell whether there be any germ of reason in Brown-Séquard's investigations; if not, they may be forgotten and forgiven. Wishing peace to his memory, we will not soon forget the gentleness of his disposition or his affection as a friend. He died at Paris on Sunday, April 1.

PROFESSOR ROBERTSON SMITH.

THE death of Prof. Robertson Smith, on March 31, at a comparatively early age, is a profound loss to the whole thinking world.

Unfortunately for Science, and (in too many respects) for himself, his splendid intellectual power was diverted, early in his career, from Physics and Mathematics, in which he had given sure earnest of success. He turned his attention to eastern languages, and acquired a knowledge of Hebrew, Arabic, and other tongues, quite exceptional in the case of a Briton.

Dr. Smith was born at Keig, Aberdeenshire, in 1846, and educated at Aberdeen University, the New College, Edinburgh, and the Universities of Bonn and Göttingen. In 1868 he became Assistant to the Professor of Physics in Edinburgh University; in 1870, at the age of twenty-four, he was appointed to the chair of Hebrew in the Free Church College of Aberdeen. A few years later he fell under the suspicion of holding heterodox views concerning Biblical history. Orthodoxy raised her voice against him in the newspapers, in the churches, in the Presbyteries, and finally, in the General Assembly of the Free Church of Scotland, and the clamour culminated in his dismissal from the Professorship at Aberdeen in 1881. This was effected, *not* by a direct condemnation of his published opinions, but by a monstrous (temporary) alliance between ignorant fanaticism and cultivated jesuitry, which deplored the "unsettling tendency" of his articles!

He next became successor to Prof. Baynes in the Editorship of the last edition of the *Encyclopædia Britannica;* and here his business qualities, as well as his extraordinary range of learning, came prominently before the world. In 1883 Dr. Smith was appointed Reader in Arabic at Cambridge, and three years later he succeeded the late Mr. Bradshaw as librarian to the University. He was afterwards elected to a Fellowship at Christ's College, and to the Professorship of Arabic.

What Smith might have done in science is shown by his masterly paper "*On the Flow of Electricity in Conducting Surfaces*" (*Proc. R.S.E.*, 1870), which was rapidly written in the brief intervals of leisure afforded by his dual life as simultaneously a Student in the Free Church College, and Assistant to the Professor of Natural Philosophy in Edinburgh University.

We understand that his engagement as Assistant to Prof. Tait had its origin in the extremely remarkable appearance made by young Smith as a Candidate in the Examination for the Ferguson Scholarships, an examination in which most of the very best men in the four Scottish Universities are annually pitted against one another.

In Edinburgh University he did splendid service in the work of initiating the Physical Laboratory:—and there can be no doubt that the *esprit de corps*, and the genuine enthusiasm for scientific investigation, which he was so influential in exciting there, have inaugurated and promoted many a successful career (not in this country alone, but in far regions everywhere), and that, near and far, his death will be heard of with heart-felt sorrow.

A light and playful feature of his too few years of scientific work consisted in his exposures of the hollowness of the pretentions of certain "philosophers": when they ventured to tread on scientific ground. Several of these will be found in the *Proceedings and Transactions* of the Royal Society of Edinburgh (1869-71). Smith treats his antagonist "tenderly, as if he loved him," but the exposure is none the less complete.

A writer in the *Times* thus testifies to Dr. Smith's remarkable powers: "In him there has passed away a man who possessed not only one of the most learned but also one of the most brilliant and striking minds in either of the great English Universities, and who was held in the highest regard by the leading orientalists of the continent. His extraordinary range of knowledge, the swiftness and acuteness of his intellect, and his passionate love of truth combined to make an almost unique personality. His talents for mathematics and physical science were scarcely less remarkable than those for linguistic studies, and if he had not preferred the latter, there is no question that he could have reached great eminence in the former."

NOTES.

AT the meeting of the Convocation of the University of London on Tuesday, the University was saved from committing an act detrimental to its best interests. The report of the annual committee condemning the recommendations of the Gresham Commissioners as to the reconstruction of the University was under consideration. It was urged by the supporters of the report that the rapidly increasing number of candidates who present themselves for the University examinations, was a sufficient argument against any change of constitution. We agree with Dr. Hart, that the University has raised the standard of education, that it has encouraged the aspirations of persons unable to bear the expense of residence in University towns, and that it has done much for the higher education of women. But the time has arrived when the University must become more than a mere examining body, if it wishes to keep pace with the times. Members of Convocation who are jealous of the prerogative position at present occupied should look around, and then ask themselves whether London ought not to have a teaching University like those of other capitals in Europe. A mistaken idea as to the dignity of the University should not be allowed to stand in the way of the proposed developments. It would be far more dignified to accept the changes, unless, indeed, the University of London desires to find itself eclipsed by another with a charter more suited to the requirements of to-day. Some of the most eminent members of Convocation recognise the necessity of the old order giving place to the new. Prof. Sylvanus Thompson pointed out that when functions were, as in the case of London University, extremely limited, they should be extended. "Why should not," he said, "the University perform all those great duties of encouraging research and learning and of teaching, which were an essential part of a true University. He hoped the matter would be approached in a temperate spirit, and that they would not stand on a mistaken notion of their dignity. There might be blots on the scheme which they should seek to remove, but was it wise to oppose the scheme in a thoroughly hostile spirit? Let them beware of showing such a spirit, for it might be that a new University would arise, discharging all the functions of a University, and the present University of London might be left in the cold. The substitution of a new charter for an old did not, as they knew from past experience, impair the continuity of their existence. It would be a great pity if two Universities should arise—one not called by the name of the capital, but doing all the work of a University, whilst that which was called the University of London was restricted to the narrow sphere of examinations." Mr. Thiselton Dyer also supported the recommendations of the Royal Commissioners, rightly remarking that the scheme would enable the University to develop its full powers, especially in the department of post-graduate study, in which lies the true glory of a University. The resolution of the annual committee, protesting against the withdrawal of the present charter, was eventually set aside by an almost unanimous vote. This is satisfactory as far as it goes, but it does not dispose of the matter in a very effective manner. A motion was afterwards proposed by Sir Albert Rollit, in the following form:—"That, with a view to the speedy and satisfactory reconstitution of the University, it is desirable to secure, if possible, the co-operation of the Senate and Convocation, and with this object Convocation refers the whole question of the reconstitution of the University to the annual committee, with power to nominate members of a joint consultative committee of the Senate and Convocation." This was unanimously adopted; so the University is once more given the chance of reconsidering its policy, and of gracefully accepting the proposed changes before they are forced upon it.

IN August, 1892, the Board of Trade sent to the Directors of each of the railway companies of the United Kingdom a copy of the report of the Royal Society's committee on colour vision (NATURE, vol. xlvi. p. 33), asking for observations upon the recommendations it contains. It was pointed out that, as regards the officers employed in the mercantile marine, the Board of Trade had taken steps to give effect to the recommendations of the committee on the method of testing, and the Directors were urged to give careful consideration to the matter as far as concerned persons employed on their railways. A Parliamentary paper just published contains the replies received from the railway companies. On the whole, the result is satisfactory. Many of the companies accept Holmgren's wool test for colour vision, and Snellen's type system of testing form, though a large number use modifications of them, or supplement them with other tests. The necessity of periodical examinations is generally recognised, but the interval between the examinations varies in different companies from six months to five years. The directors of the Metropolitan District Railway consider that the committee's recommendation that the colours used for lights on board ship, and for lamp signals on railways, should, as far as possible, be uniform in tint, as quite inadmissible. They say that the shades of light adopted for their signals are the result of long and careful experiments, and of trials of many shades and gradations, and are best adapted to the peculiar circumstances of underground working. It is also remarked that the cases of sighting at sea and sighting upon a railway, subject to such atmospheric variations as occur on the underground systems, are totally different. This strikes us, however, as sheer nonsense.

THE French National Society of Horticulture will hold its tenth congress next month, and at the same time the annual horticultural exhibition will take place. The congress will be of an international character, and a number of interesting questions are down for discussion. Among these subjects are: Chlorophyll considered in relation to the vigour of cultivated plants; capillarity in relation to the preparation of the soil; the means of accelerating the nitrification of substances containing nitrogen, and therefore to render them more easily assimilable; the necessity of a unit of comparison for use in connection with the various systems of heating with hot water. Further information concerning the congress can be obtained by application to the Society, 84, Rue de Grenelle, Paris.

AN International Exhibition of Horticulture and Fruit Culture will be opened in St. Petersburg on September 22, and will remain open until November 12.

THE death is announced, at Saratoff, of M. Paul Jablochkoff, the inventor of the Jablochkoff candle system of electric lighting.

THE Right Hon. Lord Bowen, a friend of science and a supporter of her interests, died on Tuesday at the age of fifty-nine. He was elected a Fellow of the Royal Society in 1885.

AN astronomical congress will be held in San Francisco in June next, in connection with the Californian Midwinter International Exhibition.

MR. A. D. HALL has been appointed Principal of the Agricultural College at Wye, established by the joint county councils of Kent and Surrey.

A WRITER in the current number of the *Chemical News* enumerates some of the streets, avenues, and public squares in Paris, named after eminent men on account of their scientific labours. In some instances the streets thus designated are appropriately placed near learned institutions with which the

investigators' names were associated; in others, the names of men engaged in the same branch of science are grouped within small areas. It is pointed out that the "Jardin des Plantes is bounded by streets named respectively Cuvier, Buffon, and Geoffroy St. Hilaire; while in the immediate vicinity are the streets Lacépède and the Place Jussieu. Elsewhere in Paris the following names occur:—Lamarck, Linnæus, de Saussure, and Humboldt. Near the École de Médecine runs the street Dupuytren, and in the same quarter the eminent physician Velpeau is honoured. Near the Hospital La Salpêtrière two English physicians lend their names to streets, Harvey and Jenner. In the neighbourhood of the Arc de Triomphe occur the names of the astronomers Copernicus, Galileo, Kepler, Euler, and Newton; elsewhere we find the streets Huyghens, Laplace, and Herschell. Mathematicians and physicists have not been forgotten, as shown by the occurrence of the following street names:—Biot, Pascal, Lalande, Lahire, D'Alembert, Dulong, Arago, Monge, Legendre, Ampère, Fresnel, Becquerel, Galvani, Volta, Franklin, and Faraday. Ampère, Galvani, and Faraday are near each other. Philosophy is represented by Descartes, Auguste Comte, and Bacon; engineering by Vauban, Watt, Stephenson, and Fulton; useful inventions by Bernard Palissy and Guttenberg; exploration by Christopher Columbus and Magellan. Chemists have received, however, a larger share of the honours than any other single class, not even excepting men of letters. Thus we find streets named after the French chemists Bayen, Berthollet, Cadet, Chaptal, Darcet, Daguerre, Gay-Lussac, Lavoisier, Langier, Orfila, Parmentier, Payen, Raspail, Réaumur, Rouelle, Thénard, and Vauquelin; the Swede Berzelius; and the Englishmen Davy, Faraday, Priestley, Cavendish, and Watt." A straw is sufficient to tell which way the wind blows, and the above simple facts serve to show that the municipal authorities of Paris consider the names of men of science just as worthy of being handed down to posterity as those of followers of other professions. Similar authorities on this side of the Channel have not yet reached the condition in which scientific workers are thus recognised.

THE Paris Geographical Society has made the following awards for geographical research:—A gold medal to M. Casimir Maistre for his exploration between the Congo and Niger; a gold medal to Prince Henry of Orleans for his scientific journey to Tonkin and in the Laos country; Prix Pierre-Felix Fournier to M. Vital Cuinet for his important work on "Turkey in Asia"; a gold medal to M. André Delebecque for his researches on French lakes; a gold medal to M. E. Foa for his explorations in South Africa, from the Cape to Lake Nyasa; Prix Herbet Fournet to M. P. Savorgnan de Brazza for his explorations in the French Congo, and for the part he has played in the colonial expansion of France; a gold medal to M. M. Monnier for the whole of his explorations, and especially for his voyage to the Ivory Coast; a gold medal to M. H. Schirmer for his monograph on the Sahara; a silver medal to Dr. A. Hagen for his scientific studies on the New Hebrides; a silver medal to M. L. Vignon for his works on French colonies, and especially for his important work "La France en Algérie"; Prix Jomard to M. Camille Imbault-Huart for his work on the "Island of Formosa."

THE exploration of the Lukuga river, which forms the periodic outlet of Lake Tanganyika, by the Katanga expedition under M. Delcommune, forms the subject of a short article and map in a recent issue of the *Mouvement Géographique*. The river was traced down to its confluence with the Lualaba or Upper Congo, in the last months of 1892. After leaving the lake the river pierced the Kakazi hills in a gorge, lined by cliffs 300 metres high, then expands in a marshy tract, contracts to pass another gorge, and expands once more on the plain, where it enters the Lualaba 230 miles from its source in Lake Tanganyika, and at a level 300 metres lower. Though the volume of the river was small at the time of observation, and the water very shallow, evidence was found of the occasional occurrence of very heavy floods. It appeared that the Lukuga first became an outlet of the lake in consequence of an exceptional rise of the water-level forcing an exit through the most easily breached part of its coast-line.

THE Norwegian whaler *Jason*, Captain Larsen, has succeeded in reaching what is probably a higher southern latitude than any steam vessel had previously done. Part of the log of the vessel has been forwarded to Dr. John Murray, who communicated it to the April number of the *Scottish Geographical Magazine*, along with a map of the *Jason's* route. The discoveries made were, in Dr. Murray's opinion, the most important since Ross's voyage. The Dundee and Norwegian sealers in 1892 found the sea to the south of Joinville and Louis Philippe Lands blocked with ice and swarming with seals; but in November 1893, Captain Larsen found clear water, and saw few seals. On December 1, when in lat. 66° 4′ S. and long. 59° 49′ W., rocky land was seen to the east, the coast-tending from N.W. to S.E. High snow-covered land was seen to the south on December 4, in lat. 67° S. and long. 60° W., and two days later the ship reached her farthest south point, 68° 10′ S., finding a stretch of low bay ice with few cracks. A group of islands was found on the return, situated about 65° 7′ S. and 58° 22′ W., on two of which active volcanoes were observed. Captain Larsen landed on these islands, which were not covered with snow; but in order to do so, he had to cross seven miles of ice, using Norwegian snow-shoes for that purpose. Volcanic rocks were strewn on this ice, evidently thrown up by the volcanoes. The currents were observed to come from the south, and southerly winds were frequently met with, indicating the possibility of an Antarctic area of high atmospheric pressure. The map on which these discoveries are marked shows Grahamsland as a peninsula, and involves a slight alteration in the provisional sketch of the probable outline of the Antarctic continent. The result of this cruise adds great point to the agitation for an Antarctic expedition on a large scale, and it is interesting to note that the open sea so far south occurred simultaneously with an exceptional dispersal of Antarctic ice over the southern ocean.

BUT comparatively little is known of the bacterial contents of sea-water, and by far the greater part of the information which we have on this subject has been collected by Dr. H. L. Russell. The first observations made by this investigator were carried out at the Naples Zoological Station, and were subsequently published in the *Zeitschrift f. Hygiene*, vol. xi. 1891. Since then Dr. Russell has made an elaborate inquiry into the conditions affecting the distribution of bacteria, both in sea-water and mud, collected from the Atlantic Ocean near the coast of Massachusetts. A reprint in pamphlet form of these results, published from time to time in the *Botanical Gazette*, places very conveniently before the reader the various questions which have been attacked. Four new varieties of bacilli have been isolated, described, and carefully drawn, but to none of them was any pathogenic property attached. One of the most prevalent of the sea-mud forms that was isolated in the Mediterranean, was also found to be a common inhabitant of the sea-slime in this part of the Atlantic. One of the varieties isolated was found exclusively in the ground layers of the sea-bottom, whilst the three other forms were found both in the water and the underlying ground layers. Sunshine produced as disastrous results on these sea-water bacteria as on those obtained from fresh water. In his conclusions Dr. Russell points out that the indigenous marine flora of both

water and sea-floor is restricted to relatively few species; a marked contrast to the bacterial contents of rivers, lakes, &c.

WE have received from the Berlin Aquarium Society a copy of the regulations and of several other documents relating to the Marine Zoological Station established in 1891 by that enterprising body at Rovigno, in the Adriatic. Primarily intended as a source of supply of living marine animals to the Berlin Aquarium, the Rovigno station is also equipped for the purposes of scientific research with all the ordinary apparatus and reagents of a biological laboratory, a Jung microtome, a circulation of pure sea-water, a steam-launch, and a growing library. The site of the laboratory seems to have been very carefully chosen with a view to the purity of the sea-water supply, several available and nearer sites having been rejected owing to the existence of an excess of fresh-water or some other source of contamination. The fauna is rich and varied, the climate mild and genial; and Rovigno, without pretending to be in the van of modern culture, seems to be a pleasant and hospitable town, not least among its attractions being an excellent light wine at sixpence per litre! No charge is made for working in the laboratory, and permission may generally be obtained upon application to the Berlin Aquarium. The Rovigno staff is always willing to supply information as to lodgings in the town, and can also put up four naturalists at a time in the laboratory house at the moderate charge of one shilling per day. Altogether, British naturalists in search of fresh seas and creatures new may well consider the generous claims of the Rovigno station.

THE Royal Meteorological Institute of the Netherlands has issued its forty-fourth *Jaarboek*, containing observations made thrice daily at a number of stations, and hourly at four places. A considerable improvement has recently been made in the Dutch meteorological service by the adoption of the international scheme of publication recommended by the meteorological congresses; but it has already been pointed out by Dr. Hellmann that a further improvement might be made by taking the evening observations at one hour, instead of 7h., 8h., or 10h. p.m. as at present. There are few countries that can boast of a longer continuous series of trustworthy observations.

THE Rev. S. Chevalier, Director of the Zi-ka-wei Observatory, near Shanghai, has published a detailed discussion of the typhoons of 1892, based on observations made in the months of July, August, and September, on ships and at land stations. The pamphlet contains synoptic charts and valuable data for the study of the behaviour of these storms, and also a chapter devoted to the examination of some important questions relating to them. It has been stated that an area of high pressure always precedes, by some days, the arrival of a typhoon, but out of five of the principal typhoons of the year 1892 the author finds that only one was preceded by an anticyclone. Another important question is that of the convergence of the winds towards the centre of the cyclone. The observations show that the winds do converge towards the centre, not only in the exterior zone of the typhoon but also in the whirl itself. With regard to determining the distance of the centre of the typhoon according to the fall of the barometer, the conclusion arrived at is that while the fall is more likely to give an idea of the distance of the centre than the absolute height, the figures show clearly that no exact measure of the distance can be obtained by that means. An empirical rule for determining the rate of progress of the centre, formulated by Captain Fournier, has been found useful in some cases. An explanation of this rule and examples of its application are given in the pamphlet in question.

THE determination of the pitches of very high notes appears to be greatly facilitated by an arrangement recently worked out by F. Melde, and described in the current number of *Wiedemann's Annalen*. The extreme difficulty of distinguishing between the various octaves of the same high note, led Mr. Melde to abandon the use of the ear altogether, and to apply the microscope to the more reliable vibrographic method. To prepare the plate for taking the traces, he melted a mixture of stearine and olive oil, and spread it out with the finger, thus obtaining a thin layer with a delicate ridged structure, which could be renewed by simply passing the finger over it. The tracing point chosen was a short piece of hair from the violin bow. By attaching one of these to each of the vibrating bodies, say a high tuning-fork and a rod vibrating longitudinally, and drawing the glass plate rapidly over the two tracing points, wave curves were obtained whose periods could be easily compared under the microscope. The tuning-forks were set vibrating preferably by means of a wet glass rod rubbing over a piece of cork attached to one of the prongs. This manner of exciting vibrations offers several advantages over that of the violin bow. The sounds produced are much more intense, they can be produced by either hand, or two at a time, and the rod is less perishable and less likely to get into the way of the other apparatus.

AN interesting paper on the difference of potential between an aqueous and alcoholic solution of the same salt, by A. Campetti, appears in the *Atti dell'Accademia di Torino*, vol. xxix. The author has determined the difference of potential which exists at the surface of separation between an alcoholic and aqueous solution of various salts, such as ammonium chloride, lithium chloride, calcium chloride, &c., which are soluble both in water and alcohol. The difference of potential was measured by means of dropping mercury electrodes, which have given satisfactory results in the hands of Pascheri. The measurements were undertaken with a view to seeing whether the numbers obtained by experiment agreed with the values obtained from Planck's formula, which gives the difference of potential in terms of the concentrations and ionic velocities of the electrolytes. The author finds that the formula is not applicable, but that in the case of two different solvents it is necessary to suppose there is some additional force coming into play, which is not taken account of in Planck's equation. He intends, in a subsequent paper, to give the results he has obtained on the ionic velocities in different solutions.

IN connection with the question as to the point of application of the mechanical force experienced by a conductor conveying a current in a magnetic field, M. Pellat has communicated a second paper to the Société Francaise de Physique, in which he comes to an opposite conclusion to that given in a former paper on this subject (see note in NATURE, March 22). The error in the former paper was due to the omission of a term in one of the equations. For if we consider a gramme ring at rest and on short circuit, and suppose that the field magnets are rotating, the wire of the armature is traversed by an induced current which warms it up, and it would be necessary to withdraw a quantity of heat Q to bring it back to its initial condition. If we consider the armature alone as a system, the electromagnetic forces, in this case, perform no work, and this heat communicated to the ring can only be due to energy supplied to the ring by the action of the electromagnetic forces, the product of an electromotive force by the quantity of electricity displaced being the equivalent of work, and this product may be called the work of the electromotive forces; it is work done on the system, and calling it e we have $e = JQ$. The same takes place when the ring is replaced by the Foucault disc. Consequently, in the case when the disc is in movement, the field magnets being fixed, it w is the work done by the weights which drive the disc, and x that done by the electromagnetic forces, we get

$e + x + w = JQ$. Hence, since $e = JQ$, $x = -w$. On the other hand, if we consider the disc and field magnets as forming the system under consideration, then $w = JQ$, and therefore $e = -w$. Since, therefore, the work done by the electromagnetic forces, in the case of the turning disc, is not zero, while the induced currents remain at rest with regard to the field magnets, the point of application of the electromagnetic forces must be the matter conveying the currents, and not the current itself, as the faulty reasoning in the previous paper indicated.

DURING 1893 a number of British agriculturists visited Canada, with a view to report upon the agricultural resources of the country. Among these visitors were Profs. James Long and Robert Wallace, and the reports prepared by these gentlemen have just been published. With the object of seeing exactly what is done by the Government for the benefit of the farmer, Prof. Long visited three of the five experimental farms which are now in full working order in the Dominion—those of Ottawa, Brandon, and Indian Head. The Ottawa farm is some five hundred acres in extent, and the reports of the experimental work done in it are sent to 25,000 farmers. The Manitoba experimental farm consists of 625 acres of land, in which a large number of valuable tests of grain suited to the country have been carried out. The experimental farm at Indian Head covers 680 acres. These farms are of the utmost importance to agriculturists. Hundreds of experiments are made in them with cereals, pulse, grasses, fruits, vegetables, forest trees, and plants of other kinds, with the object of providing the farmer with the best seed or the best variety. Some day, perhaps, our Government will promote the prosperity of agricultural interests in the British Islands, by establishing and endowing similar experimental stations here.

THE members of the London Geological Field Class will visit Wanborough and Guildford on Saturday, April 21, under the direction of Prof. H. G. Seeley, F.R.S.

MESSRS. BLACKIE AND SON have issued a guide to the Science and Art Department examinations in heat, and one to the examinations in hygiene. Both books contain answers to questions set from 1886 to 1893, inclusive.

THE "Handbook of Tasmania" for the year 1893, has been received. It contains a large amount of important statistical information referring to the colony, and a brief epitome of the historical portion of the "Tasmanian Official Record," which will in future be issued tri-annually instead of annually.

THE April volume of *The Country Month by Month* (Bliss, Sands, and Foster) should be obtained by all ramblers through "meadows pied" and over "hillsides breaking in blossom," during this month. The book is brightly written by Mrs. J. A. Owen and Prof. G. S. Boulger, and forms a most interesting companion for country walks.

THE scientific publications of the Government of South Australia are very much in arrears. We have only just received the volume of meteorological observations made at the Adelaide Observatory and other places in South Australia and the northern territory, during the years 1886-7, under the direction of Sir Charles Todd, C.M.G., F.R.S.

THE Camera Club Conference will be opened by Captain Abney, at the Society of Arts, on Monday, April 23. Among the papers down for reading on the following day is one by Prof. W. Roberts-Austen "On the Methods of Recording High Temperatures by the Aid of Photography." Mr. A. Mallock will treat of "The Amount of Photographic Action Produced by Various Lengths of Exposure and Intensities of Light," and Mr. Andrew Pringle on "The Keeping Qualities of the Modern Dry Plate."

THE *Journal* of the Royal Statistical Society for March contains an important and comprehensive paper (the Howard Medal Prize Essay) on "The Perils and Protection of Infant Life," by Dr. Hugh R. Jones. The author concludes by saying: "I have insisted that the preventable forms of child neglect are in the main referable to want of parental responsibility—a condition which, it is certain, largely depends on ignorance. The remedy—the only remedy—in which I have any faith or confidence, is education."

THE report of Mr. C. Meldrum, the Director of the Royal Alfred Observatory, for the year 1892 has recently been issued. Though the work of the observatory refers chiefly to meteorology and terrestrial magnetism, a very useful part of it belongs to astronomical physics, for photographs of the sun are taken every day, when the weather permits. During 1892, 303 solar negatives and 285 prints were forwarded to the Solar Physics Committee for reduction. Records were obtained of well-marked magnetic disturbances on the following dates:—January 4-5, February 13-15 (this was the disturbance which accompanied the great sun-spot of February 1892), March 6-7, March 12-13, April 25-27, May 18-20, June 27-29, July 12-14, July 16-17, August 12-13, September 13, and December 5-6.

THE Royal Meteorological Society and the Sanitary Institute have arranged a course of lectures on meteorology in relation to hygiene, to be given in the Parkes Museum on Mondays and Thursdays, from April 23 to May 10. Mr. G. J. Symons, F.R.S., will begin the course with a lecture on "Instruments and Observations and their Representation." He will be followed by Dr. H. R. Mill on the "Temperature of Air, Soil, and Water." Mr. R. H. Scott, F.R.S., will lecture on "Barometric Conditions and Air Movements"; Mr. W. Marriott on "Moisture, its Determination and Measurement"; Dr. C. Theodore Williams on "Climate in Relation to Health, and Geographical Distribution of Disease"; and Mr. F. Gaster on "Fog, Clouds, and Sunshine."

WE have received from Messrs. O. Newmann and Co. a copy of a small book, devised and arranged after the directions of Dr. H. Zwick, on "Optical Experiments." In it are described a series of 150 experiments illustrating the laws of the propagation, reflection, and refraction of light. To make this course more useful to the class of student for which it is specially intended, namely beginners, the apparatus chosen is of a simple kind. The light source adopted throughout is that of a candle, and the experiments are selected accordingly. All the instruments referred to in the text are stated to be perfectly trustworthy, and the experiments are arranged for class-work so that many scholars may view them at the same time. For those wishing to occupy themselves with the more simple physical experiments, the book will be a useful guide. The descriptions of the experiments would perhaps have been improved if some of the technical terms employed had been more fully defined; for instance, in the first experiment the beginner is introduced to the words "rectilineal transmission," "translucent," &c. In the preface, however, Dr. Zwick refers the reader, concerning the headings, to any good text-book of natural philosophy, thus restricting himself solely to the description of the experiments. Numerous diagrams accompany the text.

AT the Institution of Civil Engineers, on April 3, Mr. C. Hunt gave some interesting particulars with regard to the manufacture of gas. It has been generally assumed that the deficient yield of tar which usually accompanied the use of a high carbonising temperature is fully made up by increased production of gas. In Mr. Hunt's experience, however, the highest production of gas has been accompanied by the largest yield, both of tar and ammoniated liquor. Experiments have

shown that there is a falling off of illuminating value when very high yields of gas are obtained. While the best general results may be obtained from carbonising at a fairly high temperature, it is essential that the gaseous products should be enabled to pass freely away and without encountering in the ascension-pipe any absorbent of hydrocarbons such as thick tar. Mr. Hunt has also tested the lime and air process for eliminating sulphur compounds from gas. Daily tests were made of the amount of oxygen in the gas from certain gas-works, and it was almost invariably found that when the oxygen went up the sulphur compounds followed. From this experience it was concluded (1) that oxygen, so far from assisting in the removal of sulphur compounds, was actually prejudicial, at all events, when present in any appreciable quantity; (2) that it was of use mainly for oxidation of the sulphuretted hydrogen by which economy of lime was effected, and the spent lime, being chiefly in the form of carbonate, with a large percentage of free sulphur, was rendered practically inodorous; (3) that the quantity of oxygen, either pure or as atmospheric air, which might be safely employed, having regard to reduction of sulphur compounds, varied with the CO_2 present, *i.e.* the less CO_2 the more oxygen. It further appeared that unless air could be almost completely excluded, the lime and air process was less suitable for the removal of sulphur compounds than one in which each impurity was separately attacked.

THE final results of an elaborate investigation of the atomic weight of barium are communicated by Prof. Richards, of Harvard, to the current issue of the *Zeitschrift für Anorganische Chemie*. The care which has been bestowed upon the perfection of the analytical processes involved, and upon the preparation of absolutely pure materials, together with the really remarkable agreement between the large number of individual values obtained, will doubtless cause this stœchiometrical contribution of the Harvard laboratory to take high rank among the more exact atomic weight determinations. A short time ago, Prof. Richards gave an account in the same publication of a series of determinations based upon the analysis of barium bromide, from which the value 137·43 for the atomic weight of barium was derived. This number is considerably higher than the usually accepted value, 136·8, derived from the determinations of former observers. In order to confirm his work, Prof. Richards has since carried out a similar investigation of the chloride of barium, an undertaking much more complicated than that of the bromide, on account of the slight solubility of silver chloride in water. Eleven series of experiments, including altogether forty-nine individual atomic weight estimations, have now been carried out, having for their object the determination of the ratio of barium chloride to silver chloride, of barium chloride to metallic silver, of barium bromide to silver bromide, and of barium bromide to silver. The atomic weight finally arrived at, if oxygen is valued at 16, is 137·43; the actual number obtained by use of the chloride was 137·439, and that derived from the bromide 137·430. Moreover, the highest and lowest individual values obtained among the whole fifty separate estimations were 137·42 and 137·45, an amount of accordance which affords evidence of the extreme precautions taken, and of the high degree of accuracy attained. If the Stas value for oxygen, 15·96, is assumed, the atomic weight of barium is 137·10, and if the new value, 15·88, is taken as comparative standard, that of barium becomes 136·41. It is interesting that the experiments with barium chloride afford a means of independently ascertaining the atomic weight of chlorine, and the number thus obtained is 35·457, identical with the value ascribed to it by Stas.

THE additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mrs. Walter Palmer; two Leopards (*Felis pardus*, ♂ ♀) from south-east Africa, presented by Mr. J. Gardiner Muir; a Vulpine Phalanger (*Phalangista vulpina*, ♂) from Australia, presented by Mr. Raymond W. Cooper; a Crab-eating Opossum (*Didelphys cancrivora*, ♂) from St. Vincent, presented by Mr. G. Stephen; a Tawny Owl (*Syrnium aluco*) British, presented by Mr. G. L. Hunt; a Greek Tortoise (*Testudo græca*) European, presented by Miss Leigh; a —— Elaps (*Elaps*, sp. inc.), a Pointed Tree Snake (*Dryophis acuminata*), a Clouded Snake (*Leptognathus nebulosis*) from Trinidad, W.I., presented by Mr. R. R. Mole; a Tarantula Spider (*Mygale*, sp. inc.) from Trinidad, W.I., presented by the Rev. S. D. Wright; a Malabar Parrakeet (*Palæornis columboides*) from India, deposited; four Bahama ducks (*Dafila bahamensis*, ♂ ♂, ♀ ♀) from South America, two Mandarin Ducks (*Œx galericulata*, ♀ ♀) from China, a Spotted-billed Duck (*Anas pœcilorhyncha*, ♀) from India, a Ruddy Sheldrake (*Tadorna casarca*, ♀) European, four White-backed Pigeons (*Columba leuconota*) from India, purchased; a Burrhel Wild Sheep (*Ovis burrhel*, ♂) from the Himalayas, received in exchange.

OUR ASTRONOMICAL COLUMN.

DENNING'S COMET.—*Astronomische Nachrichten* (No. 3222) contains the following elements, computed by M. Schulhof, for the comet discovered by Mr. Denning on March 26:—

T = 1894 February 13·20392 Paris Mean Time.

x = 132° 14′ 31″·6
Ω = 75 51 46·1 } Mean Eq. 1894.
i = 6 31 14·0

log q = 0·084720

These elements resemble those of comets seen in 1231 and 1746.

Ephemeris for Berlin Midnight.

1894.		R.A. h. m. s.		Decl. ° ′
April 12	...	10 47 37	...	+23 14·6
13	...	50 7	...	22 45·5
14	...	52 33	...	22 16·9
15	...	54 57	...	21 48·6
16	...	57 18	...	21 20·7
17	...	10 59 36	...	20 53·3
18	...	11 1 51	...	20 26·3

THE NATAL OBSERVATORY.—The superintendent of the Natal Observatory has issued his report for the fiscal year 1892–93. The principal series of observations made during this period was the comparison of the declinations deduced from observations made at the observatories in the northern and southern hemispheres, by a comparison by Talcott's method, of the zenith distances of northern stars and southern circumpolar stars. The opposition of Mars in 1892 threw a deal of extra work upon the observatory. Thirty-eight sets of meridian observations of the planet were obtained, and sixty-two sets of observations taken on opposite sides of the meridian towards the eastern or western horizon. The whole series of these observations have been completely reduced and tabulated, ready for the final discussion for obtaining the value of the solar parallax and distance of the sun as soon as the meridian observations of the planet, made in the northern hemisphere, have been received. The observations made at the Cape observatory supplement those obtained at Natal, and the two sets combine to form a complete set extending over the whole period of opposition. This year will bring another favourable opportunity for determining the solar distance from observations for the opposition of Mars, and the observatory will be far better equipped for observing this opposition than was the case during the last one, and if the weather be favourable a very satisfactory series of observations should be obtained during this, the last, opportunity until the year 1911.

A NEW COMET.—The following announcement has been sent out by the Astronomer Royal:—"Bright comet Holmes, April 9. Right Ascension, 17h. 58m.; North Declination, 71° 30′."

THE INTERNATIONAL MEDICAL CONGRESS.

THE International Medical Congress, held at Rome, came to an end last week. In point of numbers it was a great success, as many as seven thousand members and recognised guests being in attendance, without mentioning the large number of visitors not connected with the Congress.

The Congress was formally closed on April 5, the final proceedings being very enthusiastic.

Prof. Baccelli, the president, in bidding the delegates farewell, said that in attending the Congress they bore testimony to the fact that for enlightened minds the claims of science were paramount. He proposed that the next Congress, which would be the twelfth, should be held in Russia, leaving it to the Government of that country to determine the place of meeting.

M. Danileffsky, in the name of the Russian Government, accepted Signor Baccelli's proposal, the announcement being received with applause. The representatives of all the foreign committees then spoke in turn, and referred in warm terms to the hospitality shown to them by the King and Queen of Italy and the Italian Government.

We hope to give in our next issue an account of the proceedings of some of the sections. In the meantime, however, we reprint from the *British Medical Journal* the abstracts of two addresses of great interest.

Prof. Michael Foster on the Organisation of Science.

One of the most salient features of animals is a division of parts whereby each part does its best to fulfil the work required of it. On the other hand, all the parts of the body are so united that every part works for the common good. Just as in the body politic there are laws and unwritten customs which regulate the actions of the members, so also with the workers in science. Differentiation had proceeded to a great degree amongst scientific workers; each inquirer has now to limit his inquiries not only to one science, but to one part of that science, and there is no doubt that in the future division of labour will have to proceed still further.

So much for division; but what about integration? Is it possible for anything to be done to unite the different scientific workers together? I think that there is, and it seems to me that this International Congress of Medicine—of medicine which is the mother of all sciences—is a suitable opportunity, and Rome is a fitting place to propose the doctrine that human wit may well devise some tie that will bind all the workers of the world together by one indissoluble knot. What is wanted in science is organisation; by this the labours of the individual will be lightened and the progress of science will be furthered. Let me now ask whether organisation can be applied and inquiries carried out by single investigators?

There is, however, a danger which I do not want to underrate, for we must bear in mind that an investigator is like a poet, *nascitur non fit*, and there is a danger that by organisation we may tend to nurse the unfit and hamper the fit. There are two main incitements to investigation—one is love of fame and the other love of truth, that curiosity to know the truth which drove Adam and Eve from the garden, and which has ever since stimulated mankind. Ambition will be hampered by organisation, the lover of truth for its own sake will be aided, and the latter is undoubtedly the more important of the two. As I look around me, I see everywhere waste of effort. Every inquirer knows that when he commences an inquiry he is sure to come upon side issues which have to be investigated, and he is obliged either to devote much time to them and partly to solve them, or he has to leave them alone. Every inquirer goes to his rest leaving many of his problems unsolved. There are plenty of young men capable and anxious to solve them, but, owing to the want of organisation, they do not know what to undertake, or they dig wells where there is no water. In all this energy is wasted, and in addition a great deal of work is thrust upon the world which the world were much better without—work which is crude, unfinished, unmatured, a veritable sewage thrown into the pure stream of science, which has to be got rid of before the stream can again become free from impurity. Is there any way by which this waste of energy may be diminished and this increasing flow of useless matter lessened? It is on this point that I wish to make a suggestion to the Congress. In the old times there were guilds by which the workers in any one branch were united together. Now in science many men have laboratories and no men to work in them, or no men that are fitted to work in them; others, again, have men and no laboratories. Would it not be possible to form a guild, and so unite these workers, so that by the guild the work done might be polished and completed before it is given to the world?

There are many kinds of inquiry which would be much benefited by concerted action. Two of these which merge into each other are statistical inquiry and what we may call skilled inquiry. The chief feature of the former is that the data which are gathered should be homogeneous. There should be no exercise of individual judgment by the inquirer. It is evident that the value of statistics largely depends upon the width of the field covered, and the collection of statistics by many nations at the same time would be of the greatest value. I can especially aver that this is the case in the biological sciences. By this means we might avoid the collection of statistics based on insufficient cases or over so limited an area as to be worthless, couched in percentages, so that they have an apparent value which is most misleading and dangerous. The second kind of inquiry is the skilled inquiry, that kind of inquiry which should only be undertaken by skilled men. As an example, I may mention a solar eclipse. How valuable the knowledge that has resulted from several skilled men observing and discovering the same thing at the same time! The favourable opportunity for an investigation may be a short one, and the advantage gained by concerted action would be in such a case very great. Again, the number of skilled observers living at any one time is not great, and they are spread over many lands. The problems of the future must be faced by the best men, and why should not these men work together? Why should not the best men be selected—now an Italian, now a German, now a Frenchman—because they are best to do the work for which they are best fitted? It is only in this way that we can get the best work done in the future.

Expense is another reason why scientific work should be taken up by nations in common, for every day the pursuit of scientific investigations becomes more costly, and may in any given case be too expensive even for the richest nation.

If such a proposal be a good one, then there must be some international organisation if it is to be possible. No nation waits to prepare for war until the drum beats to arms, so in science we should be ready with our organisation for whatever work may present itself. The chief difficulty of starting such an organisation is the expense at the commencement; when that is once got over, the cost of fuel to keep it going is not great. If once in working order, a permanent organisation could at any time start the machinery which was necessary for any special work. Scientific work is the property of the whole world, and as such the whole world should combine to fight the powers of darkness and ignorance.

The dangers which apply to the individual in such an organisation also apply to the nation. Ambition when applied to a nation is called patriotism; but surely the love of truth is higher even than patriotism. Leaving generalities, every worker knows how much difficulty small things create in his work. For instance, nomenclature. How great a help it would be if there were only an international tribunal before whom every new name had to go, and who would, as it were, stamp the coin of science before it was allowed to pass into circulation. Again, it may happen that some inquiry has to be carried on under special conditions. An example of this is the work done at the zoological station at Naples. This is in reality an international institution, although it has been chiefly originated by one man; such an institution ought to be international, and ought not to depend for its existence upon the energy of one man.

One more instance. The condition of scientific literature can only be described as one of chaos. Think of the literature that a scientific worker has to read through before he can know what has been done by others—journals, weekly, monthly, yearly, in all languages, journals upon all subjects! Whereas, if all the papers on one subject could be collected under one cover, think of the saving of time! Even if this cannot be done, at least it might be possible to have a universal index which should appear at frequent intervals, and which should be re-classified every five, and again in ten years, and so on. Such a list of titles would enormously lessen our labours. I would suggest that this Congress should initiate the work, should set in motion the formation of such an index. If this be done it will be a commencement in organisation, and if this be done successfully we

may then pass on to other international works which may present more danger and greater difficulty.

Prof. V. Babes on the Position of the State in Respect to Modern Bacteriological Research.

The health of the community is under the care of the Department for Internal Administration of the State; and inasmuch as health is essential to the happiness of the individual and the development of human energy, it appears, for most important economic reasons, to have a first claim on the Government. Those learned in such matters are, however, of opinion that, in spite of its immense importance, of all the different departments of internal administration that of hygiene has remained the least developed in Europe. I will first attempt to throw light on this sad circumstance, affecting as it does the most valuable of human possessions—one that gives value to other possessions—and then I will search for means to obtain for sanitation its proper position amongst State institutions.

HISTORICAL SURVEY.

The care of public health does not necessarily advance hand in hand with education; a lively and practical public spirit and a great vitality in the people cause a place to be yielded to the demands of State sanitation. The oldest civilised peoples regarded it as a public duty to protect the health of the individuals. With a view to this, the laws of Sparta, of the ancient Egyptians, and of the Israelites, had more hold than modern legislation on the life of individuals. Still, their rules were not founded on any sure basis, but rested entirely on old traditions and experiences, which the spirit of the period clothed in religious or political dress.

In the laws of these old nations matters were regulated, which, according to our modern feelings are now left to the care of the individual, and sexual disease was more rigorously opposed than it is at present. Leprosy, from which the first civilised nations ran great danger, was opposed by more rational laws than it is thought can be opposed to the just as dangerous or more harmful diseases of to-day. The good results of the working of the Mosaic laws can still be seen even in our days when State sanitation can derive so much aid from modern sanitary science. The Mosaic laws owing to their religious form took deep root in the domestic life of the people, and the vitality of the Jews of to-day bears witness to their wisdom. The Jews thrive where the native population, in spite of special legal protection, is decimated by infant mortality and infectious diseases. The hardening of the constitution, the dress and baths of the people are neglected by modern legislation for the reason, though expressed in various ways, "that the State has only to look after the health of individuals so far as the health of individuals affects the community."

When one contrasts this vaunted principle of individual liberty with the limitation of this liberty which is effected in the interest of religion, of the ruling classes, and even of traditions and conventional ideas, one cannot repress the thought that this magnanimous permission of the State allowing each individual to make himself ill if he likes, to treat himself as he thinks best, and spread his illness, is not merely dependent on the principle of individual liberty.

But also in another direction did the civilised nations of antiquity set us a good example—namely, in the repression of general causes of disease. Aqueducts and canals were made at great expense, marshes were drained; during the plague of Athens great fires were made and excreta burned, dead bodies were cremated, and the principles of public hygiene were also popularised by lectures. In spite of the much greater State incomes and the technical facilities of modern times, most modern States cannot nearly rival those of ancient times in the proportion of their sanitary undertakings to the number of their population.

In respect of public health, Rome advanced still further than Eastern civilisation. Aqueducts and canals were undertaken in early times; owing to the number of public baths in Rome, probably each citizen could have a free bath daily, and similar establishments existed in the smaller towns of the Roman empire. The irruption of barbarian hordes on the Roman empire disturbed the whole organisation of public health, and Christianity to some extent helped in producing this disturbance, especially by its ascetic disregard for corporal welfare, and by the absolute separation, which it enjoined, of religion from all matters of bodily health.

Epidemics raged and exercised a wholesome influence, in part by reducing the population, and by directing attention to the infectious nature of diseases. People began to notice that contagion was carried about by men and clothing, with the result that quarantine and sanitary police were introduced by some towns of Upper Italy. Venice was particularly active in these matters of hygiene, but the unsettled political state of Italy long prevented the proper development of State sanitation. After the unification of Italy this development soon began to show itself, and the law of 1866, and particularly that of 1888 ("Sulla tutela dell, Igiene e della Sanità publica"), were framed, the latter of which might serve as a model to other States of Europe, with the exception perhaps of England. By this law the authorities on hygiene take that position which, as competent authorities, is due to them. As well as a competent upper board of health there are provincial boards of health, all of which of their own initiative can move proposals on hygienic questions, and must be consulted on sanitary ordinances. These boards of health are not dependent on the administrative officers, and all urgent measures recommended by them must be immediately carried out by the prefects.

In England a practical public spirit early developed itself. What was accomplished in hygiene began from below, and took deep root in the customs of the people, before developing into institutions of the State; this insured its usefulness and recognition. The practical independence of the parishes, as well as the Parliamentary system of that country, showed to advantage in this matter; there were water supply committees, and the parishes left to the sanitary authorities the choice of their own methods. As in other countries, infectious diseases first gave occasion for thorough trial of sanitary arrangements. Committees were formed for statistical inquiry into mortality with regard to soil, overcrowding, with regard to the pollution of air, water, &c., and the activity of these committees led to important conclusions regarding the artisan population, which had attained so great an importance owing to the growth of the manufacturing towns.

The Public Health Act of 1848 was formed in accordance with the then existing state of scientific knowledge on a statistical basis, a testimony to the public spirit of the country. Local bodies, under the guidance of a doctor, had executive power, and could levy rates to cover the expense of water supply, canalisation, &c. Unfortunately, as usually happens in such cases, when a better hygienic condition was reached, the means by which it had been obtained were neglected. The Board of Health was abolished, but, on the other hand, the Local Boards gained in power. In 1871–72 a Board was instituted for seeing to the poor, sanitary matters, and Local Government, the whole country being divided up for this purpose into sanitary districts. Each of these districts possesses a medical officer of health, a sanitary inspector, and a public analyst. These officers work in connection with each other, and with the central officers, and possess the power of taking measures to oppose epidemics.

In Prussia the sanitary arrangements have a bureaucratic aspect. There was a College of Medicine and a special College of Hygiene, to which the doctors of towns and districts were subservient. In 1862 officers were appointed to the different provinces, but their power was limited by the central bureau.

In Austria, since 1870, there has been a chief sanitary officer working with the junior ones, who, at all events, have the power to take first steps.

In Roumania, by the law of 1873, the sanitary administration is placed in active communication with the doctors of towns and districts, and controls them by yearly inspection. The latter are, in the same way as the hospital doctors, recommended by the special sanitary adviser to the central administration.

In France, although the medical schools are distinguished, public health is not sufficiently cared for, because the learned scientific bodies have hardly any voice in its administration. The prefect and the mayor do all the administrative work, and an authority on hygiene is only consulted when the prefect thinks fit.

Of late years attempts have been made to include institutions for the furtherance of scientific medicine within the State

organisations for hygiene. We shall see that just the most rational hygienic measures are opposed and partly abolished on the plea of their being inconvenient to commerce and intercourse, and to the influential Government administrators. International arrangements for protection against epidemics have also lately several times been neglected for the sake of the commerce and intercourse of the great nations, and partly at the sacrifice of smaller nations with less complete sanitary arrangements.

The Position of Doctors towards the State.—The medical profession in many countries is not permitted to exercise any executive right to protect the country against epidemics. It must be allowed that there is a tendency for the scientific men employed in some State institutions of hygiene to separate themselves from the statesmen who founded these institutions. It must appear to us doctors unintelligible that, though statesmen recognise the immense importance of public health, they will not surrender the executive power of sanitary administration into the hands of those who have made it their special study. Doctors constitute a hard-worked class, possessing neither the time nor the authority to make their claim felt, and it is to be regretted that so few members of the upper classes of society devote themselves to medicine, which offers them such a field for useful work.

Doctors are not much attracted towards State matters of hygiene, because of the smallness of the pay allowed to those who enter the service of public hygiene. The State should pay its sanitary advisers better, since it expects of them a special professional education, and should, at the same time, forbid them the practice of ordinary or legal medicine. Doctors would then be able to devote themselves to finding out and remedying the causes injurious to public health, just as they would those injurious to the health of a family. Finally, every facility should be given them of making themselves familiar with the science of government, especially legislation, political economy, and statistics.

Government Sanitary Institutions.—The best way to improve the quality of the doctors is for the State to afford them the means of attaining the highest essential education. This necessitates State institutions specially designed for the purpose. An attempt of this kind was made in 1876 in Germany, but want of understanding and money caused the institution to fall short of the mark. The Imperial Board of Health at present does not possess, as it was at first intended, the superintendence either of medical and veterinary measures or of medical instruction, neither are the laboratories sufficiently endowed to meet the requirements of proper sanitary research. Nevertheless, with the exception of Roumania, no other country possesses a similar institution, though they possess institutions, privately erected, for the study of infectious diseases, which act more or less in harmony with the State administration.

A few words, therefore, may be said on this institution of Roumania. As Roumania stands on the boundary between East and West, it was peculiarly exposed to infectious diseases, not to mention several imperfectly known diseases of the country itself. In 1887, epidemics amongst the cattle and widespread hydrophobia rendered it advisable to establish such an institution in Roumania; moreover, no sort of institution for pathological anatomy, pathology, or bacteriology existed there at that time. The institution is well endowed, and adapted to meet the requirements of scientific investigation and instruction, but unfortunately possesses no administrative authority.

[Prof. Babes then gave a description of the work carried on in the various departments of the Roumanian Institute, showing in what way a State institution of this nature may, even in spite of special difficulties, render service to hygiene and science. He went on to say that]:—

Such an institute should always be in connection with a hospital for infectious diseases, and the institute itself should be divided into five or six closely-connected parts: (1) For clinical treatment and experimentation; (2) for pathological anatomy, bacteriology, and experimental pathology; (3) for infectious diseases of animals; (4) for chemistry; (5) for statistics, superintendence, and the library; (6) for lecture rooms, museum, and management.

The building should consist of a main edifice and several pavilions. The chief edifice must be for laboratories, and, if outside the town, there must be a dwelling house close by for the director, staff, and servants. There must be a completely isolated pavilion for inoculation of men, and about three others for examination of animals, and there must be several places for breeding animals.

The staff should consist of director, about four superintendents of departments, eight assistants, officials in charge of statistics, a librarian, a manager, and about eight or ten servants. The total cost of the undertaking would reach about 1,000,000 francs.

The director and his staff should give lectures, &c., with special regard to hygienic administration in its widest sense—for doctors in the public service, for candidates desirous of obtaining medical offices, for architects, engineers, administrative officials, and students. The institute for pathology and bacteriology might be under the control of a "home office" or a "health office," but must have the right of preparing hygienic laws for the State authorities.

Besides this great institution there should be well-endowed professional schools for lower officers of health, and the elements of hygiene should be taught by capable teachers in all schools. No public buildings, aqueducts, or canals should be constructed by persons who have not received proper instruction in hygiene.

Institutions of this kind could systematically investigate the most important hygienic and medical questions. In times of peace the fight should be for the people's health, and only a scheme of this kind will enable hygiene to secure her place as the most important part of statesmanship.

THE ATTITUDE OF STATESMEN TOWARDS THE CLAIMS OF HYGIENE.

The chief reasons advanced why statesmen refuse to give very great power to the hygienic authorities, may be enumerated as follows: That the necessary means are wanting to enable the State to undertake the task demanded; that the personal liberty of the individual would be endangered; that the scientific basis is still not sufficiently sure; that the demands of science are very often hard to carry out; and, lastly, that if they were carried out, other equally necessary State duties might have thereby to be neglected, or the consequences might be injurious to the State (Löhning).

(*a*) *Liberty of the Individual.*—Different countries and schools are not agreed on its proper bounds. One opinion is that the State has not the right to exercise restraint on a man, provided that he hurts himself only. Stein, on the other hand, considers that the health of the individual affects the community just as much as it does the individual himself; and, indeed, so many diseases have turned out to be more or less of infectious nature, that the ground is now removed on which the former opinion was founded. Some hold up as their model English principles of individual liberty, whereas it is exactly in England that the sanitary authorities have most control over this individual liberty. It is obviously not logical to argue that because it is not right to compel a man to undergo an ordinary amputation, therefore one should have no power over a man when he has an infectious disease. Again, if the State is compelled to control the liberty of a criminal, why should it not also control that of persons affected with syphilis or tuberculosis, who may spread their diseases and thus harm others? Another reason (less frequently mentioned) against the right of restricting individual liberty is that this power might be misused for the sake of party politics, &c. This affords an additional argument in favour of having a sanitary administration quite independent of party politics.

(*b*) *The Disposal of Public Funds.*—A more difficult question is whether the State possesses money enough at her disposal both for looking after public health and the health of individuals. Emergency measures adopted during epidemics such as cholera, can often not be carried out owing to want of previous organisation in the hygienic department. A bureaucratic paper regiment is nowhere so unpractical as in battle against the powers of nature. The administrations for war and religion in most large nations are best endowed, whilst the condition of the other administrations depends greatly on the energy and influence of the Minister at the time, and since hygiene is usually included in the department of the Minister for the Interior, who is no professional man, but often influenced by party interests, the prospect in this direction is not very hopeful. An independent Ministry of Hygiene, with a professional man at its head, could do much more.

Under the present state of "armed peace" in Europe, the

maintenance of such large armies is very costly to the different Governments. Part of the army might possibly be made use of for sanitary purposes without impairing its power in case of war. But besides the army, other departments (religion and law) are richly supplied in comparison with hygiene. On the whole, it seems that hygiene is neglected because the State funds are employed for other and less necessary purposes.

(*c*) *The Importance of Hygienic in comparison with other State Expenses.*—It must be allowed that quarantine is hurtful to commerce, but modern quarantine methods are much less so than the older ones. Quarantine is also a hindrance to intercourse, but in this respect affects the ruling and wealthy classes rather than the lower ones, to which latter, on the other hand, epidemics are more baneful. If the money gained by neglecting quarantine arrangements were spent for other sanitary purposes or for the lower classes, one could not object so strongly; but it is spent on the army, and therefore against the direct interests of the lower classes.

It is objected that quarantine is unpractical. I cannot enter on that question here, but perhaps the failure of quarantine measures on the frontier depends not so much on the nature of the infectious disease as on insufficient knowledge or want of exactness in carrying out the measures. At any rate no international arrangement has the right to withdraw rational quarantine from a State which has hitherto been protected by it, and whose internal arrangements are not sufficiently organised to suppress an epidemic should one arise. The Hamburg cholera epidemic was more injurious to the town than a rational quarantine would have been. However important school instruction may be to the State, schools should be closed immediately on the outbreak of an epidemic. The danger in institutions for small children is especially great on account of their peculiar susceptibility to disease and mortality from it.

Position of Modern Bacteriology with respect to its Usefulness to the State.

One reason given for the State neglecting the care of health is the belief that medical science and hygiene cannot on sure ground fight against and keep off disease. This cannot be altogether denied, and must be discussed as regards the various diseases, but the belief arises in part from the means employed by the State against the diseases being insufficient, and therefore failing to produce the required effect.

(*a*) *Precautions about Water and Soil.*—Modern science has demonstrated the important part played by drinking water in the production of some diseases. Cholera bacilli have been found in bad drinking water, so also saprogenic bacilli, which, according to my investigation, play an important part in infantile diarrhœa, enteric fever, and dysentery. The bacteria of suppuration have likewise been found in drinking water; and, according to my latest investigations, it appears that the parasites of malaria pass through one stage of their development in water. It is therefore clear that one urgent duty of the State is to provide good drinking water. This may be obtained from deep [wells or from springs direct from the rocks, or (under careful management) by filtration through sand. Our discovery that by small quantities of alum, water may not only be clarified, but also sterilised, may in time be made of some practical use. On the whole, one must doubt whether water obtained by sand filtration is sufficiently good to be used as drinking water, and the various household filters must be rejected.

The soil must be purified by drainage, but the canalisation of towns is still an open question. The drains of a town can only be carried into a river when the river is of large size. In last year's cholera epidemic in Roumania, I found that the water from the centre of the Danube was almost sterile at only a small distance below the infected towns, although the cholera bacillus could be repeatedly found in the water of the immediate neighbourhood of the towns. Therefore, although drinking-water from the Danube in the immediate neighbourhood of the towns could undoubtedly be a cause of the spread of cholera, it seems to me very unlikely that a town can be infected from another town lying much higher up on the river.

[Prof. Babes pointed out that the air can only be rendered infective through dust, though different gases in impure air can produce other illnesses. He afterwards considered the means to counteract such diseases as tuberculosis, syphilis, cholera, typhus, yellow fever, the plague, and small-pox, urging that the State should interfere to prevent the spread of all these and many others. Continuing, he said]:—

From these few examples it becomes manifest that a State, perfected in the way I have laid down, could by the means at our disposal already do much more for the health of its citizens than it does at present, and it is clear that the erection of proper institutions would help to this end. It is clear also that we are not justified in separating the public health from that of the individual, but just on this account the State work will be increased and a thorough reform of the sanitary administration appears necessary.

If we were to contrast the demands made here with those acknowledged by statesmen, we should see that the latter limit the rights of the State too much and do not take the universal importance of hygiene into due consideration. Although they profess to acknowledge the immense importance of hygiene, they place other State interests in the front, which prevent the carrying out of measures for the advantage of hygiene; they only recognise certain conditions under which the State can take care of the health of individuals, and they always dread the interference of the State with family life, though in the interest of public health.

Against these objections science will be powerless until it can practically and clearly demonstrate the results of modern research; but on our part it will first be necessary to free ourselves of all non-scientific interests, and leave to others the interests of commerce, industry, politics, the army, and the family. There should be doctors who are not fettered by practice, but specially trained to make known to the ruling bodies—especially the Parliament—the advances and practical application of science, so as to obtain that position for the organisation of hygiene which belongs to it as being of the greatest importance for the happiness of the citizens.

The first result of this should be the erection of a richly-endowed institute of State hygiene, in which laboratory work may be turned to practical use, and which may serve as a high school for the statesmen in question, directors of hygiene and hospitals, and all Government officials, whether of the departments for instruction, medicine, or the useful arts, who occupy themselves with matters of hygiene.

An international and social reform should be obtained, because individual health cannot be separated from public health, because the health of one class is necessary to the health of other classes, and the health of the lower classes is of the highest economical value to the State. The health, however, of the lower classes is affected by an unjust want of the primary necessities of life and health, as well as by the insufficient care taken by the State for public and private health. A settling of the social question becomes, therefore, essential for public health.

Furthermore, there would have to be an international agreement by which the sanitary interests of the working classes are placed above the interests of capital and competition, and by which a part of the expensive State institutions—namely, the armies—are lent or given up for hygienic purposes.

The position of the sanitary officials should be raised, and all the strength of the sanitary department should be used to fill up lacunæ in professional knowledge. The sanitary administration should have equal power with the Ministry, but should be without the political instability of the latter, and, on urgent occasions, should have the free right of direction. Its organs should be more numerous, higher placed, well paid, and excluded from all other political or medical work.

Under such conditions sanitary questions can be thoroughly and scientifically considered, and the proper extent can be found to which the State shall enter on matters of individual and public health.

Although the free mental development of the individual is necessary for progress, the proper conditions for bodily development, which consist chiefly of the keeping off of harmful external influences, are more and more found to belong to the sphere of State work. The State thus perfected is justified and bound to interfere directly or indirectly in the freedom of individual life, and moreover to a much greater extent than before seemed justifiable, because modern research tells that this is in favour of the sanitary development of the community.

Although the sanitary administration of to-day, even in the best developed countries, is but poorly furnished with power, and in most civilised countries is absolutely powerless, nevertheless, in some few countries rational measures could be carried into effect which would clearly show how beneficial the general

adoption of such measures would be. As soon as a sanitary measure has been approved anywhere, as soon as some hygienic discovery has been made in the workshops of medical science, it should be the duty of the State to try it, to estimate its practical value, and to make it generally known.

It is only by such means that hygiene will become a science, that this science will become the most important part of statesmanship, and that the State will become, as it ought to, a healthy State.

ACROSS CENTRAL ASIA.

AT the meeting of the Royal Geographical Society, on April 9, Mr. St. George Littledale read a paper on his recent journey across Central Asia. Mr. and Mrs. Littledale left England in January 1893, with the intention of crossing Asia from west to east, filling up some blanks in the map, and procuring specimens of the wild camel. After purchasing nearly two pony-loads of silver Yamboos, known on the Chinese coast as Sycee Silver, they travelled in carts to Kurla, where they organized a caravan of twenty ponies and forty donkeys, and followed the river Tarim to Lob Nor. They camped by the Lob Nor swamp, but found the water too salt near the edge to drink; by wading out some distance they were able to get some less brackish, which was just drinkable. Along the Altyn Tag range, as far as the Galechan Bulak, there was a certain amount of water and grazing. This was the point where the great Russian traveller, Prjevalsky, turned back; but beyond, the desert was of an appalling nature—hardly any grass was to be found, and water was very scarce; all the men suffered greatly from thirst, the animals lost flesh rapidly, and many died. Water as a rule was only found every second day. Mr. Littledale in this district shot four wild camels, one of which he has presented to the British Museum. Prjevalsky's wild horse was not seen. The guides were thorough scoundrels, and tried to wreck the expedition in every way; on one occasion they denied the existence of a spring from which they were discovered getting water secretly during the night.

Mr. Littledale was unable to see any trace of a large range of mountains marked on the maps as running north-east from the Altyn Tag. When a few days' journey from Sai-ju they met the first inhabitants, and in vain tried by bribes to get a guide to show a pass over the mountains. They afterwards discovered that their interpreter was playing false; he was scheming to get to some town where he could desert.

They passed an embankment several miles in length, which it was difficult to account for unless it was a continuation of the Great Wall of China from Suchan, two hundred miles to the east. At Sai-ju the Chinese officials were civil, but tried to prevent the travellers returning to the mountains, and their men, exhausted with their journey, were now in addition terrified at the tales they heard of the Tonguts, a Tibetan robber tribe, and refused at first to go on.

Colonel Yule questioned the accuracy of Marco Polo's statement that it was a month's journey from Lob Nor to Sai-ju; but, curiously enough, it took Mr. Littledale exactly thirty days to traverse the distance. As they travelled further east, and crossed the Humboldt range, they found the map which had been constructed from native evidence entirely wrong, and a considerable readjustment is necessary in order to secure an approach to accuracy. They passed large herds of yaks and thousands of antelopes and wild asses. Guides were a great difficulty, and the party were soon left to find their own way. At one place upwards of a hundred mounted Tonguts, carrying lances at least fourteen feet long, match-lock guns, and swords, came past their camp. Their followers predicted an immediate attack. Two Ladakis were sent to parley with them; one expounded a repeating rifle with such marked effect that when the other man proposed to explain the beauties of a revolver they begged him to put it aside, and any idea, if it ever existed, of attacking the camp died a natural death.

Mr. Littledale found his own way over the mountains by a pass, and reached the head waters of the Buhain Gol. They travelled for six days through a luxuriant grass country, and camped on the shores of Koko Nor. Thirteen days more found them at Lanchan, where they disbanded their caravan; their interpreter, who was an arrant coward, absolutely refusing to go to Pekin. Here some China inland missionaries kindly helped them to arrange a raft, on which they drifted down the Hoang-ho, a journey of exceptional interest through country which is largely un-mapped. Soon after leaving Lanchan the river dashes through a narrow gorge, and the raft had several narrow escapes of being broken up; it was knocked out of shape, and some of the logs smashed. The boatmen had each an inflated sheepskin to act as a life-buoy in case of accident, but none were provided for the passengers. Lower down the river became broader and shallower, and they changed their raft for a flat-bottomed scow, and reached Bonto in twenty-five days. From Bonto to the Great Wall they passed through a country abounding in ruined towns and villages, the result of the disastrous Mahommedan rebellion in 1861. On September 27 they passed through the Great Wall, and reached Pekin three days later.

ELECTRIC TRACTION.

IN the present state of electrical science and practice, electric traction must be considered as a branch of the electrical transmission of energy. We require, first of all, a natural source of energy, such as coal or other fuel, or water at a high elevation or in motion. In the next place, we require a prime mover to transform energy into work, such as a steam or gas engine, a turbine, or water- or tide-wheel. Then this work has to be transformed into electric current, by means of a dynamo or magneto-electric machine, the so-called primary machine. The electric current has then to be transmitted from the place where it is produced to the place where it has to be used, by means of a conductor or a storage battery. The current has next to be retransformed into work, by means of a motor carried by or attached to the vehicle which has to be moved. This work has then to be mechanically transmitted from the motor to the axle of the wheel of the car which travels along the line.

In each of these transformations and transmissions a loss takes place, reducing the original unit of energy to a less and less fraction of itself. In the case of water, with a turbine as the prime mover, we obtain 60 per cent. of the energy as work or motive power, or an efficiency of ·6. With a steam-engine, owing to the coal having to break up water into steam, a proportion only of the heat or expansive energy of which can be applied as pressure to drive the piston, because of the impossibility of obtaining, at least at present, a perfect vacuum, or, stated otherwise, of getting the lower limit of temperature anywhere near the absolute zero; and again, owing to the loss occasioned by transforming the motion of translation of the piston into rotatory motion, we have a much smaller efficiency than in the case of a water-wheel. About one eighth only of the energy of the coal is transformed in a steam engine into work to drive the axle, or we have an efficiency of only ·125.

The efficiency of electrical machines is very high, as high as ·9 with primary machines or dynamos, and ·75 with secondary machines or motors. The conductor, or its substitute a storage battery, offers a resistance to the passage of the current, and when the latter is used its weight is so much extra weight to be carried by the car.

All these considerations seem to lead to the conclusion that before electric traction can be employed on a very large scale, we must possess a means of producing the electricity on the spot and at the time it has to be used, or, in other words, we must possess a battery in which the energy of coal can be transformed directly into electric current, so that we may do without storage batteries in which to carry electric energy about, or heavy copper conductors through which to convey it at moderately low tension from the spot where it is produced to where it is used, or light aërial conductors through which to convey it at high tension.

How long we shall be without this, or how many minds are engaged in the solution of this or some such problem, we know not, but the moment it is solved, and solved doubtless it will be, there will be such a transformation scene in the industrial applications of electricity as one can hardly conceive. It would mean that for almost every purpose except those in which heating is required, electricity would or could be used. An electric light-producing battery in every house, quite independently of any mains in the streets; an electric power-producing battery, to carry us whither we would on rails or on the street; and in every house, to put an end to all the evils attendant on crowded factories and workshops in crowded streets and towns; such

and other advantages would result from turning electricity from a servant into a master, from a mere transformer of energy into a source of energy.

But we have to do with things as they are:—One hundred per cent. of water-power turned into a net motor power of thirty-three and a third per cent. on the average of the best results; and certainly a wonderful result in itself—nothing of the kind could possibly be obtained either with a steam or a gas engine, and it points to the direction in which, at all events in the meantime, we have to look for a cheap supply of energy for electric traction.

Electric traction may be looked upon as the most economically difficult application of the electrical transmission of energy. The problem of the supply of electrical energy to a factory, for driving such industrial machines as lathes and sewing-machines, and for its illumination when need be, from an electrical main; the problem of utilising a single large steam-engine within a works for supplying motive power to all the different shops, so as to get rid of the waste and inconvenience of shafting, gearing and belting, is not without its difficulties; but these problems are, from the nature of the case, economically simple. The work that has to be done is of a uniform steady character within a compact space.

The problem of electric traction is quite otherwise; the load is now on, now off; the electrical resistance of the line is always varying with the distance traversed; here there are gradients, there curves; whilst the demand for cars, and the most economical supply of car-loads, are matters all of which have to be taken into consideration, and have their influence on the economy of the undertaking.

Six systems have been employed for supplying the motor on the car with electricity; these are using the rails on which the cars travel as conductors. This was done in the first undertakings at Lichterfelde, and at Brighton in the first instance; having a special rail as conductor either beside or between the rails on which the car travels, as used at Portrush, now at Brighton, and on the City and South London underground electric railway; using underground conductors with an open conduit or slot in the road, as at Budapest, Blackpool, and elsewhere; having an insulated underground conductor, such as that laid down for a short distance near Hammersmith; overhead conductors, the system which has the largest application at present, and first used between Frankfort and Offenbach, and mainly in use in the United States of America, where some 3000 miles of electric tramways are said to exist. In the sixth system the conductors are replaced by storage batteries.

The rails on which the cars run are now seldom used for the transmission of the current, as being an uneconomical application, but the use of the third rail is a simple and convenient method, where, as in this country, a pressure or tension above 500 volts is not permitted, and where a third rail on the surface, as in rural districts, or in special tunnels, is not an inconvenience; in urban districts, on the other hand, underground conductors are more suitable. There are two ways of arranging the circuit in underground conductors; either connecting the positive and negative poles of the generator, to two insulated underground conductors respectively, or connecting one pole to the insulated underground conductors, and the other to the rails, which in the latter case are in continuous conductive connection, besides having cross connections at different points.

The use of thin aërial conducting wires is interesting in connection with the practical appreciation of the fact, which took place some years ago, that electric energy consists of two factors, viz. the electromotive force or tension and the current strength. As it is to the latter only that a metallic conductor offers resistance, a certain amount of energy may be transmitted through a very thin wire, if care is taken that the electromotive force of the current is high enough. This is the system which it is proposed to use on the St. Louis and Chicago Electric Railway. The distance between these two towns is 250 miles, and it is proposed to run the cars at the rate of 100 miles an hour; the line is to be divided into twenty-five sections of ten miles each, and in the centre of each section there will be a transformer station. The current is to be generated at a tension of 500 volts, transformed to a tension of 25,000 volts, at which it will be transmitted to the several transformer stations, and will be there reduced to 3000 volts, transmitted to the wire, and thence to alternating current motors attached to the cars, each driving axle being supplied with a separate motor.

Secondary or storage batteries, which is the sixth system, to which we have referred, are specially suitable for use on existing tramways, on account of their simplicity and immediate applicability. The objections to them are their weight and the necessity of renewing them from time to time. As regards the former, they weigh from 1½ to 2 tons, and increase the weight to be propelled from 20 to 25 per cent., and there seems to be a real difficulty in making these batteries at the same time light and durable. The batteries which are oxidised by the direct action of the current are found to be too heavy for electric traction, and those in which the oxide is mechanically applied have been more generally used, the positive plate having a paste of red lead, Pb_3O_4, and the negative a paste of litharge, PbO. The life of a storage battery depends upon its being discharged at a low rate, whilst in traction high rates of discharge are required. It is the positive plate which becomes disintegrated, and cannot again be brought into the condition of metallic lead; the negative plate lasts for a very long time, and can then be re-cast.

This system has been employed on the Birmingham Electric Tramway. On this line a method of controlling the circuit is in use, obviating the necessity of inserting resistances in the circuit, which is always a wasteful way of employing the current. By this means the driver is able with a switch handle to apply from a fourth to the whole of the power which the batteries can produce; the whole would be available when required to start the tram, or when going up-hill with a heavy load, whilst a fourth would be used when travelling on the level with a light load. There are two other positions in which a half or three-quarters can be used as required.

A consideration of importance in connection with electric traction is the style of motor to be used; it should be able to do its work equally well when starting, when after having started it is under the influence of the full current, or where at the further end of the line the current is reduced by the resistance of the conductor; it must be able to be stopped in a moment, and work efficiently with all variations of speed and load. For these purposes shunt motors are not so suitable as series motors, in which the field-magnet coils are connected up in series with the armature, and hence the latter and compound wound motors are those most frequently used. Its special design depends upon the space at disposal in which to fix it, and upon the gearing—whether spur, chain, or worm gearing—used to transmit its motion to the driving axle of the car. In some instances it is advantageous to drive each pair of wheels by a separate motor.

In conclusion, it may be stated that the present conditions under which electric traction is carried on are altogether in its favour, namely, light tramway cars following one another in frequent succession, and travelling at a moderate speed. What is proposed to be done on the St. Louis and Chicago Railway is something quite different. It will probably be difficult to find passengers enough to fill cars to follow one another at a sufficiently quick rate to make the undertaking pay. And then as regards the very high speeds proposed to be used there and elsewhere, one hundred up to two hundred miles an hour, the cars will have to be made of special forms to resist the enormous pressure of the air at these high velocities, and specially ventilated; whilst the effective horse-power required to be supplied by the motor will greatly increase the weight of the car.

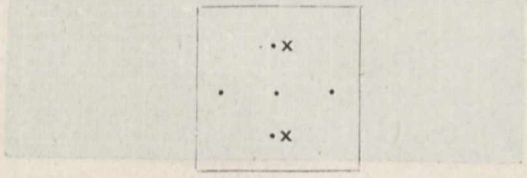
E. F. BAMBER.

EDUCATIONAL AGRICULTURAL EXPERIMENTS.

THE Agricultural Research Association of Scotland was founded for the purpose of obtaining trustworthy and useful information on agricultural subjects, by means of scientific investigation and practical experiments. The report of the committee for 1893 shows that the work of the association continues to proceed satisfactorily. Research work is always difficult to maintain, and a committee fostering it must regard it as an unavoidable, though unpleasant, duty to press its claims. "It is a matter of much regret to the committee," we read, "that we should have so constantly to press for adequate means to carry out the work, and that progress should so constantly be checked for want of means. But the reason is obvious, for an association confining itself to investigation holds a peculiar position. It is different, on the one hand, from organisations that are enabled to return interest for the money spent; and, on

the other hand, from those benevolent institutions from which no interest is expected. An experiment can never be in itself a source of money profit. Benefit may be regarded as certain; but while at times it may be immediate, it is often remote, and not unfrequently the benefit is derived in practice without crediting, or even tracing, the source from which the benefit has sprung."

Among other matters in the report from which this extract has been taken, is a description of educational agricultural experiments intended to be performed by schoolmasters in country districts. The suggestion that a scheme of simple experiments should be framed, such as teachers might suitably carry out for illustration, was made at a meeting of the Institute of Agricultural Education for the North-Eastern Counties of Scotland, consisting exclusively of certificated teachers of agriculture. Mr. T. Jamieson, Mr. W. A. Simpson, and Mr. Gavin Grieg, have now drawn up a scheme on the lines proposed. To show the effects of partial manuring, they suggest a series of tests, such as those shown from A to F, inclusive, in Fig 1. A will thus exhibit the effect of nitrogen alone; B, of potassium alone; C, of phosphorus; D, of nitrogen and phosphorus; E, of phosphorus and potassium; and F, of potassium and nitrogen. The series of experiments indicated by 1 to 6 in the figure have been designed to show the effect of complete manuring. No. 5, having no manure, will afford a comparison with the others. No. 6 will show the effect of complete manuring, as given in the usual manure mixtures. No. 1 to 4, inclusive, will show the effect of new forms of phosphate proposed for manure. For the steeping of the seeds in No. 2, a solution containing about one or two per cent. of potassium carbonate should be made, and the seeds allowed to lie in it for about twelve hours. The committee have prepared full directions as to the manner in which the experiments should be carried out. Twelve flower-pots are required, or wooden boxes, 9 × 9 × 12 inches deep. The soil with which these are to be filled should be dug out from a cavity 6 × 3 × 1 foot deep, and intimately mixed. It is suggested that five seeds be inserted in each pot or box, thus:—



Fifty days after sowing, the two plants marked × have to be taken up and sent to Mr. Jamieson, at the Research Station, Peterculter, Aberdeen, together with a 1 lb. sample of the soil employed. The experiments from Nos. 1 to 6, inclusive, will thus afford comparison with the farm trials to be performed by farmers in different parts of Scotland. The scheme will therefore not only prove of great educational advantage, but will lead to results of scientific value.

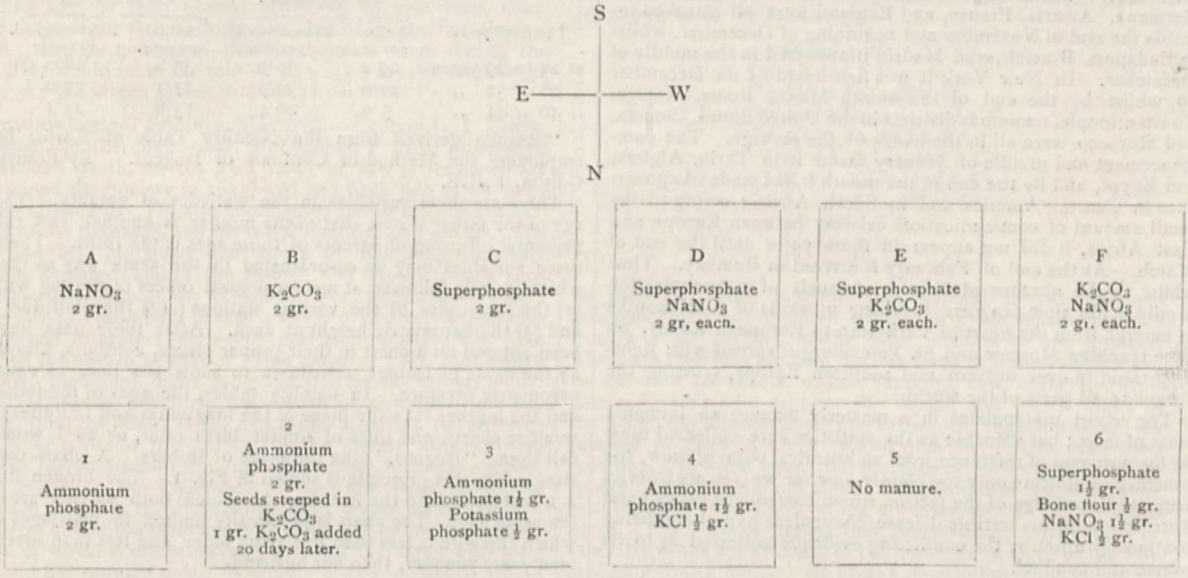


FIG. 1.

THE INFLUENZA EPIDEMIC IN GERMANY IN 1889–90.

THE patient compilation of countless facts, and their elaborate arrangement, is a task in the performance of which the Germans are *facile princeps*. If any fresh instance were required, we need only refer the reader to the official report, which has just been issued, of the history of the influenza epidemic which spread through Germany in the years 1889–90. This document covers upwards of two hundred pages of the large quarto volume containing the "Arbeiten aus dem Kaiserlichen Gesundheitsamte," and has been drawn up by Dr. Paul L. Friedrich, Königlicher Sächsische Assistenzarzt I. Klasse, Kommandirt zum Kaiserlichen Gesundheitsamte.

No pains have been spared to secure, as far as possible, trustworthy official data from all parts of the country concerning the various factors intimately connected with the epidemic. The first forty pages of the report contain elaborate details and statistics as to the dates when influenza first made its appearance, and the period during which it remained, in the various provinces and cities of the empire. From the information collected it appears that Berlin and Charlottenburg were the first districts in which it declared itself. Statistics have also been gathered together of the varying intensity of the scourge in different parts of the country, and an endeavour has been made to ascertain the influence, if any, of different occupations on the path pursued by the epidemic. So many conflicting reports were received as to the effect exercised by the kind of employment on the susceptibility of the individual to influenza, that it was impossible to arrive at any definite conclusion. In some districts the evidence went to show that a remarkable immunity to the disease was exhibited by people engaged in *out-door* occupations, whilst from other parts the statistics collected pointed equally strongly to the freedom from attacks exhibited by workpeople employed *within doors*. In some glass works, however, careful observations showed that the employés who succumbed first to influenza were those who were farthest removed from the furnaces, and that those whose work was to remove the glass from the latter, and who were therefore working in a very heated atmosphere, enjoyed a remarkable immunity. Dr. Heiszler, who is responsible for these observations, ascribes the undoubted freedom from influenza experienced by hese workpeople, to the air in the immediate

vicinity of these furnaces being relatively sterile, the microbes being doubtless unable to exist at such a high temperature. Influenza appears to have but little regard for either sex or age, for it attacked indiscriminately men, women, and children between the ages of fifteen and sixty. Its taste was proved to be equally catholic as regards climate and situation, neither meteorological nor geographical conditions appearing to exercise any sort of control on its genesis and distribution.

The effect of the scourge on the death rate from other diseases has also been carefully investigated, and, as far as the statistics go, it would appear to have materially increased the deaths ascribed to pulmonary consumption.

Innumerable tables are appended to the report, but, perhaps from a popular point of view, the following statement, compiled from official data, showing the time occupied by the epidemic in travelling from east to west, is of most general interest.

Influenza was present as an epidemic in June 1889 in Turkestan, it only reached East Russia (Wjatka) after a lapse of four months, in the middle of October. On October 28 it appeared in West Siberia, and after an interval of three months, travelling eastwards, it reached Japan in January 1890, and Hong Kong in February. On its westward course it moved more rapidly, for it appeared in epidemic form at the commencement of November 1889 in Moscow, and about a fortnight later in St. Petersburg. The capitals of Sweden, Denmark, Germany, Austria, France, and England were all attacked towards the end of November and beginning of December, whilst in Budapest, Brussels, and Madrid it appeared in the middle of December. In New York it was first heard of on December 19, whilst by the end of the month Milan, Rome, Naples, Constantinople, numerous districts in the United States, Canada, and Morocco were all in the hands of the scourge. The commencement and middle of January found it in Turin, Algiers, and Egypt, and by the end of the month it had made its appearance in Central America and in South Africa; owing to the small amount of communication existing between Europe and East Africa, it did not appear in these parts until the end of March. At the end of February it arrived in Bombay. Thus whilst in the absence of definite channels of communication it only made slow progress, requiring upwards of four months to emerge from the heart of Turkestan to European Russia, on once reaching Moscow and St. Petersburg it spread with lightning rapidity over western and southern Europe, crossing the oceans to all parts of the world.

The report manipulates in a masterly manner an immense mass of facts; but valuable as the statistics here collected must be for purposes of reference from an historical point of view, the conclusions indicate only too plainly how far we yet are from an accurate knowledge of the factors which control the genesis and distribution of this terrible disease, convenient hypotheses being continually upset by the conflicting evidence collected as to its course and conduct.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, vol. iii. No. 6. (New York: Macmillan. March, 1894). — Prof. Harkness (pp. 135–141) gives a careful and appreciative abstract of the Cours d'Analyse de l'École Polytechnique, by Camille Jordan, a work commended by Prof. Klein in "The Evanston Colloquium," and which, in its second edition, is "entièrement refondue." Three interesting, though short, notes on Permutations (pp. 142–148) are furnished by Prof. F. Morley. They are headed a plea for the chess-board in teaching determinants, a special rule of signs, and the enumeration of positions. There are numerous references to the authorities on the subject. Notes and new publications are full as usual.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 18.—"An Estimate of the Degree of Legitimate Natality, as shown in the Table of Natality compiled by the Author from Observations made at Budapest." By Joseph Körösi, Member of the Hungarian Academy of Sciences, Director of Municipal Statistics.

The author has tabulated the age of the 71,800 married couples given in the Census of 1891, conforming to the single year-combinations. The virtual number of these combinations—as 45 productive years of the male have to be combined with each of the 40 productive years of the female—is about 2000. Knowing thus the number of all age-combinations, he observed for four years (two before and two after the Census) the 46,931 births amongst couples of those ages. By dividing the figures obtained by four, he got the yearly probability of birth for each age-combination.

As the legitimate natality is to be regarded as a resultant between two distinct forces, the instinct of nature which urges towards multiplication and the forethought which causes moral restraint, it was also desirable to get an insight into the march of the physiological fertility alone.

Two degrees of fertility for each age were therefore obtained. The difference between the degree of physiological and that of the actual fertility shows, a few cases of procreative exhaustion being excepted, the influence of the moral factor. In the somewhat advanced ages this moral restraint exercises an influence exceeding all expectation. With the mothers of 30 to 35 it reduces the fertility to 78 per cent. (instead of 100 per cent.), with those of 43 to 2 per cent., *i.e.* 98/100 of the physiological faculty is suppressed. With men the influence is also very great, though weaker than with women.

Out of a large number of data here follow some figures to characterise the results:

	For the mother.		For the father.	
The fertility is	Actual. per cent.	Physiological. per cent.	Actual. per cent.	Physiological. per cent.
at 25 to 29 years	29·2	30·9	35 8	28·0 (?)
,, 30 ,, 34 ,,	20·6	32·9	27·1	27·0
,, 40 ,, 44 ,,	5·9	20·4	13·8	21·1

"Results derived from the Natality Table of Körösi by employing the Method of Contours or Isogens." By Francis Galton, F.R.S.

There are three variables in the statistics of natality. The age of the father is one, that of the mother is another, and the percental offspring of parents of those ages is the third. These three variables may be co-ordinated in the same way as that which is daily followed at meteorological offices in dealing with (1) the longitudes of the various stations; (2) their latitudes; and (3) the barometric height at each. After these data have been entered on a chart in their proper places, contours, known by the name of isobars, are drawn to show the lines of equal barometric pressure. In natality tables, the ages of the father and the mother take the place of the longitudes and latitudes in weather charts, and lines of similar birth rates, or as I would call them, "isogens," take the place of isobars. A chart constructed on this principle is shown in Fig. 1. The broken line A B corresponds to the instances in which both parents are of the same age. The chart is practically limited to marriages in which the wife is less than five years older, and less than seventeen years younger, than her husband.

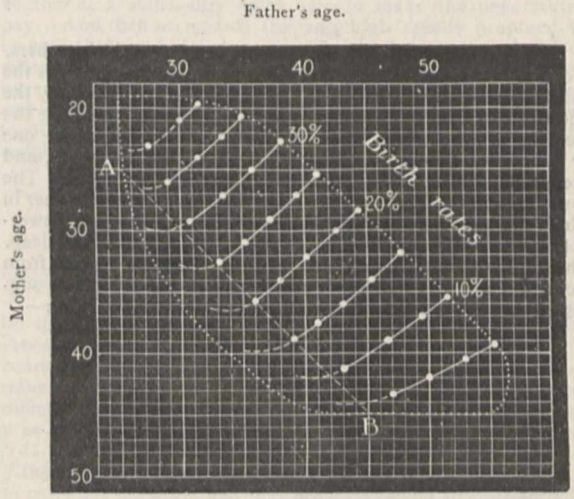


Fig. 1.

It will be noticed that the isogens run in nearly straight, diagonal, and equidistant lines across the greater par. of

the chart. As a consequence of this straightness, the *sums of the ages* of the parents to which each point in the straight portion of the same isogen refers is *constant*. The difference between their ages is of no account whatever in eight or nine tenths of the total number of marriages; it is only when the wife is older than the husband, or when she approaches the limit of the child-bearing age, that this curious law ceases to hold true.

Again, through a coincidence between the increasing age of either parent and the decrease of fertility, it happens that the sum of the three elements of (1) father's age, (2) mother's age, (3) percental birth rate in a year has a value that is itself appropriately constant.

From this follows the curious law that if we wish to calculate the percental birth rate per annum for a married couple within the limits of the chart where the isogens run straight and parallel, we have only to add the ages of the father and mother and subtract the total from 93 or 94, in order to obtain it with considerable precision. The approximate limits within which this law obtains are: (1) the wife is not to be older than her husband; (2) she is not to be less than twenty-three years of age, nor (3) more than forty.

Example.—In any large number of husbands and wives living under like conditions to the inhabitants of Budapest, whose respective ages at their nearest birthdays, to 21st June, 1892, were: that of the father, thirty-five, that of the mother, twenty-seven; then the number of children born to them during the year 1892 would be at the rate of $93-(35+27)$ per cent. $= 31$ per cent; the isogen makes it about 32 per cent.

Entomological Society, March 28.—Captain H. J. Elwes, President, in the chair.—Mr. McLachlan, F.R.S., announced the sudden death, on the 23rd inst., of Mr. J. Jenner-Weir, who joined the Society in 1845, and had been one of its most regular attendants. He also commented on the scientific attainments of the deceased, and his social qualities and virtues. Mr. Goss and Mr. Merrifield also spoke of their long friendship with the deceased, and of the respect and esteem which they entertained for him.—Mr. W. Borrer, jun., exhibited a wasp's nest which had been built in such a way as to conceal the entrance thereto and to protect the whole nest from observation. He believed the nest to be that of *Vespa vulgaris*. Mr. McLachlan and Mr. Blandford made some remarks on the subject.—Mr. G. F. Hampson exhibited a specimen of *Gaudaritis flavata*, Moore, from the Khári Hills, and called attention to the existence in the males of this species, in the closely allied British species *Cidaria dotata*, Linn., and also in two Japanese species, of an organ on the under-side of the fore wing, which he suggested might be for stridulation; this organ consisting of a small scar of hyaline membranes situated just below the middle of vein 2, which is much curved; this scar is fringed with long hair, and has running down its middle a row of sharp spines situated on the aborted remains of vein 1, and which is curved up close to vein 2; the spines would naturally rub against part of the costa of the hind wing, but no spines or unusual roughening seems to exist on that or on any of the veins on the upper side of hind wing against which they could strike; below the scar is situated a large shallow fovea or pit in the membrane, slightly developed in *C. dotata* and *C. flavata*, but much more prominently in the two Japanese species, and, should the organ prove to be for stridulation, would probably act as a sounding board. Mr. Hampson said that in the Japanese species closely allied to *flavata*, the males have no trace of this curious organ. Prof. E. B. Poulton, F.R.S., Lord Walsingham, F.R.S., and Mr. Hampson took part in the discussion which ensued.—The Rev. T. A. Marshall communicated a paper entitled "A Monograph of the British Braconidæ, part v."—Mons. Louis Péringuey communicated a paper entitled "Descriptions of new Cicindelidæ from Mashunaland."—Prof. Poulton gave an account of his recent tour in the United States, and commented on the entomological and other collections contained in the American museums. Lord Walsingham, Mr. Hampson, and the President also made some remarks on the subject.

EDINBURGH.

Royal Society, March 5.—Prof. Sir W. Turner, Vice-President, in the chair.—Prof. Crum Brown read the first part of a paper on the division of a parallelepiped into tetrahedra. The subject of the paper was the question suggested by Lord Kelvin: In how many ways can a parallelepiped be cut into tetrahedra without introducing new corners? In the first part the author discusses the division of the cube into tetrahedra, all the corners of the tetrahedra coinciding with the corners of the cube. Noting the corners of the cube A, B, C, D, $\bar{A}$, $\bar{B}$, $\bar{C}$, $\bar{D}$, so that A $\bar{A}$, &c. are body diagonals of the cube, and A B, A C, A D, &c. face diagonals, and therefore A $\bar{B}$, &c. edges, we have the following five forms of tetrahedra: A B C D, A $\bar{B}$ $\bar{C}$ $\bar{D}$, A $\bar{A}$ B C, A $\bar{A}$ B $\bar{C}$, and A $\bar{A}$ C $\bar{B}$, and no more, for A B C D and A $\bar{A}$ B $\bar{B}$ have all four corners in one plane. These tetrahedra may be designated O, Δ, I, L, Γ, respectively. O has a volume one-third of the cube, has no part of the surface of the cube, and can occur in two positions in the cube, A B C D and $\bar{A}$ $\bar{B}$ $\bar{C}$ $\bar{D}$. Δ has a volume one-sixth of the cube, has three faces coinciding each with half of a face of the cube, and can occur in eight positions. I has a volume one-sixth of that of the cube, has one face coinciding with half a face of the cube, and can occur in twenty-four positions. L and Γ are enantiomorph, each has a volume one-sixth of the cube, and each can occur in twelve positions. These give fifty-eight positions in all, which, with the twelve groupings of four corners all four in one plane, make up the seventy groups of four corners. The author then goes on to discuss the number of ways in which these tetrahedra can be built together to form a cube. These are shown to be the following:—

1 O and 4 Δ's,
3 Δ's and 3 Γ's,
*2 Δ's, 2 I's, and 2 L's,
*2 Δ's, 2 I's, 1 L, and 1 Γ,
*2 Δ's, 2 I's, and 2 Γ's,
1 Δ, 1 I, 3 L's, and 1 Γ,
1 Δ, 1 I, 2 L's, and 2 Γ's,
1 Δ, 1 I, 1 L, and 3 Γ's,
4 L's and 2 Γ's,
3 L's and 3 Γ's,
2 L's, and 4 Γ's.

Of these the three marked * correspond to two different arrangements each, in one of which the plane separating an I from a Δ are parallel, in the other inclined to one another. There are therefore fourteen distinct ways in which a cube can be cut into tetrahedra without making new corners.—Prof. Cossar Ewart read a paper on the second and fourth digits of the horse, their development and subsequent degeneration. He referred to cases in which two or even three digits had been recorded. In some cases the presence of such digits is due to subdivision of the normal middle digit, in others it is due to the restoration of those digits which are always found in the fossil horse. Prof. Ewart argues that the terminal "buttons" or tubercles of the splint bones of the horse are vestiges of the lost second or fourth digits. He gives a description of the condition of the digits in embryos of different ages. In embryos under 1 inch in length no evidence was found of the phalanges of the second or fourth digits, but in a slightly larger embryo a rudiment of the second finger, connected by a complete joint to the second metacarpal, could be made out. The second and fourth phalanges attained their greatest development in embryos about 14 inches in length. The second finger then showed a terminal phalanx and an indistinct second phalanx connected to a large first phalanx which was joined by a very complete joint to its metacarpal. The apex of the terminal phalanx was surrounded by a cap corresponding possibly to one of the deeper layers of the normal hoof. In older embryos the joints were never so complete, the second and third joints rapidly disappearing, so that the second and fourth toes of all the limbs consisted of an elongated piece of cartilage connected by more or less distinct joints to the metacarpals. In still older embryos the fused phalanges are ossified and are firmly connected to the splints so as to form the well-known "buttons."

March 19.—Prof. Geikie, Vice-President, in the chair.—Prof. Crum Brown communicated the second part of his paper on the division of a parallelepiped into tetrahedra. He showed that there are 180 distinct ways in which this may be done without introducing a new corner.—A paper, by Mr. Gregg Wilson, on the reproduction of the edible crab, was communicated.—Mr. C. A. Stevenson read a paper on telegraphic communication by induction by means of coils. Such communication has been found possible when two circular coils of 200 yards diameter were placed horizontally at a distance of one quarter of a mile apart.

DUBLIN.

Royal Dublin Society, March 21, 1894.—Sir Howard Grubb, F.R.S., in the chair.—Prof. G. F. Fitzgerald, F.R.S., and Dr. J. Joly, F.R.S., read a paper on a method of determining the ratio of the specific heats of gases.—Dr. J. Alfred Scott described a method for colouring lantern-slides for scientific diagrams and other purposes. The author explained that the gelatine surface should be soaked and then drained. In this damp condition the aniline dyes may be applied in watery solutions with a brush; the depth of colour depending on the strength of the solution and the length of time it is allowed to act on any one spot. The colours most suitable were found to be eosin, tartrazine yellow, vesuvin, indigo-carmine. These colours can be mixed without forming new chemical bodies of a different colour, and spread very evenly. Eosin is, however, liable to fade, if very pale; it should therefore be painted rather more intensely if the slide is intended to be often in the lantern. Coloured inks suitable for writing with a pen on plain, cleaned glass, can be made by thickening solutions of aniline with ten per cent. of dextrine; good colour for this purpose being eosin, and iodine green. A good, nearly black, colour may be made from writing ink, "encre noire," made slightly alkaline with ammonia, and thickened with ten per cent. dextrine.—Prof. Arthur A. Rambaut read a paper on the great meteor of February 8. This remarkable object was seen at a great many places, from Whitby in the north to London in the south, and from Ballinasloe, co. Galway, to Chelmsford. To have been so widely conspicuous within a few minutes of noon in bright sunshine, the meteor must have been one of very unusual dimensions. The time of the occurrence was 28 mins. after noon (Greenwich mean time). As seen from Dunsink the meteor fell vertically from an altitude of 25° to within 5° of the horizon at an azimuth of 10° N. of E. A large number of accounts from different parts of the country reached Prof. Rambaut, from which he concludes that it was first seen at a height of 59·4 ± 4·1 miles, in longitude 2° 54′ W. and latitude 53° 40′ N., and was last seen at a height of fourteen miles in longitude 1° 35′ W., and latitude 53° 35′ N. The duration and consequently the velocity is very variously estimated, but the mean of the best estimates gives a velocity of about nineteen miles per second. The path was very distinctly curved; and therefore the radiant is very doubtful. No account of anything unusual, in the way of a fall of meteoric stones or iron, is forthcoming, and the meteor seems to have been wholly dissipated in mid-air.—Prof. Johnson exhibited the sporangia of *Litosiphon laminariæ*, Harv., by means of the Society's lantern.

PARIS.

Academy of Sciences, April 2.—M. Lœwy in the chair. The decease of M. Brown-Séquard was announced by M. Troost.—Observations of the new comet Denning (1894, March 26), by M. O. Callandreau.—Observations of the planet 1894 AZ (Courty, March 5) and Denning's comet, made with the great equatorial at Bordeaux observatory, by MM. G. Rayet and L. Picart.—Observations of the same comet, made at Paris observatory, by M. G. Bigourdan. In the remarks on this comet, it is noted that the tail points (March 27) in a direction apparently perpendicular to the line joining the comet and the sun.—Observations of the same comet, made at Toulouse observatory (Brunner equatorial), by MM. E. Cosserat and F. Rossard.—Parabolic elements of the same comet, by M. L. Schulhof.—On the movement of a system of variable form, by M. L. Picart.—On the first differential projective invariant of rectilinear congruences, by M. Émile Waelsch.—Distribution of deformations in metals submitted to strains, by M. L. Hartmann. New experiments give the same laws for the effects of percussion as were found for the distribution of deformations produced under the application of a static strain.—Action of water on bicalcic phosphate, by MM. A. Joly and E. Sorel. By boiling with successive quantities of water the tricalcic phosphate, $Ca_3P_2O_8$, $\frac{1}{2}H_2O$, is produced. With a single quantity of water and long contact at the boiling point, a further action produces anhydrous bicalcic phosphate.—On the blue colouration which leuco-auramine assumes in contact with acids, by M. A. Rosenstiehl.—On the fixation of iodine by starch, by M. E. G. Rouvier.—The disease "Toile," produced by *Botrytis cinerea*, by MM. Prillieux and Delacroix.—On the spark spectra of some minerals, by M. A. de Gramont. A large number of oxides, arsenides, antimonides, sulpharsenides, and sulphantimonides are given, together with crocoisite, anglesite, and a few others.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Man and Woman: H. Ellis (W. Scott).—A Manual of Microchemical Analysis: Prof. H. Behrens (Macmillan).—A Text-Book of Field Geology: W. H. Penning, 2nd edition (Baillière).—Odorographia, 2nd series: J. C. Sawer (Gurney).—An Introduction to Structural Botany: Dr. D. H. Scott (Black).—Observations Intlques. Polaires, 1882-83: Expédition Danoise, Observations faites a Godthaab: A. F. W. Paulsen (Copenhague).—The Ex-Meridian: H. B. Goodwin (Philip).—The Country Month by Month, April: J. A. Owen and Prof. Boulger (Bliss).—Handbook of Tasmania, 1893: R. M. Johnston (Hobart).—Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1891-92 (Bombay).

PAMPHLETS.—Report for 1893 on the Lancashire Sea-Fisheries Laboratory at University College, Liverpool: Prof. Herdman (Liverpool).—Illustrated Official Handbook to the Aquarium, &c. under the Control of the Exhibition Trustees, Melbourne (Melbourne).—What has Opium-smoking to do with Christianity? (Shanghai).—Ueber das Verhältniss des Männlichen und Weiblichen Geschlechts in der Natur: Dr. G. Klebs (Jena, Fischer).—Guide to the Exams. in Hygiene and Answers to Questions, Elementary Stage, 1886-93: W. J. Harrison (Blackie).—Guide to the Exams. in Heat and Answers to Questions, Advanced Stage, 1881-93 (Blackie).—Di un Nuovo Elettrometro Idiostatico: Prof. A. Righi (Bologna).—On the Modifications of Clouds, London, 1803: L. Howard; No. 3 of Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus (Berlin, Asher).—Bird-Life in Arctic Norway: R. Collett, translated by A. H. Cocks (Porter).

SERIALS.—Journal of the Royal Statistical Society, March (Stanford).—Minnesota Botanical Studies, Bulletin No. 9, Part 2 (Minn.).—Geological Magazine, April (K. Paul).—Medical Magazine, April (Southwood).—Annals of Scottish Natural History, April (Edinburgh, Douglas).—Zeitschrift für Physikalische Chemie, xiii. Band, 3 Heft (Leipzig, Engelmann).—Engineering Magazine, April (New York).—Himmel und Erde, April (Berlin).

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