THURSDAY, JUNE 13, 1889.

THE ELEMENTS OF VITAL STATISTICS.

The Elements of Vital Statistics. By A. Newsholme, M.D. (London: Sonnenschein, 1889.)

DR. NEWSHOLME has written a book which, though intended primarily as a guide to medical officers of health and students preparing for the various sanitary examinations, will be found by the general reader to form a convenient compendium of useful facts and of the conclusions deducible therefrom. For the writing of such a book the author was well qualified, having been distinguished as University Scholar in Medicine, and having had, in addition to the ordinary practice of a medical man, considerable experience as a medical officer of health, formerly at Clapham and recently at Brighton. A work of this kind must necessarily consist largely of information derived from the census returns, public registers, and reports; and an author's ability is shown in the selection of the information, its arrangement, and verbal presentation.

Like many persons who have given attention to the subject of vital statistics, whether for sanitary or financial purposes, Dr. Newsholme attaches great value to a correct and more frequent census, and to a complete and accurate registration of births, marriages, and deaths, the cause of death being in all cases carefully ascertained and recorded. He also desires a systematic and extended registration of sickness, its nature and duration; urging that the concurrent publication of information furnished by such registration, and involving the announcement of the outbreak, the spread, and the subsequent contraction of epidemics, would lead to results of the highest public benefit.

The requirements of a good census from a sanitarian's standpoint are said to be that the enumeration shall be accurate and complete—to this we may say, of course—and that it shall be simultaneous throughout the country, in order to avoid the disturbing influences of migration—again, of course. It is suggested that the particulars demanded at the taking of the census should comprise the following items as a minimum: name, sex, age (children under two years stated in months), relation to head of household, conjugal condition, calling, religious persuasion, illiteracy, birthplace and nationality, language, residence, infirmities, this last term meaning, we presume, serious infirmities, such as those of the blind, the deaf, and the dumb, and the several forms of insanity. We ourselves do not see in what way a sanitarian is concerned with the religious persuasions of the people, or with language as apart from and independent of nationality; nor do we think a sanitarian, or any other student or scientific worker, could extract any useful knowledge out of the untested declarations of uneducated persons relative to the ability or inability of themselves and their families to read and write. We do not altogether agree with our author in advocating inquiry on these points; but we entirely agree with him on the remaining points he mentions, to which, in the main, however, the country at large may be considered already to have assented. We would emphasize, with him, the desirability of taking the ages of the youngest children in months; at any rate, for the first year of life. Considering the heavy mortality prevailing during infancy—about one-fifth of all the births being followed by death within two years—and considering its rapid change from month to month, as the development of the infant progresses, it is an obvious requirement of this branch of the subject that steps should be taken to ascertain the mortality for each succeeding month of a child's life, and thus verify the estimates and partial results that have already been published. We would also emphasize, with our author, the desirability that the calling or occupation of each person should be given with sufficient definiteness to obviate confusion. At present one experiences some difficulty in manipulating the figures of the Registrar-General's Office; a difficulty arising not only from the classification of occupation, and partly unavoidable, but also from the inclusion in one figure of masters with workmen, and sometimes of those who have retired from an employment with those actively engaged in it. There is, as is self-evident, the greatest difficulty in obtaining precise information from the millions of an entire population; but the Registrar-General has, no doubt, turned his attention in the directions now indicated with a view to future action.

The Civil Registration Act was passed in 1837, but for a long while the registration of births was defective, it having been estimated that as many as 5 per cent. of the births were lost sight of. This is a fact not to be forgotten in dealing with earlier years. The registration of births was made compulsory by the Births and Deaths Registration Act of 1874; but the record gives neither the age of the mother at the date of the birth of the child, nor the order of its birth (first, second, third, &c.); so that we can know neither the number of children borne by mothers at each year of the mother's age, nor the average number borne in the course of a mother's lifetime. The birth-rate in a community is commonly represented by the ratio of births to population, so many per thousand; but the basis of 1000 living, including, as it does, a varying proportion of men, women, and children, is not a perfect basis; and, to get the true birth-rate, the number of births should be compared with the number of women between the ages of about 16 and 45. The population basis is, as a rule, however, adequate for practical purposes, and tables, so constructed, display, throughout Europe generally, a tendency in the birth-rate to decline. In the United Kingdom the decline has been fairly regular and continuous for some years past, the decline amounting to almost 3 per thousand in seven years.

The chapter on births contains, under the head of "The Malthusian Hypothesis," some remarks respecting the famous essay on the theory of population published in 1798. As popularly understood, the hypothesis was to the effect that the growth of a population must be circumscribed by the means of subsistence. The remarks are especially directed against the doctrine that "the population is increasing in a geometrical progression, the means of subsistence in an arithmetical progression; and unless wars, destructive epidemics, marshes, dense towns, close workshops, and other deadly agents, carry off the excess of the numbers born, . . . the whole people must be exposed to a slow process of starvation." Our author

is quite right in attacking this theory, but it is substantially no answer to the theory to say that a geometrical progression may progress so slowly as hardly to progress at all; or that, when the number of births falls below the number of deaths, there is a decreasing geometrical ratio instead of an increasing one. Such an argument is, doubtless, the correct statement of a purely theoretical truth of abstract mathematics, but it does not meet the case as popularly understood. Also inconclusive, in our opinion, are some of the comments on increase of subsistence. To define subsistence as "all that supplies men's wants" is to adopt a definition of the term which calls for definition more loudly than the word defined; and to suggest that we may look to human industry and scientific discovery for the increase of food is to open up before us a very doubtful and probably disappointing prospect. The teachings of Malthus may have been more or less refuted by the history of the present century, but we all agree that the danger of population outrunning subsistence is one that common-sense demands should always be kept in view.

The marriage-rate is usually obtained by comparing the number of marriages with the number of the population in which they occur. This method is exact enough for many purposes, but to attain theoretical accuracy the comparison should be made with the number of eligible bachelors, spinsters, widowers, and widows. Like the birth-rate, the marriage-rate appears to be on the decline, not only in this Kingdom, but also throughout Europe. In England and Wales, bachelors now marry at a mean age of 26·2 years and spinsters at 24·6 years, the age at marriage exhibiting a tendency to increase. The average number of births to a marriage is for England and Wales about 4½; the average for Italy being 5·15; Prussia, 4·92; Austria, 3·73; and France, 3·42. In England and Wales the average duration of ordinary married life has been computed at about 27 years.

It is customary to state the death-rate by comparing the number of deaths with the number living, but the results require to be received with caution. The population of a place may vary in its age and sex composition with the arrival of immigrants and the departure of emigrants; also from an excess or defect of births over or under deaths; also from other and special causes; and these disturbing elements cannot always be left out of consideration. Thus, the general death-rate in England and Wales in 1881 was 18·9, for all ages, while the general death-rate in France was 22·0; but had the age-distribution in France been the same as in England, the French rate would have been 20·9, and it is clearly with this figure, and not with the 22·0, that the English figure is justly to be placed in comparison. With respect to the registration of death, and with a view to obtain better information as to the cause of death, Dr. Newsholme favours the appointment of medical registrars, and thinks the certificate of the medical attendant on the deceased should be withheld from the family and sent direct to the registrar.

To the general reader the discussion of the influence exerted on mortality by climatic and social conditions, by recent sanitary legislation, by density of population, and by occupation, is sure to prove attractive. Figures are adduced to demonstrate that mortality is usually highest in the first quarter of the year and lowest in the third; and we are told that mild winters and cool summers both lower the mortality, the former especially of the old, and the latter of the young. Pervious subsoils apparently afford a better protection against lung-disease and diphtheria than retentive ones, as might naturally be expected; but not so with phthisis, which, according to the figures quoted, is no great respecter of subsoil. As is popularly understood, the death-rates for married persons of both sexes are more favourable than for the single or widowed, but it must not be forgotten that in marrying and giving in marriage a process of natural selection takes place, and that it is only the more or less healthy, if not also the more or less strong, that enter the married state. The aggregation of an ever-increasing proportion of the population in towns has an unfavourable effect on mortality; for the general death-rate in the urban districts, which, according to the mean rates for the country, and making due allowance for age and sex, should have been 20·4, was as high as 23·1, while in the rural districts, where it would have been estimated at 22·83, it was only 19·0. However, the inferiority of town to country, in this respect, is, apparently, becoming less marked. Next to the subject of crowding in towns, comes up for consideration the subject of crowding in houses. Some observations in Glasgow tended to show that among those living in one and two roomed houses the death-rate was 27·74 per 1000; among the occupants of three and four roomed houses, 19·45; and among those living in houses of five rooms and upwards only 11·23; but such results cannot be attributed solely to the extent of house accommodation. The fewer the rooms, as a rule, the poorer the person, and therefore the less able to procure a supply of good and sufficient nourishment, suitable clothing for summer and winter, healthful occupation and recreation, and, in times of sickness, efficient medical attendance and comforts. Of the increased mortality to the poor man, one cannot say what portion is to be ascribed to the narrowness of his habitation, and what portion to the combination of various other and accompanying causes. A whole chapter of the book under notice is devoted to the effect of occupation on the death-rate, but we have not the space to allow of quoting from it. The chapters on the mortality due to each of the seven chief infectious diseases, and to certain other special diseases that flesh is heir to, will prove little less interesting to the reader than those to which we have more fully referred.

Dr. Newsholme is evidently very earnest in his advocacy of the national registration of sickness, *i.e.* sickness of a disabling character. The number of deaths registered as due to a specified disease may or may not give an indication of the prevalence of that disease. The prompt registration of sickness would result in various advantages to the public health. Prophylactic measures could and would be taken to prevent the spread of threatening epidemics; the isolation of patients and suspects would be more generally provided for; the children of an infected family would be debarred from attending school; while the public excitement consequent on any unusual warning given by the registration would lead to the discovery of conditions conducive to disease, to the thorough inspection of houses, workshops, public drains, clothing, and the food and water supplies. Such

periods of excitement would have an educational value among parents and householders, and teachers of all kinds, and a better knowledge of sanitary principles would manifest its presence amongst us in a greater freedom from sickness and in an enhanced vigour of mind and body. If the registration of sickness, by informing us, warning us, and alarming us, will compel public attention, and direct it to matters of public health, and enable us to resist our worst and deadliest foes, by all means let us have registration.

When one reflects on the attention given to sanitation for, at least, the last twenty years, and on the labour and money devoted to it since 1872, when the Public Health Act came into operation, one naturally asks what has been the effect on the national death-rate of all the sacrifices we have made. The answer is, on the whole, satisfactory. The mean annual death-rate per 1000 in England and Wales, at all ages, males and females taken separately, has fallen in each of the last three quinquennia, as under :—

	Males.	Females.
30 years, 1841—70	23·3 ...	21·4
5 years, 1871—75	23·3 ...	20·7
5 years, 1876—80	22·2 ...	19·5
5 years, 1881—85	20·4 ...	18·2

Here there is manifested a striking reduction in the general death-rate, both for males and females. But it is desirable to examine this improvement more in detail, and to differentiate for age as well as sex. When this is done, the change in the death-rate stands out very distinctly.

Mean Annual Death-rates in England and Wales for Periods of Years and Groups of Ages; Males and Females separately.

Ages.	Males.				Females.			
	1841—70	1871—75	1876—80	1881—85	1841—70	1871—75	1876—80	1881—85
0— 5	72·5	70·0	67·2	59·6	62·7	60·0	57·0	50·5
5—10	8·6	7·2	6·4	5·8	8·4	6·6	6·0	5·6
10—15	4·8	4·0	3·5	3·2	5·0	4·0	3·6	3·3
15—20	6·7	5·7	5·0	4·6	7·3	6·0	5·1	4·7
20—25	8·9	8·1	6·8	6·0	8·6	7·5	6·3	5·9
25—35	9·8	10·1	8·7	8·2	10·1	9·2	7·9	7·9
35—45	13·0	14·3	13·5	12·7	12·4	12·0	11·2	10·9
45—55	18·5	20·1	19·0	19·4	15·7	15·8	14·9	15·2
55—65	32·0	34·7	34·6	33·6	27·8	28·8	28·9	27·8
65—75	66·7	69·4	67·6	68·8	59·7	61·0	60·2	59·5
75—85	147·4	148·0	146·7	144·6	135·1	134·3	132·3	129·4
85 and upwards	311·6	315·0	304·1	296·4	288·8	285·9	274·0	267·8

From this table it is seen at a glance that the improvement in the death-rate has been very considerable for all ages up to 25; less considerable from 25 to 45 in the case of males, and 25 to 55 in the case of females; and that for subsequent ages the change is, on the whole, somewhat adverse. The proportion of urban population to rural has increased till at the present moment it may be stated as 2 : 1, but despite this fact there has been a striking and continuous fall in the mortality. Of course, it may be argued that the spread of education, and the diffusion of a knowledge of elementary physiological facts, have had something to do with bringing about this result, and the argument is admissible; but they cannot account either for the suddenness with which the fall set in or the persistency with which it has continued. To sanitary works and operations is, probably in a large measure, to be attributed the improvement in the death-rate as shown above, an improvement that gives 1,800,047 additional years of life to the 858,878 children annually born in England, extending the average lifetime of the 437,492 males by nearly a year and a half, and of the 421,386 females by not less than two years and three-quarters. Apparently, we are taking care of the women and children, especially the latter, and if anything could now be done to alleviate the wear and tear of adult life, arising from the increasing severity of competition, especially among men, and to check the evil effects of crowding together in great towns, these remarkable figures might become more remarkable, and human life healthier, happier, and still better worth living.

In conclusion, we may say that the book is clearly and pleasantly written, that the arrangement of the work is excellent, and that, although it cannot contain much that is new, it is interesting from the first page to the last.

BIRD-LIFE OF THE BORDERS.

Bird-Life of the Borders: Records of Wild Sport and Natural History on Moorland and Sea. By Abel Chapman. (London: Gurney and Jackson, 1889.)

THIS is an admirable book of its kind. On the one hand, its "records of wild sport" will be full of interest to devotees of the gun and rod; while, on the other hand, the trustworthiness of its "natural history" is guaranteed by a statement in the preface that the proofs have been revised by Mr. Howard Saunders. But it is not enough to say that the natural history is trustworthy: it is also full of original observations, interesting alike to the bird-lover and the scientific ornithologist. In particular, we may instance a very suggestive chapter on migration, which shows among other things the importance in this connection of distinguishing between a species and its constituent individuals. Certain birds occur in certain regions all the year round, and therefore in those regions might be regarded as non-migratory; but, as a matter of fact, such regions constitute "overlapping zones" doubly crossed by the birds in question during their migrations north and south, so that although the species occupies such a region all the year round, it does so only in virtue of a continual changing of its representative individuals; "those individuals which occupied this area in summer will be wintering 1000 miles south, while their vacated places are occupied by others which had passed the summer 1000 miles north."

Again, there are some curious observations on what the author calls "pseudo-erotism," by which he means a display of amatory instincts which occurs on the part of black-game, plovers, gulls, &c., in October, or even later.

"On wet, foggy mornings in particular, one hears the old blackcocks 'crooning,' 'bubbling,' and 'sneezing,' as excitedly as on a fine day in spring. With a glass, I have watched one surrounded by his harem, strutting round some bare little knowe in the fullest 'play.' . . . Whether this is merely a chronological miscalculation, or arises from some specific cause, the origin of which may be lost in the mists of a remote past, the instinct certainly exists," &c.

There is another point to which we would like to draw attention. It is, of course, well known that telegraph-wires are very destructive of bird life upon open moors; but it is generally supposed that, after the wires have been set up for a year or two, the birds learn by experience to avoid them, and so do not come to grief in nearly such large numbers as they do when the wires are first erected. Now, whether or not this supposition is well founded, it appears certain, from Mr. Chapman's systematic observations upon the mortality thus occasioned, that it occurs perennially to an astonishing degree. The observations were conducted along a line of telegraph wires (nineteen in number), and are as follows:—

"I have heard it estimated by farmers and shepherds (and believe they are not far wrong) that more grouse meet their deaths annually from these mischievous wires than are killed by all the shooters on the moor around. . . . This destruction is going on at all seasons of the year. It is no exaggeration to say that the roadside is, at certain seasons, strewn with remains. Besides grouse, I have picked up black-game, partridge, curlew, golden plover, snipe, peewits, and other birds. Every morning, at break of day, come out the marauding bands of rooks from the lowland woods, reconnoitering along the roadside, and feasting on the dead and dying."

As evidence of the cruelty inflicted by the wires, quotations are made from the author's note-book, of which the following is an example:—

"October 6.—Found to-day four grouse which had been severely damaged by flying against the telegraph wires on Elsdon Hill. Two were already dead, and pulled to bits by the crows. The third had evidently received his wound late the night before, and the blow had completely carried away his crop, which at that time would be full of heather. The poor bird had been hungry this morning, and, regardless or oblivious of having no crop, had been feeding—his throat, down to the huge gash, being crammed with heather-shoots. I never saw anything more pitiable in my life. This bird could still fly, but very weakly, and could not possibly long have survived. The fourth grouse had been injured some time before. He also had received a horrible gash across the breast, but it appeared to be slowly healing."

Now, as Mr. Chapman says "it would be easy to adduce hundreds of similar instances" from his own neighbourhood alone, every sensible man must agree with him when he adds—

"Surely, in these days of ultra-humanitarianism, of R.S.P.C.A. Associations, and of 'Wild Bird Protection Acts'—when a maudlin sentimentality comforts itself by fining a poor man for shooting a wild goose in March, or for overworking his horse on which perhaps depends his daily bread—surely, in these days, the wanton cruelty and useless waste above described (carried on for a national profit) should not be permitted."

Of course the answer to this is, that telegraph wires are nowadays an absolute necessity; but, on the other hand, there is a simple solution of the difficulty, which we will mention in the hope that it may be taken up by the "R.S.P.C.A.," or some private M.P. in search of material out of which to construct a Bill. Let an Act be passed, enjoining that all telegraph-wires extending over moorlands, or other open spaces frequented by birds, shall be run underground.

"Bird-Life of the Borders" is profusely illustrated, and in all respects well deserves the patronage both of sportsmen and field-naturalists.

OUR BOOK SHELF.

Curiosa Mathematica. Part I. A New Theory of Parallels. By Charles L. Dodgson, M.A. Second Edition. (London: Macmillan and Co., 1889.)

WE noticed the first edition of this *brochure* in NATURE (vol. xxxix. p. 124) at some length; and now merely wish to touch upon one or two points which our author animadverts upon in his new preface. Mr. Dodgson apparently fails even now, after our letter in NATURE (*l.c.*, p. 175), to realize our difficulty with the construction in Prop. vi. He says:—"Bisect the angle: that gives halves. Bisect the halves: that gives quarters. Bisect again: that gives eighths. Bisect once more: that gives sixteenths. *Voilà tout!*" Shade of Euclid! who knows not such things? We admitted the same (*l.c.*, p. 175), but stated that our difficulty in the construction was the condition imposed in the enunciation: viz., "the chord of each such sector not less than the radius of the circle." Take Mr. Dodgson's illustration of a sixteenth, this would necessitate that the original angle should be at least 960°. We do not object to that or to any other size. But this, or what is tantamount thereto, we have already brought forward, and have further noted that no one of the chords in Mr. Dodgson's figures is even equal to the radius. But this is not a point touching the author's argument; and we notice it only because he has pilloried us therefor in his new preface, which *some* people will read, contrary to his recorded experience. We thought the remarks we wrote (p. 175) touching viii. and xi. would have amply satisfied him, but he returns to the subject. We need only say that the present enunciations of these propositions, had they been given in the first edition, would have saved us from any misapprehension of the author's argument. This edition is little more than a slightly corrected (there was very little need of correction) and so improved edition. The proof of Prop. i. is new: on p. 9, line 4, an = might advantageously, we think, precede AB. The new forms of viii. and xi. are: "It is not true that the angles of every triangle are together greater than two right angles," and "It is not true that the angles of every triangle are together less than two right angles." On p. 23 there is an uncorrected false reference in line 5 up: for iii. read iv. The proof of xii. has been recast, and in the appendix ii. (pp. 43, 44) about a page of matter, with Euclid's definitions of ratio, has been interpolated. On p. 56 the name R. Simpson occurs twice: it should be R. Simson or T. Simpson. It would be possible now, we should suppose, after a year's interval, to speak in somewhat clearer language ("I understand") of Mr. (now Prof.) Cook Wilson's investigations. After a hasty re-examination of Mr. Dodgson's argument, we can only reiterate our admiration for this first part of the "Curiosa Mathematica." We hope other parts are on the way. R. T.

Longmans' New Atlas. Edited by George Chisholm, M.A., B.Sc., Fellow of the Royal Geographical and Statistical Societies. (London: Longmans, Green, and Co., 1889.)

THIS atlas, although primarily designed for use in schools, aims at being a school and a reference atlas in one, and the attempt to effect a compromise between the two is certainly laudable. It contains 40 quarto and 16 octavo maps, illustrating the physical conditions of the earth, and dealing with climate, vegetation, products, distribution of population, ethnography, and religion. The maps are finished in a good style, and reference to them is considerably facilitated by the system of ledger indexing that has been adopted. In only a few cases has

the rainfall been given. It would have been well if a map had been constructed to show the mean annual rainfall over the entire globe.

The magnetic variation map is complete as far as it goes, but since it does not reach below lat. 60° S., the two foci in the southern hemisphere are not shown, and to a beginner it would appear as if such foci existed only in the northern hemisphere.

The physical features of different parts of the earth are generally well illustrated; but in an attempt to eliminate names that have been considered superfluous, it is doubtful whether in some cases the line of demarcation has not been overstepped and the maps left comparatively bare. The two ethnological plates, and the full explanatory note contributed by Mr. A. H. Keane, are worthy of commendation. Some of the subjects of the plates containing typical scenes from different parts of the world seem rather out of place in an atlas like this. We refer to such small cuts as "Children enjoying a Ride on a Dog Sledge" and "Children tobogganing in Canada." Again, another cut which is supposed to illustrate "An Aurora Borealis" is but a mournful representation of one of the grandest of natural phenomena, and might be omitted altogether for the idea it conveys of the character of an aurora.

Most of these plates, however, exhibit the physiographic aspect of different parts of the globe in a very clear light. Indeed, such an atlas as the one before us should play an important part in public school education, and deserves a high place among the political and physical atlases now in use.

Travels in the Atlas and Southern Morocco. By Joseph Thomson, F.R.G.S. (London: George Philip and Son, 1889.)

WHEN Mr. Thomson began his exploration of Morocco, his intention was to write a complete account of that interesting country. His purpose was, however, thwarted by the fact that he was recalled to England much earlier than he had anticipated; so that he has been able to write only a narrative of his personal experiences during his travels. In order to preserve what he calls "the popular and handy character of the volume," he has omitted many things of general and scientific interest which will see the light through more appropriate channels. The book ought to be cordially welcomed by a large class of readers, for it presents many vivid sketches of places which have hitherto been very inadequately known, and the people of Morocco are not less graphically depicted than the physical features of the country itself. Mr. Thomson, we need scarcely say, is a most careful and exact observer, and he has a vigorous, straightforward style, which makes it pleasant for his readers to attend him from point to point of his story. The interest of the volume is greatly increased by a number of admirable illustrations from photographs.

Eclectic Physical Geography. By Russell Hinman. (London: Sampson Low and Co., 1889.)

WE have much pleasure in drawing attention to an English edition of this admirable text-book, which has already been reviewed in our columns. We can confidently recommend it both to teachers and students. The numerous maps with which the book is illustrated will make it especially useful to teachers.

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.*]

"Mithradatism."

I AM anxious to introduce the above word for the purpose of indicating the phenomenon of immunity to poison (whether of bacterial or other origin) induced by administering to an organism gradually increased doses of poison. Mithradates Eupator, the sixth and greate t of that name, King of Pontus, is stated in classical tradition to have so far impregnated his system with poisons on which he experimented, that finally, when he wished to kill himself by some drug, he was unable to do so, having inadvertently rendered himself "immune" or refractory to all known agents of the kind.

I suggested this term in a lecture at the Royal Institution last week; and previously, in conversation with Dr. Roux, in Paris, proposed its use. The utility of the related terms "mithradatize" and "mithradatic" is obvious. The mithradatic theory of inoculations is opposed to the theory of "exhaustion of the soil" and to that of "inhibition by the introduction of chemical substances *directly* inimical to the growth of disease germs."

The Persian god Mithras is not inappropriately associated with the conquest of poisons, since the scorpion was represented as lying at his feet. E. RAY LANKESTER.

45 Grove End Road, N.W., June 3.

Report of the Royal Commission on the University of London.

WILL you allow me to submit to your readers a somewhat different view of the Report of the Royal Commission from that of the able article which appears in to-day's NATURE?

The writer puts the case clearly and forcibly from the position of University College; and thence, looking down upon the existing University, he recommends it to "afford, by means of a general examination, a test of attainment for students in institutions of as yet imperfect efficiency, and for private students." Those who are justly proud of the work that has been done by the present University (which the Commission fully and unanimously acknowledge) are well aware of its imperfections. More or less "imperfect efficiency" might be asserted of most human institutions. But the University has already elaborated a scheme of reform which in its essentials has been accepted by the Commission; and we may hope that it would grant even more liberal terms in order to secure the great public object of unity. It is beside the mark to propose, not the reform of the University—that both Senate and Convocation desire—not even its destruction, for that would leave the chance of making a better one in its stead; but its perpetuation in a starved, degraded, and hopeless state.

Surely it would be wiser for University and King's Colleges to accept the position offered them of taking the leading part in the reconstituted University, and sharing in its prosperity. For what would they surrender? The faint hope of obtaining a reversal of the Report after an uncertain period of suspense—always trying for a public institution—and then the task of making a new and rival University in London, of providing degrees not inferior in credit and yet not superior in difficulty to those of the older University, of conciliating the antagonistic principles on which the two Colleges were founded and are still supported, and of either persuading richer, larger, and older medical schools to join them, or running great risk of being forsaken by their own medical faculties.

Both Colleges have, under discouragement and undeserved neglect, performed excellent work, and University College in particular has done wonders in the last fifteen or twenty years. They have always had a grievance against the University of London, and were justified in getting tired of waiting on a tardigrade Senate and an amorphous Convocation. They saw a chance of obtaining a new joint charter, and pushed their claims at all hazards, including the loss of some of their most distinguished members. They have not succeeded, and on the whole they will probably be thankful that they have not, for their success would have meant the barter of a splendid birthright for a doubtful immediate triumph.

The writer of the article does not consider the question of the great medical schools of London, except to say that "the rejection of a separate University for Medicine is good in itself"; but in fact the grievance of these bodies is far greater and more pressing than that of University Co lege.

In the real University of London that we all hope to see——teaching, examining, learning, and growing—the three or four best of these schools will form constituents in many respects more academical, more collegiate, and more powerful than the non-medical Faculties of University and King's Colleges. They have traditions, they have endowments, and they have a scientific

as well as a purely medical discipline. Their students are for the most part older than those of the Arts Faculties, they have more of a common life, and they are wholly engaged in the studies of the place; whereas a large number of the nominal students in the two Colleges are buyers of scraps of knowledge, rather than University students as the phrase is understood at Oxford, at Edinburgh, or at Leipzig.

The chief difficulty which the minority of the Commissioners have evidently felt is that, by the constitution of the existing University, candidates are admitted to most of its degrees who have passed the several examinations, whether they have been educated in Colleges or no, and whether in London or elsewhere.

But it must be remembered (1) that this was not the original constitution of the University, but a later modification; (2) that the change has never been carried out in the Faculty of Medicine, which is confessedly the most successful of the four, and that practically it has been confined to the Faculty of Arts, which is confessedly the weakest; (3) that there is no insuperable difficulty in the same University granting degrees to collegiate students and to non-collegiate, to local students and to others; for Oxford and Cambridge give the same degrees to men from College and to those who are "unattached," and the University of Dublin has for many years admitted graduates from outside as well as students of Trinity College; (4) that when a teaching University for London has been organized, the number of collegiate students will steadily increase, while that of outsiders will diminish; for local centres will gradually develop and claim independent existence, as they have already at Manchester, at Calcutta, and at Bombay.

Surely, when the first feeling of disappointment has passed away, the Professors of University and of King's Colleges will see that they have still a splendid position waiting for them to occupy. Together with the medical schools, they will enter upon the vantage-ground which fifty years have gained for the present University of London. They will influence, and almost direct, it, if agreed among themselves; and if now and then Doctors and even Teachers find that they cannot have their way in everything, may not the few exceptions be just those in which it is well for the most liberal and enlightened professorial, or clerical, or professional opinion to be moderated by the judgment of laymen?

London needs a University worthy of the greatest city in the world. Three constituents, and three only, are necessary to its formation; and it is not too much to say that no two can make it, but that any one of the three can mar it. To obtain this great public object, the existing University will have to give up many of its prejudices and many of its powers; the medical schools will have to give up some of their independence; University and King's Colleges will give up little but a grievance. In the long run, by united forces, each healthy and vigorous constituent of the renovated University will share in the prosperity and the progress of the whole. The strongest and the best will have the largest share.

June 6. A London Teacher.

A Lizard Swallowed by a Viper.

As it appears from the "Notes" in the last number of Nature that the swallowing of a lizard by a viper is not usual, I may mention an instance which came under my own observation. Many years since, I captured a viper on Cannock Chase, in Staffordshire. The animal was rather sluggish, so I got it into a box unhurt, and carried it home. There I shook it out on to the ground. There came out first the slimy body of a *Lacerta vivipara*, followed by a thinner and livelier viper than that which had entered the prison. This result was not surprising, for the victim was about half as long as the swallower, which may explain the ejection of the former when the latter exchanged the fresh air of the Chase for a stuffy box. The lizard, however, in this case was dead, and digestion had begun. T. G. Bonney.

Remarkable Meteors.

The spring of 1889 has afforded a very unusual number of fireballs, though it is somewhat rare to find the vernal season prolific in these phenomena. In the autumn, it is true, we frequently hear of conspicuous meteors, but the earlier months of the year are by no means rich in such apparitions.

On March 11, 6h. 36m., a fine meteor of the colour and brilliancy of Venus was seen at London.

March 13, 10h. 25m. Large, bright meteor, without sparks or trail, observed at Dublin.

March 22, 24, 27, and 31. Fireballs appeared at Wexford, Dublin, &c.

April 15, 12h. 24m. Very brilliant fireball observed at Bristol, Bath, Dublin, Lincoln, London, Ramsbury, Worthing, and other places. Though the full moon was shining, the meteor burst out with startling effect, and lit up the sky and landscape for several seconds with a degree nearly equal to daylight.

April 27, 8h. 51m. Fireball equal to Venus seen at Bristol and Trowbridge. It fell vertically and moved slowly from a radiant probably at R.A. 119°, Decl. 28° N., a few degrees east of Castor and Pollux.

May 22, 10h. 8m. A very slow-moving meteor, as bright as Jupiter, and having a great length of path, observed at Bristol, Reading, Clifton, &c.

May 29, 10h. 45m. Fireball, fully 12′ in diameter, and shaped like a club, noticed at Leeds. It travelled with extreme slowness, occupying 9 seconds in traversing the 26° from 141° + 20° to 113° + 23½°. Its probable radiant was either at 176° + 9° or 210° − 5°.

Of these various bodies, the most remarkable were those of April 15 and May 22. The former was undoubtedly one of the most brilliant fireballs seen in recent years. The descriptions of its apparent path are not, however, sufficiently precise and accordant to enable its height to be ascertained. It appears to have emanated from a radiant point near Arcturus, and to have been very low in the atmosphere at the time of its final outburst and disappearance.

With regard to the meteor of May 22, it displayed some rather exceptional characteristics, though in point of brilliancy it was certainly inferior to several of the fireballs which have been lately recorded. As observed by the writer at Bristol, it passed about 6° below Vega, and was lost sight of behind buildings, which intercepted the view, when close to η Ophiuchi. Its path of 62° was performed in 16 *seconds*, so that the motion was extremely slow. As the nucleus sailed slowly along, it distributed a train of yellowish sparks in its wake. At Reading, the meteor was seen by Mr. G. T. Davis while observing coloured stars. He noticed its course with particular care as from about 1° west of Corona to between β and δ Scorpii, and gives the points of the observed beginning and ending as 226° + 31° and 239° − 24°, length of track 56°. He notes, however, that this line of flight should probably be extended to include the whole visible arc of the meteor's course. The duration was estimated as 15 *seconds*. A yellow train of 15° in length followed the head of the meteor as it slowly trailed across the sky, and Mr. Davis describes the whole effect as a splendid one. At Clifton an observer watched the object as it passed from the northern [??] sky to the star Vega, and from thence into the north-east confines of Scorpio. He remarks that the most curious point in connection with its career was its long duration, which must have been 18 *or* 20 *seconds*.

Comparing the pair of observations at Bristol and Reading, it is found that the radiant point of this conspicuous meteor was at 63° + 35°, in azimuth 153¼° (reckoned west from south), and altitude 1°. It was therefore pursuing a course very nearly parallel with that part of the earth's surface above which it appeared. When first seen at Bristol it was passing over a point 6 miles east of Oxford at a height of 50 miles. The Reading observer caught sight of it when 6 miles east by south of Farnham, the height being the same. When the object was obscured by houses at Bristol, its height had increased to about 55 miles. At Reading it was last seen when above a point 10 miles west of Orleans, in France at a height of 58 miles. The rapidly increasing distance of the meteor prior to its disappearance was of course due to the earth's curvature.

The real length of path observed at Bristol was 196 miles, described in 16 seconds, so that the velocity was 12¼ miles per second. At Reading the length was 249 miles in 15 seconds—velocity 16⅓ miles per second. Parabolic velocity would be about 20 miles per second, so that it is probable the meteor was revolving in an ellipse of very slight eccentricity—in fact, the orbit appears to have been nearly circular in form.

The radiant point of this meteor is situated some 7° south-east of ϵ Persei. The position is a very unusual one for a meteor shower occurring at this period of the year. When the effects of zenithal attraction are allowed for, the radiant is found to be several degrees below the position as above assigned from a simple projection of the two paths, and within about

12° of the sun's place. The very slow motion of the meteor, its considerable length of path, and the exceptional point from which it diverged, combine to render it an object of especial interest, and further observations of its apparent path would be valuable. It probably became visible at an earlier part of its path than when first seen at Bristol in Lyra, and it is desirable to ascertain, if possible, a more precise result for its point of appearance. The entire length of its course might then be derived, when it would possibly be found that the distance assigned from present data is much shorter than that really traversed by the meteor. The Bristol and Reading observations indicate the whole length as nearly 300 miles, and this, though undoubtedly under the true value, is yet far greater than the customary tracks over which the flights of these bodies extend.

Bristol, May 31. W. F. DENNING.

Palæolithic Implements from the Hills near Dunstable.

DURING the past twelve months I have found a small number of Palæolithic implements at great elevations in North Hertfordshire and South Bedfordshire, unconnected with existing river valleys. Four of the implements—1386, 1387, 1393, and 1398 in my collection—are from Caddington: height above Ordnance datum, 595 feet 9 inches. The dry valley close by, to the west, is 470 feet, and the ground gradually falls southwards to 409 feet at the source of the Ver, near Markyate Street, at a distance of 1¾ mile. The sections at Caddington exhibit red "clay with flints," brick earth (or clay), and tenacious brown clay or loam, surmounted by blackish earth, containing broken white-coated flints, a few ochreous flints, and numerous blackish Tertiary pebbles. The whole deposit rests on chalk, and varies in depth from 2 feet to 50 feet. Aware of the importance of finding the worked flints in the undisturbed material, I have, after long searching, found a single implement and one or two flakes *in situ* at the stony bottom of the upper deposit of tenacious brown clay at a depth of 3 and 4 feet from the surface. A single small Palæolithic implement I have found on the surface at Kensworth: height above Ordnance datum, 759 feet 8 inches. The bottom of the valley, 1¼ mile to the west, at the source of the Ouzel, is 414 feet. Half an ovate Palæolithic implement, obviously derived from the hill-tops, I have found in a field at the bottom of a chalky valley near Houghton Regis. The Caddington implements are pointed (or tongue-shaped), slightly abraded, small in size, and cinnamon-brown in colour. The interest attached to these finds rests not only on the great heights mentioned and the positions away from existing river valleys, but in the nature, age, and mode of deposit of the upper tenacious brown clay in which the implements are embedded. The implements themselves agree in make and appearance with the well-known brown or ochreous implements often found in non-ochreous sand, &c., in existing river valleys. I have at present seen no traces of fossil bones or fresh-water shells in the deposits mentioned. WORTHINGTON G. SMITH.

Dunstable.

Japanese Clocks.

WITH reference to your notice of the Japanese clocks purchased for this Museum, and described by Mr. A. Rambaut, it may prove of interest to point out in somewhat fuller detail the conclusions at which he has arrived as to the cause of the peculiarities in their construction It was on account of these, to me, unintelligible peculiarities, that I invited Mr. Rambaut to undertake their explanation, and this, I venture to think, he has very thoroughly accomplished as follows. The three clocks agree in having a dial on which the time is indicated by a pointer attached to, and descending with, the weights. In other respects they differ, though all are made more or less on the same principle. The largest of the three appears the most important, and the greater part of the paper is occupied in explaining its construction. The dial of this is divided by vertical lines into six equal spaces, which are crossed by a series of thirteen graceful curves. An examination of these curves leads to the conclusion that they were intended to divide the day and night, at all seasons of the year, into six equal portions each. This system was common enough in ancient times, but the peculiarity of these clocks is that they show the day to have been reckoned, not from sunrise till sunset, but from the first noticeable streak of morning twilight until the sun had reached a corresponding distance below the western horizon. This distance is equal to 13°, and the form of the curves leads to the conclusion that the clock was constructed in a latitude of about 34° 7′, very little less than that of Miako, formerly one of the principal cities in Japan. An examination of the two other clocks, although they differ very much in detail, supports the conclusions derived from a study of the first. V. BALL.

Science and Art Museum, Dublin, June 1.

Luminous Night-Clouds.

FOR the first time this year these clouds appeared in this locality last night, between 10 p.m. and midnight. I inclose sketches, as with my reports in former years, made at half-hour intervals, exhibiting development and movement; which latter has been in this case from west to east, a direction the reverse of light local wind. A depression of temperature was noticed, as on former occasions. Minimum (on grass) fell to 40° F.

It may be remembered by some of your readers that when first pointing attention to this annual phenomenon some years ago, and affirming the self-luminous character of these cloudlets, at apparently high altitudes, the name "nubeculæ boreales" was suggested to distinguish them from simple auroral effects. Herr Jesse, of Berlin, has recently (NATURE, vol. xxxix. p. 537) noted their occurrence toward the South Pole also, and pointed to their probable cosmical importance. Detailed observations of any of your correspondents, made during the present reappearance of this phenomenon, would be accepted by the writer thankfully, toward a fuller discussion of the subject. If, as would appear, it is chiefly of a Polar character, the name proposed should be modified to include the South Pole, and these clouds so designated "nubeculæ polares" (or "noctilucæ").

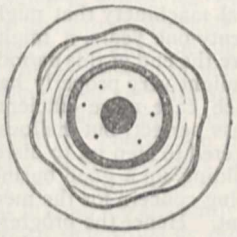
D. J. ROWAN.

Dundrum, Co. Dublin, June 8.

Note on some Hailstones that fell at Liverpool on Sunday, June 2, 1889.

BEING in the Physical Laboratory at about 3.35 p.m., about which time a violent thunderstorm took place, accompanied by hail and rain, I went outside and picked up what seemed to me a fine specimen of hail. I brought it inside, measured its diameter with a pair of calipers, and found it to be 2·9 centimetres.

I then placed it on a slate slab, on which it gradually melted down until it showed a very fine section, a picture of which is given below.



The centre was circular, and consisted of opaque ice, about the size of an ordinary hailstone; this was surrounded by a circle of almost perfectly clear ice, this again by a circle of opaque ice, and this once more was surrounded by almost clear ice, but with fine circular lines in it, and bounded by a beautifully frilled outline of opaque ice, which imitated in shape the spheroidal state of a drop of water. Outside this again was a thick layer of clear ice of crystalline form, the position of whose angles I have not shown, as I did not observe their position with regard to the frill inside sufficiently well.

The diagram is drawn to the right size, omitting the angles on the outer covering of ice, the dark parts represent white opaque ice.

If a hailstone is formed during electric oscillation from cloud to cloud, and if it receives opaque ice from one cloud and clear ice from another, the alternation of layers would be a natural consequence. The violence of the hail scarcely seemed as great as their size justified, and this suggested that electrostatic attraction had upheld them against the force of gravitation down to a moderate height above the ground.

I believe almost all the lightning flashes that occurred were between two clouds, as, although I was looking out for the form of the flashes, I could only see the sky lit up with a brilliant red

or pinkish glow. Dr. Howard found some hailstones that were cylindrical in form; those that I found were approximately round but for the sharp edges of crystalline structure. Mr. B. Davies measured one and found it to be 3·5 centimetres in diameter. All the large stones that I found showed the same construction; in every one there was the same frilled appearance of an internal surface: this was also observed by Mr. B. Davies.

EDWARD E. ROBINSON.
Physical Laboratory, University College, Liverpool.

THE SUBDIVISION OF THE ELECTRIC LIGHT.

TEN years ago the subdivision of the electric light was the burning question of the day. Again it has been revived, but the present subdivision is a legal and not an electrical problem.

The public interest in electricity roused by the sensational telegrams about Edison's work in 1878-79, and by the wonders seen at the Paris Electrical Exhibition in 1881, as well as at the Exhibition at the Crystal Palace in the following year, made people reflect that the electric lighting of our streets and houses might breed a monster as tyrannical as the water companies; consequently, paternal legislation passed an ill-considered Bill, the "Electric Lighting Act of 1882," to curb electrical repaciousness.

But had our law-givers paid attention to what was taking place in the City, and had they also possessed some acquaintance with the difficulties connected with the problem of electric distribution, they would have seen that it was on the Stock Exchange that the devouring electric Hydra was rampant, and that the general supply of electricity was in 1882 but a weak puny infant, which would require the most tender care to enable it to reach boyhood. Instead, however, of fostering the babe, the framers of the Act of 1882 showed their absolute ignorance of the way in which a new industry grows up, by introducing a clause which specified that at the end of twenty-one years the local authority might take over any installation for electrically lighting a district on paying the simple market value of the land and plant without giving anything for good-will. In view of the improvements in electrical machinery that might be expected to take place in twenty-one years, it might have been anticipated that before the end of this period the dynamos and other apparatus might very properly have been replaced twice over, in each case more efficient apparatus being substituted for less perfect; but the local authorities were still to be empowered to step in, to disregard all that had been done in building up a good business, and purchase the whole as a going concern for the mere market value of the land and plant. Hence the progress of electric lighting in England was strangled at its birth, while vast sums were squandered on the legalized gambling of the Stock Exchange, the public being unmercifully fleeced, and then left without electric lighting or belief in it.

This instance of paternal legislation was but a repetition of the one-sided Act passed to remedy the extortion that sometimes accompanied the operation of bills of sale. In this case the interests of the borrower were alone present in the minds of the framers of the Act, and they quite forgot that by making the recovery of debts on bills of sale very difficult they would introduce a new and even greater hardship, by making the borrowing of money on bills of sale frequently impossible.

This bone of contention, the Electric Lighting Act of 1882, was steadily snarled over and growled at, until last year the two Houses of Parliament saw fit to swallow a new Act, which, by extending the period of compulsory purchase to forty-two years, and by recognizing that the development of an electric light installation might represent something much more valuable than the market value of the land and plant, has at last made the general distribution of the electric current commercially possible.

But in the meantime, over a vast area extending from Regent's Park on the north to the Thames on the south, from the Law Courts on the east to Park Lane on the west, some thousands of electric lamps had been dotted, all fed from one central station in the basement under the restaurant of the Grosvenor Gallery in Bond Street. And to avoid the difficulties that would be introduced by the clauses in the 1882 Electric Lighting Act, if the streets were broken up and the wires put underground, the London Electric Supply Corporation, to whom the Grosvenor Gallery installation belongs, erected their cables, some 50 miles in length, over the tops of the houses. Hence, the legislation that was intended to avoid a vested interest being acquired in street conduits has forced the erection on the house-tops of a network of high-pressure mains which have now to be specially legislated for.

The productive capacity of the Grosvenor Gallery plant having been fully reached, while applications to supply current for thousands of incandescent lamps had to be shelved for want of means of generating the necessary current, the London Electric Supply Association commenced the erection of a vast station on the banks of the Thames at Deptford for the supply of current for some millions of incandescent lamps; and it has been mainly due to the application on the part of the company to obtain powers to run their wires along twenty-seven railways and tramways, and through thirty parishes, that the recent inquiry by the Board of Trade, lasting from April 3 to May 1, has been held to examine into the whole question of the electric lighting of London. The result of this inquiry is contained in a long Report that has just been submitted to the Secretary of the Railway Department of the Board of Trade by Major Marindin, this Report being agreed to by Major Cardew.

Eight companies—viz. the Chelsea Electricity Supply Company, the Electrical Power Storage Company, the House to House Electric Light Supply Company, the Kensington and Knightsbridge Electric Lighting Company, the London Electric Supply Corporation, the Metropolitan Electric Supply Company, the Notting Hill Electric Lighting Company, and the Westminster Electric Supply Corporation—applied for thirteen provisional orders and two licenses. A license is a permission granted for seven years, but it is renewable at the end of this period. The Board of Trade, however, can only grant a license when the consent of the local authority has been previously obtained. A provisional order, on the other hand, requires no consent of the local authority of the district, and is granted for a period of forty-two years. After a provisional order has been approved of by the Board of Trade, it requires to be confirmed by a Bill in Parliament before it can come into force. Neither the license nor the provisional order when granted is exclusive or creates any monopoly.

The first point considered in Major Marindin's Report is the systems of supply proposed to be used by the various companies applying for powers. They may be divided into a supply by direct current, and a supply by alternate current. The direct supply by means of continuous currents is dealt with under three heads:—(*a*) The system adopted by the Chelsea Company—viz. the use of one generating station for a considerable area, supplying current to charge several accumulator stations at different points within the area of supply with a pressure of from 1000 to 2000 volts, each station having a duplicate set of accumulators. The supply mains leading from these accumulator stations are intended to carry the current directly into the houses at a pressure of 100 volts, the supply being entirely from the accumulators. This is the system of transformation that was originally suggested by Sir William Thomson at the meeting of the British Association at York. (*b*) The system adopted by the Kensington and Knightsbridge Company, which is at the present

moment supplying partly by accumulators and partly by dynamos—the former doing the whole work during the hours of minimum supply, and the latter being employed in charging the accumulators and supplementing the direct supply from the accumulators during the hours of maximum supply. The accumulators are all stationed at the generating station, and merely serve as a reserve of power. Since they are not employed to effect a transformation from a high to a low pressure, they do not introduce any saving in the size of the distributing mains, as in the case of the Chelsea system. Hence the Kensington system, which the Notting Hill Company proposes also to adopt, would require several generating stations for the lighting of a large area. (*c*) Direct supply at low pressure without the use of accumulators, such as is at present employed by the St. James's and Pall Mall Company. This system is also only suited for distribution over small areas, not exceeding half a mile in radius, since the absence of any system of transformation necessitates the employment of very large conductors. This last system has also the disadvantage of alternate current distribution, as the supply, being directly dependent on the steady working of the machinery, is liable to be seriously affected by even a temporary breakdown, which is, of course, not the case with the direct current systems (*a*) and (*b*).

It is interesting to note that no system of direct current transformation, other than that effected by the use of accumulators, has been proposed by any of the companies or referred to in Major Marindin's Report; probably because all direct current transformers, "motor-dynamos," &c., that have yet been devised, employ moving parts, and are therefore in their present form unsuitable for transformation in private houses. We cannot, however, but think that such direct current transformers might be very economically employed at distributing stations, the energy being received at high pressure from the main generating station, and distributed at low pressure to the houses in the neighbourhood of the distributing stations.

The House to House, the London Electric Supply, and the Metropolitan use high-pressure alternate currents with transformers, except in the case of the Whitehall installation of the last company; and it speaks well for the alternate current system that, while the Metropolitan Company commenced at Whitehall with direct currents and accumulators, which they first thought so superior to the use of alternate currents, they now state in their evidence that in their extensions they propose employing alternate currents and transformers. In the case of the London Electric Company, a *double system of transformation* is to be employed between the current leaving the dynamo and the current in the houses of the consumers. The supply will be obtained from a very large generating station at Deptford, outside the crowded districts of the Metropolis, and carried through trunk mains, at the unprecedentedly high pressure of 10,000 volts, to transforming stations inside, or near, the area of supply, whence the current will be taken by distributing mains, at a pressure of 2500 or 2000 volts, to the consumers' premises, and transformed there to 100 or 50 volts. Or this second transformation may be effected at secondary transforming stations, the currents being conveyed from them to the houses at the pressure of 100 or 50 volts.

In the case of the House to House and Metropolitan Companies only one transformation is proposed to be employed, so that several generating stations must be erected; as even with a pressure of 2000 volts the conductors would have to be inconveniently thick if the electric energy were conveyed very far. The Metropolitan Company have, therefore, selected sites in Sardinia Street, Rathbone Place, South Mews (near Manchester Square), Eccleston Place, and Waterloo Bridge Wharf; from each of which a current at 1000 volts will be sent, to be transformed into 100 or 50 volts inside the consumers' premises.

The Report contains a concise account, written by Major Cardew, of the relative advantages of the direct and of the alternate systems. He refers to the fact that the employment of accumulators by the Chelsea Company at their distributing stations enables small distributing mains to be used; makes the lighting of the district unaffected by even a temporary total breakdown of the machinery, since the accumulators that are at any time supplying current to the houses are quite distinct from those that are being charged; enables a nearly constant pressure to be maintained at the houses, independently of the number of lamps that are turned on; and, lastly, the current being a direct one is applicable for the supply of motive power and for other uses besides the production of light and heat, and can be more easily measured than an alternate current. Major Cardew further adds, as an additional advantage possessed by supplying current from accumulators, that "there is no doubt that a battery current is less destructive to lamps than one supplied from dynamos, whether alternating or continuous." We doubt, however, whether there is sufficient experimental evidence on this subject to justify this conclusion.

As a set-off to these advantages the cost of accumulators is great, as well as that of the skilled attention they require, while their efficiency at maximum output is probably rather low; the automatic switches for switching the accumulators into the charging circuit when discharged and into the discharging circuit when charged, as well as for regulating the discharge from each cell, are, Major Cardew thinks, a weak point, and any failure in their action would probably ruin the accumulators; the insulation of large batteries cannot be maintained at all high; and the numerous joints that have to be maintained good in the presence of acid fumes are a source of weakness.

The special advantages of the high-pressure transformer system Major Cardew considers to be: the smallness of the mains; the absence of difficulty in maintaining constancy of pressure in the mains within 2 per cent. over a large area; the pressure in the houses may be different in different cases according to the needs of the consumer; the system is simple to work; the dynamos are simple, and can be made in easily replaceable parts.

The disadvantages are that the high pressure necessitates great care and expense in insulation; the conveying of this high pressure to at any rate one point on the consumer's premises involves some risk to life; the main cannot be handled nor connection made with it when the pressure is on; the transformers cause the regulation in the houses to be not so good as in the mains; the system cannot at present be efficiently utilized for motive power, or for electric deposition or other chemical uses, such as charging accumulators; "and it is very doubtful whether a practically successful alternating motor is likely to be brought out"; the system depends entirely on running machinery; the general efficiency must be low when the supply is near its minimum, which, so long as it is utilized for lighting alone, obtains during about eighteen hours out of the twenty-four; a serious accident at the generating station might stop the supply. "Alternating machines cannot be so readily connected together to run in parallel circuit as continuous current machines"; the instruments and methods for making measurements are far more restricted in number, and the measurements are more difficult to make, when alternate currents are in question.

The sentences in the preceding paragraph that are placed in inverted commas appear to us to be particularly rash. So far from saying "it is very doubtful whether a practically successful alternating motor is likely to be brought out," we should prefer to say that it is almost certain that, as soon as there is a widespread demand for cheap efficient alternate current motors, such motors will be forthcoming; and, after the experiments shown by Mr.

Mordey at the end of May, at the factory of the Anglo-American Brush Company, on the great facility with which alternate machines can be coupled in parallel, Major Cardew must, we think, wish that he had worded the sentence quoted above somewhat differently.

Major Cardew next criticizes the objections that have been urged against the particular scheme involving two transformations of the pressure, which the London Electric Supply Association are arranging to carry out: that having only one generating station an accident might stop the whole supply of current to hundreds of thousands of incandescent lamps. To avoid, for example, the bursting of a steam-pipe greatly impeding, if not entirely stopping, all work by filling the factory with steam, and by the steam condensing on the dynamos and fittings, and so causing the high-pressure current to flash where it ought not to go, Major Cardew recommends that the Company shall subdivide the station at Deptford so as practically to provide two distinct generating stations, or shall forthwith establish a second generating station in some other locality. With reference to another objection, that the proposed pressure of 10,000 volts is so enormously in excess of anything which has hitherto been worked with, as to cause the scheme to be a gigantic experiment, he very rightly points out that, as there has been successfully used for some time at the Grosvenor Gallery installation over ten times the pressure that was believed to be the limit of safety a few years ago, "and as the so-called experiment of still further raising the limit of pressure would, if successfully carried out, be of immense benefit both to the public and electric light undertakers, I do not consider that, under proper regulations, the London Company should be prevented from carrying out a scheme in which they have shown the greatest confidence, and which the majority of scientific witnesses who have been called approve of in principle." With this recommendation we heartily agree, since all past history has shown that it is better to be guided by experience than by preconceived notions.

The final conclusions arrived at in the Report embrace several pages, but they may be briefly summed up as follows:—"That it must be admitted that the science of electric lighting has now reached the point at which a supply can be made which will be of great benefit to the public, and that the power of obtaining this supply should be within the reach of all persons who may require it," and therefore, although the wishes of local authorities should be consulted, "the mere objection by a local authority to the introduction of a company proposing to supply electric light, upon general grounds, should not be considered sufficient to exclude such company." As the whole Metropolis may be for purposes of lighting and management of roads and streets under the control of one central authority, "the provisional orders granted for the Metropolitan area should, as far as possible, be identical in form, with identical provisions as to supply, compulsory powers, interference with streets, and more than all as to price."

That the scheme adopted in 1883, of dividing a district into two areas (A) and (B)—the former an area that it was compulsory for the company obtaining the provisional order to light; the second an area which the company might light if they thought fit, but which they could not be required to light until after the expiration of two years—be abandoned, as such a distinction of areas is not likely to work well, and is not contained in the Electric Lighting Act, being merely introduced for the purpose of convenience; and that instead the supply shall be compulsory, under requisition, over the whole area on equal terms. That, "taking the (Metropolitan) area as a whole, it does not appear that it would be wise to fix a lower maximum than 8*d.* per unit." One Board of Trade unit is one thousand watts for one hour, so that at three and a half watts per candle, which is a fair average efficiency for an incandescent lamp, if it is to have a decent life, and assuming that a sixteen candle-power gas-burner consumes 5 cubic feet per hour, the maximum price proposed for the electric supply is equivalent to gas at 7*s.* per 1000 cubic feet, or nearly three times the present actual cost of lighting by gas. In the draft provisional orders several companies have asked for the right to make a certain minimum charge irrespective of the amount of electric energy consumed; and in the case of the Metropolitan Company, they ask to be allowed to charge a householder who has electric lamps in his house £5 10*s.* a quarter even if he never turns on a single lamp. Of course such a high minimum charge would be absurd, and even that of 13*s.* 4*d.* per quarter, which the Report appears to consider a reasonable one, appears to us much too high. In fact, we think that the proposal that there should be no minimum price at all if the householder pays for connecting his house with the mains might have been strongly urged in the Report, instead of it being stated that "such a provision would hardly be necessary where the minimum is reduced as in the Metropolitan Orders,"—that is, to 13*s.* 4*d.* a quarter. It is further recommended that there shall be a revision of the prices in the form of a sliding scale based upon the basis of a 10 per cent. dividend, the standard being fixed after the experience gained by the working of the first seven years.

In view of the fact that the laying of the mains of several companies means so much dead capital which the local authority would have to pay for if it elected to purchase at the end of forty-two years, and that no matter what regulations be made as to laying of mains the interference with the street must be to a certain degree proportionate to the number of companies having powers over this street, it is recommended that powers should not be given to more than two companies over the same area, and that one of these companies should be a company using the direct current. The following is very important, since if passed it will entail a vast expense on the London Electric Supply Corporation:—"That wherever a company now supplying a district by means of overhead wires is granted an order for such area, it should be placed under the obligation to remove these overhead wires within a period of two years from the granting of the order; and if such a thing be possible that this company should be prevented from invading a district in which it has not got powers by means of overhead wires."

At this Board of Trade inquiry many arguments *pro* and *con* were advanced as to the large companies being allowed to invade the areas that had begun to be worked by small companies. The large companies raised the "no monopoly" cry, and urged that they ought to be allowed to compete everywhere; whereas the smaller companies alleged that the most certain way to bring about monopoly would be to allow the large companies to enter the areas worked by the small companies, and to use the profits gained by the large companies in non-competing districts to enable them to work for a time at a loss in the competing district, and by underselling the smaller companies to eventually drive them out and have the whole field to themselves. Taking all points into consideration, Majors Marindin and Cardew recommend that there be allotted to—

(1) The London Electric Supply Corporation: the portions of St. Martin-in-the-Fields lying to the south of the Strand and west of St. Martin's Lane; the portion of St. Margaret and St. John, Westminster, lying to the north of Victoria Street, excepting that portion of St. Margaret lying to the west of St. George, Hanover Square; St. James, Westminster; St. George, Hanover Square; Chelsea; the Greenwich District; St. Mary, Rotherhithe; St. Mary, Bermondsey; the district of St. Olave; the district of St. Saviour, Christchurch; and that portion to St. Mary, Lambeth, lying to the north of Westminster Bridge Road.

(2) The Metropolitan Electric Supply Company: St. Giles-in-the-Fields; St. George, Bloomsbury; St. Andrew, Holborn, above Bars; St. George the Martyr; St. Sepulchre, Saffron Hill; Hatton Garden; Ely Rents and Ely Place; the Liberty of Glasshouse Yard; St. Anne, Soho; St. Paul, Covent Garden; St. John the Baptist; Savoy, or precinct of Savoy; St. Mary-le-Srand; St. Clement Danes and the Liberty of the Rolls; together with the extra-parochial places known as the Charter House, Gray's Inn, Lincoln's Inn, Staple Inn, and Furnival's Inn; St. Marylebone; St. Mary, Lambeth; St. Leonard, Streatham, and Clapham; that portion of St. Martin-in-the-Fields which lies to the east of Northumberland Avenue, Charing Cross, and St. Martin's Lane.

(3) The Chelsea Electricity Supply Company: the small portion of the parish of St. Mary Abbotts at the east end of the parish contiguous to Chelsea, which has already been agreed to by the Kensington Vestry; as well as the following, which has up to this time been refused by the Vestry of St. George, Hanover Square, viz. so much of the parish of St. George, Hanover Square, as is between the line formed by the eastern boundary of Chelsea parish on the west, by Knightsbridge, St. George's Place, and Hyde Park Corner, on the north, and by Grosvenor Place, Upper Grosvenor Gardens, Lower Grosvenor Gardens, Buckingham Palace Road, Commercial Road, and Bridge Road, on the east and south-east.

(4) The House to House Electric Light Supply Company: the south-western portion of the parish of St. Mary Abbotts, Kensington, which has been offered to this company by the Vestry, and which it is willing to accept.

(5) The Kensington and Knightsbridge Electric Lighting Company: the portion of the parish of St. Mary Abbotts, Kensington, which this company is at present lighting under licence from the Vestry; so much of the parish of St. Margaret, Westminster, as lies to the west of the parish of St. George, Hanover Square, which is at present worked under licence from the Vestry of St. Margaret and St. John, if the consent of this Vestry, which is at present refused to the issue of a forty-two years' provisional order, can be obtained.

(6) The Notting Hill Electric Lighting Company: the portion of the parish of St. Mary Abbotts, Kensington, which has been allotted to the company by the Vestry.

(7) The Westminster Electric Supply Corporation: the parish of St. George, Hanover Square; and the portions of St. Margaret and St. John, Westminster, lying to the south of Victoria street.

(8) As regards the Electrical Power Storage Company: that as the articles of association of this company do not give it any power to manufacture and supply electricity for house-to-house lighting no provisional orders be given.

Lastly, that the licenses applied for by the Chelsea and House-to-House Companies for areas in the portions of the parish of Kensington already allotted to these companies by the Vestry be granted.

As regards the City itself, the Commissioners of Sewers, acting for the Corporation, are asking for tenders; but Major Marindin says that he sees "no reason why the principle that all such lighting should be done under statutory powers and obligations should be departed from in their case;" and he recommends that the Board of Trade should "urge the Commissioners of Sewers to consider whether the orders as remodelled do not sufficiently provide for all their requirements, and to consent to a division of the area of the City between the two competing companies, viz. the London and Metropolitan Companies, the latter company being allotted the portion nearest the Strand District, and the former the Central and Eastern portions of the City, so that access may be given to the parish of Clerkenwell, the Vestry of which wishes for an order to be granted to this company."

Major Marindin's Report was forwarded on May 18, by the Board of Trade, to the London County Council, for an expression of their opinion on the subject; and the Clerk to the London County Council has within the last few days sent a reply to the Assistant Secretary of the Railway Department of the Board of Trade. In this reply, while expressing the general approval of the Council to the recommendations contained in Major Marindin's Report, he communicates the following important suggestions, among several others, which the London County Council desires to make:—

"That in the case of subways being in future made in streets where wires are already laid, the companies should be under an obligation to remove the wires into such subways, and to pay a rent for the use of them, a reasonable time (say three years) free of rent being allowed as a set-off to the cost of such removal."

Such a regulation it appears to us would be very onerous in the case of companies like the Kensington and Knightsbridge Company, who have gone to a considerable expense in making small special conduits for their own wires.

"That in view of future possible reduction in the cost of production which may be made as the result of experience and invention there should be a provision that the maximum price of 8*d*. per Board of Trade unit, proposed to be adopted, shall be subject to revision at the end of seven years; and that in order to insure healthy competition between the companies during that period no amalgamation or working agreement between companies shall be permitted without the consent of the Council. That clauses should be inserted providing for the application at the end of seven years of a sliding scale of price and dividend, on the basis of a dividend of 8 per cent." (not 10 per cent. as recommended by Major Marindin to the Board of Trade), "leaving the initial price and arrangement of the scale to be determined at the expiration of the term of seven years.

"That the minimum charge for supply should be fixed as low as possible, and that should such minimum be fixed at £1 per quarter or over it should be reckoned by the year and not by the quarter, because of the irregular requirements of the consumer at different seasons of the year."

We presume this is to prevent a company charging a householder by meter in the winter quarters, and levying the minimum rate in the summer quarter.

"The Council considers that it would be to the advantage alike of the public and the companies that there should be one uniform system of regulation and control throughout the entire area of London. The Council is of opinion that, as the representative governing body of the whole of London, it should be appointed the controlling authority. The Council would further suggest that, if it be made the controlling authority, it should be empowered to discharge the following duties, viz.:—

"Inspection of lines and works.

"Testing current.

"Testing and certifying meters."

We do not know whether the London County Council is aware that a Committee of the Institution of Electrical Engineers, and a Committee of the Electrical Section of the London Chamber of Commerce, have for some time past been engaged in advising Major Cardew regarding the details of an electrical standardizing laboratory to be fitted up for the use of the Board of Trade; and we think that, while municipal regulations may very properly be left to the County Council, the standardizing and certifying of meters would more appropriately form part of the work of that body which is already in charge of the national standards of weights and measures, viz. the Board of Trade.

The letter of the Clerk of the Council goes on to say:—

"The Council, in view of the fact that some companies

have been, and are now, supplying electricity by overhead wires without statutory powers, and being convinced of the undesirability of allowing this to be continued, would venture to suggest that, in any further legislation on electric lighting, the supply of electricity in any district, before obtaining statutory powers for such district, should be prohibited under penalty."

To this we see no objection, now that the Electric Lighting Act is so modified that it is possible for an electric lighting company to reap commercial success by working under it.

THE LIFE-HISTORY OF A MARINE FOOD-FISH.[1]

II.

THE larval salmon enters the world of a size—though small—that is readily recognizable, viz. about three-fourths of an inch in length, but the marine forms under consideration, from their minute size and glassy translucency, are almost invisible to the naked eye—just a gleam of light broken by the passage of a different medium, or a tinge of pigment, arresting attention. Only in the cat-fish (which is not much—though it ought to be more—of a food-fish) with its large egg, have we a size nearly reaching that of the salmon at birth.

We had left the larval fish tossed about by the currents and unable to struggle against them, now floating with its yolk-sac uppermost, or hanging in the water with its head downward, and again making spasmodic darts hither and thither. Soon, however, it gathers strength, and at the end of a week or ten days it glides actively through the water, and avoids both obstacles and enemies, the young cod nimbly escaping the forceps, poising itself in the water with its large pectoral fins (Fig. 11), and

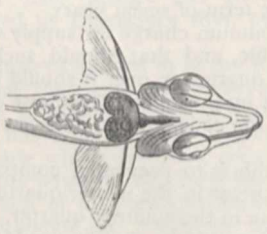


FIG. 11.—Ventral view of the anterior region of larval cod (magnified).

evincing both intelligence and dexterity. Moreover, this activity greatly promotes respiration in those like the gunard with a motionless mandible, the water being thus sent through the mouth and over the branchial region. Its mouth has now opened and the yolk-sac has been absorbed, while it feeds on the most minute of the little Copepods, especially those almost microscopic in size, that swarm in the surrounding water. The provision whereby such tiny fishes find in the ocean food suited to their capacities is one of the most striking features in Nature, but it has only recently been carefully investigated. It is a notion no longer tenable that during the winter and spring the sea, to a large extent, is devoid of the wealth of pelagic life so characteristic of the summer months—just as it is of the genial waters of the tropics. For several years, however, it has been found that a vast abundance of minute life of all kinds is present throughout the entire year—and from the surface to the bottom. Moreover, during the warmer months a constant succession of young forms rises from the eggs both of the sedentary and creeping animals on the bottom to the surface, where they sport in the summer sun, undergo certain changes, and again descend as they assume the form of the adult. The pelagic young food-fishes—swimming freely in the ocean—thus have a double chance at them; first in their very early stage as they rise, and again in their larger and later condition as they descend. The enormous numbers, countless variety, and ever-changing nature of the small animals either directly or indirectly constituting the food of these little fishes form an important feature in the economy of the sea. Such animal forms comprise those long known in the British seas, besides others more familiar to Arctic voyagers, or to the sunny waters of the Mediterranean, for, with modern apparatus and persistent efforts (thanks to the enlightened views of the Government acting through the Fishery Board), our knowledge is always extending.

It is a remarkable fact that it is primarily to plants in inshore waters that the abundance and variety of animals are in many respects due, especially if estuaries also debouch in the neighbourhood. Thus nowhere are the swarms of Sagittæ, Appendicularians, Crustaceans, and other forms of fish-food more conspicuous than in the midst of a sea teeming with Diatoms, Rhizosoleniæ, and other Algoid structures.[1] These nourish many of the lower forms upon which the Crustaceans and other higher types feed, the latter again falling a prey to the fishes. Moreover, while the larger forms of the Copepods and other Crustaceans, for example, afford suitable nourishment for the more advanced post-larval fishes, the multitudes of larval Crustaceans (*Nauplii*) are adapted to the needs of the smallest larval food-fishes. Now this plant-life is specially abundant in April and May, just when the larval and very young post-larval fishes appear more abundantly in the inshore waters, so that the cycle is nearly complete, viz. from the inorganic medium through microscopic plant and larval Crustacean to the post-larval fish. I have mentioned the neighbourhood of an estuary as a prolific source of food for young fishes, and I need only explain further by instancing the case of mussel-beds, which for months pour countless myriads of larval mussels into the adjoining sea, far beyond the needs of the area as regards mussel-culture, but which form a favourite food of the little fishes at all stages, but especially from an inch and a half to three inches in length. These fishes feed on the young mussels as they settle down on the sea-weeds, rocks, and zoophytes in August, after a free-swimming larval existence. Like some of the forms indicated above, mussels live to a considerable extent on microscopic plants and various minute organisms contained in the mud of the estuaries and other sites, so that a rich and favourite food, universally liked by fishes, is the product of these uninviting flats. Moreover, in passing, it may be remarked that, while everywhere preyed on by the food-fishes, it occasionally happens that in turn the mussel proves a source of inconvenience to them, for, settling on the gill-arches of haddocks, the mussels flourish on a site so suitable for aëration and food that they by and by press out the gill-cover and impede respiration, just as the shore-crab (which is also fond of mussels) has its eye-stalks wrenched out by the slow but sure growth of the young mussels which have fixed themselves in their sockets. Nemesis thus, by a chance of anchorage, converts a favourite food into a permanent inconvenience.

Again, in connection with the pelagic food of fishes, it is a well-known fact that adult cod are extremely fond of sea-anemones,[2] and some of the rarest species may be procured in their stomachs, a feature by no means surprising when we remember that Abbé Dicquemare cooked and ate his sea-anemones with great relish, and wrote in their favour, as also did Mr. Gosse in our own country. Now, the pelagic young fishes, instead of roaming near

[1] A Discourse delivered by Prof. W. C. McIntosh, F.R.S., at the Royal Institution, on Friday, February 1, 1889.

[1] The fact that certain fishes feed on Infusoria has not been overlooked.

[2] A favourite bait for cod in some parts; and from the fact, amongst others, that star-fishes do not molest them on the hooks, no bait is more successful.

the bottom in proximity to the anemones fixed on the rocks, and running the risk of being themselves captured for food, find in the inshore waters in summer the larval *Peachiæ* in great numbers conveniently attached by the mouth to the little Hydromedusæ (*Thaumantias hemisphærica* and *T. melanops*) which occur in swarms in mid-water. Moreover, the somewhat larger young food-fishes (2 to 3 inches) show the same liking for the Cœlenterate group, by browsing on the zoophytes (*Obelia geniculata*) which cover the stones and rocks with feathery tufts, yet the zoophytes are not much the worse for this treatment, for they by and by shoot afresh, and clothe the area once more with dense forests. The rapidity with which such zoophytes grow is remarkable, though we must remember that in some cases the old stock naturally dies off after having produced swarms of pelagic young.

Under this rich food, the young fishes grow apace; head and eyes, mouth and accessory organs, body and fins—all rapidly increase; and the little fish, hatched in the spring, say from March to May, is soon in what is known as the post-larval stage—that is, has lost its yolk-sac, has assumed a more or less uniform tint, and has gill-fringes and teeth. It is about a quarter of an inch long, and is both active and intelligent, the large head and large eyes of the young food-fishes being at this stage specially conspicuous, and in marked contrast with such as *Cottus*. The marginal fin is quite continuous at a quarter of an inch, and the lancet-like termination of the caudal end of the body is noteworthy.

About this time the ventral fins of the young fishes first make their appearance, for hitherto they have managed to do without them. Moreover, these fins in some, such as the rockling and ling, undergo remarkable development, forming in the latter (Fig. 7) a pair of great ventral wings, conspicuously coloured yellow; yet in the adult (a ground-fish) they attain no greater dimensions than in the cod, both having at a certain stage soft, free filaments or tacile processes at the tip. The ventral fins in the post-larval rockling (Fig. 12) are equally large, the distal half being black,

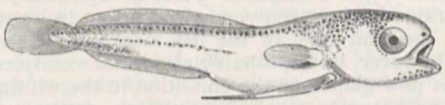


FIG. 12.—Post-larval rockling (enlarged).

so that at first sight the little fish when captured seems to possess a great ventral spine on each side. In the post-larval gurnard again, the huge pectoral fins form a drapery for the entire body when folded back, only the tip of the tail extending beyond them (Fig. 13). They are indeed pro-

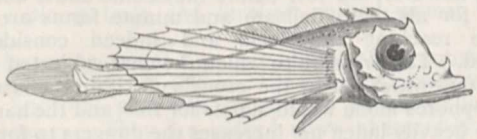


FIG. 13.—Post-larval gurnard (enlarged).

portionally as large as in the southern flying gurnards, but in these the fins reach full development only in adult life, while in the young stages they are comparatively small—exactly the reverse happening in the grey gurnard of our seas. The presence of the broad arches of pigment on the pectorals of several forms, such as the present species, green cod, and armed bullhead, is also an interesting feature. We have not yet read the riddle of all these changes, but in the ling the great ventral fins are probably connected with its roaming or pelagic life, and this explanation would also suit in the case of the rockling, both in their mature state seeking their food on the ground.

The little fishes at this stage are still more or less translucent, except in the region of the eyes, which are silvery, and on the parts where the pigment occurs. Moreover, their fondness for a minute reddish Copepod (*Calanus finmarchicus*), which occurs in myriads around them, gives the region of the stomach a faint pinkish hue from the translucency of the tissues. By and by, however, pigment appears, foreshadowing in the cod those peculiar squares which give the sides, at a somewhat later stage, their tessellated or tartan-like aspect. Besides, they are found nearer the bottom of the water, so that they can be captured in a naturalist's trawl with a fine gauze bag at the end. There is, therefore, a downward tendency as the little fishes get older and stronger, and thus in many cases a parallelism exists between them and the minute forms on which they prey, for the eggs rise on deposition toward the surface, where the helpless larvæ (or newly hatched young fishes) also often occur, and then they seek the lower regions of the water as their size increases.

There is much that is wonderful in such a life-history, especially in the metamorphoses or changes of form undergone by many of our best fishes, such as the flat fishes (Pleuronectidæ), which come out of the egg just like a haddock or cod, with an eye on each side, yet in after life have both eyes on the same side, as in Fig. 2. Nothing like this occurs in any of the higher vertebrates. Gradually during growth the body of the fish increases in depth (Fig. 14), the right or left eye passes over the ridge of the back to the opposite side (Fig. 15), while the creature, hitherto

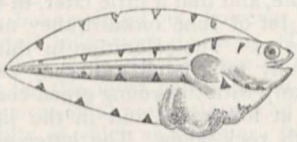


FIG. 14.—Young "witch" (*Pleuronectes cynoglossus*) in the third stage (enlarged).

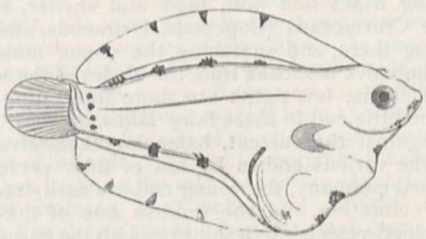


FIG. 15.—Young "witch" at a later stage, the left eye just appearing on the ridge of the head (enlarged).

pelagic, sinks deeper in the water and exhibits a tendency to lie on the side from which the eye has passed, and which gradually loses its dark pigment so as to become white.[1] It finally reaches the bottom, taking up its residence amongst the sand or sandy mud, and lying with the two eyes and the coloured side up, the white underneath. The mode by which the eye travels round has been a fruitful source of discussion with scientific men, and amongst these the names of Steenstrup, Malm, Schiödte, and Alex. Agassiz abroad, Wyville Thomson and especially Traquair in our own country, are well known. The fact is, two methods exist in Nature: in the one the eye travels over the ridge of the head, as just described in the flounder; in the other it traverses the soft and yielding tissues of the tiny fish, and so gains the other side. In *Plagusia*, the species in which the latter remarkable change occurs in the post-larval stage, the general tissues are so transparent that the creature in a glass vessel can only be noticed by the two apparently disembodied eyes, or by the gleam of light caused by its movements; and before the change ensues in its eyes it can look obliquely through its own body and see what passes on the other side.[2]

[1] The tardy disappearance of the pigment in some forms is interesting.

[2] Alex. Agassiz, Proceed. Americ. Acad. Arts. and Sci., vol. xiv. p. 8, 1878.

Up to this stage in the life-history of both round and flat fishes it will have been apparent that the efforts of man can have little effect on the vast multitudes of the eggs and minute fishes. His trawl sweeps beneath them, or they are carried harmlessly through its meshes. Not even in the case of a trawl blocked by a fish-basket and several large skate are any likely to occur. No example, indeed, was procured in the trawling expeditions for the Commission under Lord Dalhousie. The hooks of the liners are too large for the mouth at this stage, and hence they escape capture. Their small size and translucency also seem to afford protection in the case of predatory fishes of their own or other kinds, for they are rare, so far as present observation goes, in the stomach of any fish. Their great numbers are doubtless kept in check by some means, and we know that even jelly-fishes (*e.g. Pleurobrachiæ*) are very fond of post-larval fishes. It is only when they become somewhat larger that they are preyed on by their own and other species, and are swept up in thousands by the destructive shrimp-nets on our sandy shores.

While the little food-fishes are assuming the change of hue indicated in the preceding pages, they in many cases seek the inshore waters; at least systematic use of the mid-water and other nets proves that at certain seasons they are met with in large numbers at the entrance to bays or off-shore, and that a little later, in the case of the cod from the 1st of June onward, they are visible from the rocky margins. The coloration in this species (cod) is now beautifully tessellated, and they swim in groups, often in company with the young green cod, at the margin of the rocks at low water, and in the little tidal bays connected with rock-pools. The latter are often richly clothed with tangles, bladder-weed, red and green sea-weeds, and the green *Ulva*, amidst the mazes of which the young fishes find both food and shelter, capturing the little Crustaceans (Copepods, Ostracods, and others) swimming there, and snatching the young mussels and minute univalve mollusks from the blades of the seaweeds. To the zoologist few sights are more interesting than to watch the little cod in these fairy lakes, as they swim in shoals against the current, balancing themselves gracefully in the various eddies by aid of their pectoral fins. In a mixed company, the young cod are easily recognized by their coloration, and the reddish hue of the occiput, for the blood-vessels there shine through the tissues, which generally are more translucent than in the green cod.

Prof. G. O. Sars considered that about this stage there was an intimate connection between them and the hordes of Medusæ (*Aurelia* and *Cyanea*) which abound in the inshore waters towards the end of summer. He thought the young cod approached the Medusa for the sake of the minute pelagic animals stupefied by its poisonous threads, and that the fish repaid this favour by picking off a parasitic Crustacean (*Hyperia medusarum*) which clings to the Medusa. Observations, continued for a long period in this country, show however that this connection is only casual and of very little importance, and that certain *Hyperiæ* are occasionally found in vast numbers in a free condition.

As the season advances, the young cod are joined off the rocky ledges by a few pollack and whiting, but not by the haddock, which appears to have certain social views of its own—keeping probably a little farther out. The size of this cod late in autumn, as in October, varies, some reaching 4 to 5 inches in length. Their food ranges from zoophytes to crustaceans, mollusks, and small fishes, and in confinement the larger are voracious, an example about 5 inches readily attacking a smaller (3 inches), and swallowing it as far as possible, though for some time a considerable portion of the body and tail of the prey projected from the mouth. Moreover, the tessellated condition becomes less marked, and as they approach 8 inches in length a tendency in some to uniformity of tint is noticeable. Many of those, however, that continue to haunt the rocky shores and the tangle-forests beyond low water still retain for some time mottled sides, and they are known by the name of rock-cod. Further, while their growth in the earlier stages is less marked, it is now very rapid—even in confinement. The exact rate of growth in the free condition in the sea is difficult to estimate, but the little cod of an inch and a half to an inch and three-quarters in June reach lengths varying from 3 to 5 inches in autumn, and in the tanks of the laboratory, specimens 5 inches in August attain 8 inches the following March. At Arendal, in Norway, where opportunities for watching the growth of cod in confinement have been supplied with a liberality yet foreign to our country, Dannevig found that the cod of 3 mm. in April reached only 15 mm. in June, a length somewhat at variance with the condition as above stated on our shores. In July they measured 2 inches, in September 3½ inches, and in October about 4½ inches. The second year they attained 14 to 16 inches in length. In artificial circumstances, as well as in nature, it is found that great variation exists in the sizes of the young fishes of the same age, and this variation would not seem to be related to temperature.

At the stages just mentioned they now come under the notice of both liner and trawler, for young cod 5 or 6 inches in length occasionally take a haddock-hook, and those somewhat larger (9 to 18 inches) occur in certain hauls of the trawl, especially off a rocky coast like that of Aberdeenshire, south of Girdleness, as well as on the hooks of the liners on rough ground. Special trips, indeed, were, and perhaps are, made by the liners for the capture of these young cod (termed codling), and thus their numbers are kept in check.

So far as present observations go, therefore, the young cod in a free condition reach the length of from 4 to 10 inches the first year, while in the second they attain from 10 to 20 inches or more. It probably takes 3 or 4 years (and this is the original opinion of Sars) or more, to reach full maturity, and a length of 3 feet or upwards; though he mentions having seen young cod a foot in length, with mature roe and milt in the fish-market of Christiania. These, however, were probably abnormal examples.

Let us now glance at the condition in the whiting. Its earlier post-larval stages immediately following those observed in the tanks at the laboratory (for we failed to rear them) are even now somewhat obscure, but they probably approach those of allied forms such as the cod and haddock. The characteristic nature of the larval pigment, however, would lead to the belief that perhaps in the brighter tints (*e.g.* yellow), differences may occur. Such, however, are lost before they come under observation; for all these delicate and minute forms are dead before reaching the deck, and indeed considerably altered. The pressure to which they are subjected in the large mid-water net by the crowds of Hydromedusæ and Ctenophores alone would suffice for this, and the handling of the heavily laden net increases the dangers to forms so fragile. One about 12 mm. shows in spirit the dorsal and anal fins outlined though not separated from each other, and permanent rays occur in them and in the caudal. Minute ventrals are present, while the pectorals form large mobile fans. Groups of black pigment-corpuscles are distributed along the base of the dorsal and anal fins and over the brain, and a similar series occurs along the ventral median line of the abdomen. The sides have these blackish pigment-corpuscles more generally distributed than in the cod. No barbel is noticeable. When a little longer (15 mm.), the species is distinguished from the young cod by a more abundant distribution of black pigment-specks along the sides of the body and on the fins, and by the greater length and diminished depth of the first anal fin. The median line of pigment still runs along the ventral surface of the abdomen. At 20 mm. the characters that distinguish it from the cod of the same

size are better marked, viz. the distribution of dense blackish pigment along the base of the dorsal fins; and it soon spreads downward over the sides. The first anal fin assumes the character of the adult, and a minute papilla indicates a barbel. Between the stage just mentioned and a length of 28 mm. a decided change in the dense dorsal pigment takes place, viz. a tendency to form separate groups or touches (Fig. 16). These differ from

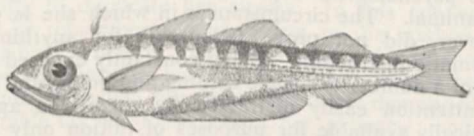


FIG. 16.—Young whiting, with serrated dorsal pigment-band and parasitic *Chalimus*.

the cod in being confined to the dorsal region, though a few bars occur at the base of the tail. The fish is also now minutely flecked, all over the head, sides, snout, and fins with black pigment, and its general outline approaches that of the adult. It is at once distinguished from the young cod by the shortness of the snout, irrespective of the features already pointed out, by the coloration, and by the shape of the first anal fin.

The differentiation of the two species, viz. the cod and the whiting, is very marked in spirit at the length of 34 mm. In the whiting the median dorsal fin is less abruptly elevated than in the cod, and the first anals diverge widely, the elongation of the latter being probably connected with the abbreviation of the abdomen. The body of the whiting is more plump and neatly rounded than in the cod, which is flatter and has generally a more prominent abdomen. The pigment-specks closely cover the sides of the body in the whiting, as well as the membranous webs of the dorsal fins, and are continued on the head. The pigment at the base of the caudal rays is more distinct in the whiting, and the lancet-like caudal termination of the body is longer in this species. The myotomes are coarser in the cod, and the surface has little of the dappled silvery sheen of the whiting. The chromatophores are larger in the cod, and are grouped in blotches over the surface, with intermediate pale patches, and the shoulder and head have much less pigment than in the whiting. Both the pectoral and ventral fins of the cod are shorter than those of the whiting. The snout in the latter is shorter and broader as well as deeper, and the short sub-mental papilla is in contrast with the long barbel of the cod of the same length. The whiting, produced from an egg of larger size, would appear to attain a plump body and finished outline sooner than the cod.

The foregoing stages are very abundant in autumn in the deep water off the Isle of May and the mouth of the Forth, but they also appear west of Inchkeith in the latter estuary. They are indeed more characteristic of the former region, as far as present observations go, than of the shallow water of the open bays, such as St. Andrews, though on reaching a somewhat larger size they are quite common in the latter expanse. Both they and the cod in these early stages are infested by a Crustacean parasite (*Chalimus*), which adheres to various parts of the head and body, just as the larval *Anceus* tenaciously attacks the young flounders in tidal harbours and inshore grounds.

The young whiting at a later stage (3 to 5 inches) joins the young cod at the margins of the rocks, and forms independent shoals in tidal harbours, as well as occurs some distance off shore, being frequently got in the mid-water net in the deeper water. Towards the latter size (6 to 7 inches) it readily takes the hooks of the liner, and in certain bays the multitudes of young whiting prove an inconvenience to the fishermen. As it increases in size great shoals are formed in the offing, though a few small are almost always found in inshore waters.

The young round fishes, such as cod, haddock, and whiting, of similar or nearly similar size, seem respectively to herd together. Thus it happens that in certain hauls of both liners and trawlers the majority agree in size. This is well known to the liners, who in former days specially sought out the young cod as already indicated. The same feature is observed in many other fishes, and probably conduces to their safety.

So far as known, the adult fishes of the three kinds specially alluded to in the preceding paragraph (viz. cod, haddock, and whiting) follow no very definite law in regard to migrations, if we except the apparent congregation in certain regions during the spawning season, as pointed out, for instance, by Sars, off Lofoten, where they occur in vast numbers from January to March. In our own country, again, the appearance of shoals of haddocks and whiting in certain localities is another example. How far such multitudes, however, are influenced by the abundance of food is still an open question. In British seas the herring is the main cause of these congregations in the cod and haddock; the former chiefly pursuing the fishes, the latter their eggs. In the same way, the abundance of Norway lobsters and similar food on the grounds called banks exercise considerable influence on the presence of cod.

It has already been pointed out, however, that in their young stages certain migrations do occur. Thus the post-larval cod by and by seeks the Laminarian region, while the older forms for the most part tend to go seaward. The same occurs even in a more pronounced manner with the ling, the adults of which as a rule are found in deep water. The pelagic post-larval ling seeks downwards as it grows, and is seldom found near the shore till it attains the length of 6 or 7 inches—in short, until it is barred with pigment. As it increases in size it migrates seaward. Similar features are noticed in the plaice. As observed in the trawling expeditions of 1884, only large plaice as a rule are procured in deep water off the east coast, while the sandy bays abound with those ranging from 11 inches downward, and none of the females of which appear to be mature. Multitudes of little plaice haunt the margins of these sandy beaches, but it cannot be said that forms which have the length, for example, of 3 inches, are confined to any particular line drawn across a bay, for small forms (2 to 4 inches) occur in hauls all over such a bay as that of St. Andrews. Small turbot and halibut in the same way are often found in the shallow bays, while the large adults are inhabitants of the deeper water. Such would not, however, seem to be the case with certain skate, very large adults of which occur in the shallow water of the sandy voes in Shetland.

On the other hand, the witch (*Pleuronectes cynoglossus*) keeps to its special areas, both as regards the young and the adult condition, so that the movements of eggs, larval and post-larval forms are circumscribed; and the same would seem to be the case with the topknot (*Zeugopterus*) and sail-fluke (*Arnoglossus*). The dab (*Pleuronectes limanda*), again, is found in all stages both in comparatively deep and comparatively shallow water.

Almost all our valuable food-fishes, therefore, are produced from minute pelagic eggs, the enormous numbers of which provide for a vast increase and wide distribution of the species; yet it cannot be said that this habit alone provides for their multiplication when the case of the herring with its demersal eggs, fixed firmly to the bottom, is considered. It has to be borne in mind, however, that the larval herring immediately mounts upward toward the surface as soon as its strength suffices.

Many striking changes occur during growth, both in external form and coloration, but it is difficult at present to lay down any general law that would apply to all cases, though those in which certain migrations take place

during growth show such changes very prominently. The young round fishes by and by roam about the sea in shoals, led hither and thither mainly by the presence of food; though in the case of the larger and adult forms, safety or freedom from molestation may have some influence. Though so minute on escaping from the egg, their growth is, by and by, rapid, and the duration of life in such as the cod is considerable. Abundance of food, more than any special instinct, would appear to be the main cause of their migrations in the adult or semi-adult state, and that food is as varied as their haunts; in short, it embraces every sub-kingdom up to their own, for fishes and their eggs form a large share of their diet.

There would be little difficulty in adding to the sea great numbers of larval forms of any species of which eggs can be procured: yet if a few adults can be obtained in such waters at the proper season it is still an open question whether the natural process with its surroundings would not be more successful.

In the foregoing remarks I have but touched on a few of the leading features of the life-history of a food-fish; for the subject is one of vast extent, and some of the points embraced in it are by no means easily solved. We have only earnestly entered on the study of the subject in this country within the last few years, and much yet remains to be done, even in some of the most common marine fishes. However, the zoological investigator is here stimulated by the fact that all his labours directly bear on the public welfare, for it need hardly be pointed out that a thorough knowledge of the development and life-histories of our food-fishes is the first step to sound legislation and effective administration. The State has in past years spent princely sums on more or less pure science, as in the memorable voyage of the *Challenger*. There can be no doubt that at the present moment the public interests demand a searching and long-continued inquiry nearer home, viz. the exhaustive investigation of all that pertains to the food-fishes of our shores, since the problems connected therewith affect the prosperity of so large a portion of the population.

ON THE MENTAL FACULTIES OF ANTHROPOPITHECUS CALVUS.[1]

THE female Chimpanzee which has now been in the Society's Menagerie for nearly six years has attracted general notice, not only on account of her peculiar zoological characters, but perhaps still more on account of her high intelligence. This is conspicuously displayed by the remarkable degree in which she is able to understand the meaning of spoken language—a degree which is fully equal to that presented by an infant a few months before emerging from infancy, and therefore higher than that which is presented by any other brute, so far, at least, as I have met with any evidence to show. Nevertheless, the only attempts that she makes by way of vocal response are three peculiar grunting noises—one indicative of assent or affirmation, another (very closely resembling the first) of dissent or negation, and the third (quite different from the other two) of thanks or recognition of favours. In disposition she is somewhat capricious, though on the whole good-humoured, fond of her keepers, and apparently never tired of a kind of bantering play which off and on they keep up with her continually. By vocalizing in a peculiar monotone (imitative of the beginning of her own "song"), they are usually able to excite her into the performance of a remarkable series of actions. First, she shoots out her lips into the well-known tubular form (depicted in Darwin's "Expression of the Emotions," p. 141), while at the same time she sings a strange howling note interrupted at regular intervals; these, however, rapidly become shorter and shorter, while the vocalization becomes louder and louder, winding up to a climax of shrieks and yells, often accompanied with a drumming of the hind feet and a vigorous shaking of the network which constitutes her cage. The whole performance ends with a few grunts.

A year or two ago it occurred to me that I might try some psychological experiments on the intelligence of this animal. The circumstances in which she is placed, however, did not prove favourable for anything like systematic instruction. Being constantly exposed to the gaze of a number of people coming and going, and having her attention easily distracted by them, the ape was practically available for purposes of tuition only during the early hours of the morning, before the Menagerie is open to the public; and, as a rule, I did not find it convenient to attend at that time. Therefore, the results which I am about to describe do not in my opinion represent what might fairly have been expected under more favourable conditions: if the Chimpanzee could have been kept as a domestic pet for a few months (as I kept the Cebus kindly lent me for the purposes of psychological observation by this Society), there can be no doubt that many much more interesting results might have been obtained. Nevertheless, it appears to me that even those which thus far have been obtained are worthy of being placed on record; and although some of them have already been published a few months ago in my work on "Mental Evolution in Man," since that time some further progress has been made; and therefore in the present paper I will state together all the facts which have been hitherto observed.

Having enlisted the intelligent co-operation of the keepers, I requested them to ask the ape repeatedly for one straw, two straws, or three straws. These she was to pick up and hand out from among the litter in her cage. No constant order was to be observed in making these requests, but, whenever she handed a number not asked for, her offer was refused, while, if she gave the proper number, her offer was accepted, and she received a piece of fruit as payment. In this way the ape was eventually taught to associate these three numbers with their names. Lastly, if two straws or three straws were demanded, she was taught to hold one straw or two straws in her mouth until she had picked up the remaining straw, and then to hand the two straws or the three straws together. This prevented any possible error arising from her interpretation of vocal tones—an error which might well have arisen if each straw had been asked for separately.

As soon as the animal understood what was required, and had learnt to associate these three numbers with their names, she never failed to give the number of straws asked for. Her education was then extended in a similar manner from three to four, and from four to five. Here, for reasons to be presently stated, I allowed her education to terminate. But more recently one of the keepers has endeavoured to advance her instruction as far as ten. The result, however, is what might have been anticipated. Although she very rarely makes any mistake in handing out one, two, three, four, or five straws, according to the number asked for; and although she is usually accurate in handing out as many as six or seven; when the numbers eight, nine, or ten are named, the result becomes more and more uncertain, so as to be suggestive of guess-work. It is evident, however, that she understands the words seven, eight, nine, and ten to betoken numbers higher than those below them; for if she is asked for any of these numbers (*i.e.* above six), she always gives some number that is above six and not more than ten; but there is no such constant accuracy displayed in handing out the exact number named as is the case below six. On the whole, then, while there is no doubt that this animal can accurately compute any number of straws up

[1] Paper read before the Zoological Society on June 4, 1889, by Prof. George J. Romanes, F.R.S.

to five, beyond five the accuracy of her computation becomes progressively diminished.

It is to be noticed that the ape exhibits some idea of multiplication; for she very frequently (especially when dealing with numbers above five) doubles over a long straw so as to make it present two ends, and thus to appear as two straws. Any of the comparatively rare errors which she now makes in dealing with numbers below six are almost invariably due to her thus endeavouring to duplicate her straws. In this connection it is to be remembered that, owing to the method above described (whereby the ape is required to place each straw separately in her mouth until the sum asked for is completed), when any high number is demanded a considerable tax is imposed upon her patience; and, as her movements are deliberate while her store of patience is but small, it is evident to all observers that the doubling of the straws is intended to save trouble by getting the sum completed with greater rapidity than is possible when every straw is picked up separately. Of course we do not recognize these doubled straws as equivalent to two straws, and therefore the persistency with which she endeavours to palm them off as such is the more noteworthy as evidence of her idea of multiplication. Moreover, I am disposed to think that the uncertainty which attends her dealing with the numbers six and seven is more largely due to her losing patience than to her losing count; although after seven I believe that her computation of the numbers themselves becomes vague, or merged in a merely general idea of many. It may also be stated that, while picking up the straws and placing them in her mouth, she looks only at the straws themselves and not at the person who asks for them: therefore she is certainly not actuated in her responses by interpreting facial expression, unconscious gesture, &c., as is no doubt the case with many dogs which on this account are sometimes accredited by their owners with powers of "thought-reading." It is needless to add that, after asking for the number of straws required, we remain silent till the ape has handed them out.

It is not necessary—indeed it would be unreasonable—to suppose that in this process of "counting" the ape employs any system of notation. We know from our own experience that there is counting and counting, *i.e.* distinguishing between low numbers by directly appreciating the difference between two quantities of sensuous perception, and distinguishing between numbers of any amount by marking each perception with a separate sign. The extent to which the former kind of computation can be carried in the case of man has been made the subject of a careful research by Prof. Preyer, of Jena (*Sitz. Ber. d. Gesell. f. Med. u. Naturwiss.*, 1881). His experiments consisted in ascertaining the number of objects (such as dots on a piece of paper) which admit of being simultaneously estimated with accuracy, and it was found that the number admits of being largely increased by practice, until, in the case of some persons, it may rise to more than twenty. But of course in the case of a brute it is not to be expected that such a high degree of proficiency even in this non-notative kind of "counting" should be attainable. The utmost that could here be expected is that a brute should exhibit some such level of ability as is presented by a young child, or by those savages whose powers of accurate computation do not appear to extend further than numbers which we write as units.[1] It was in view of such considerations that I did not attempt to carry the education of this ape beyond the number five; and the result which has attended subsequent endeavours to teach her numbers as high as ten is, as previously remarked, exactly what might have been anticipated. It may here be added that in the only records with which I am acquainted of animals exhibiting any powers of numerical computation, these powers have not extended beyond the number five. Thus, for instance, in his well-known account of these powers as presented by rooks, Leroy says:—"To deceive this suspicious bird, the plan was hit upon of sending two men into the watch-house, one of whom passed out while the other remained to shoot the bird on returning to her nest; but the rook counted and kept her distance. Next day three went, and again she perceived that only two returned. In fine, it was found necessary to send five or six men to the watch-house in order to throw out her calculations."[1] Again, Houzeau tells us that mules used in tramways at New Orleans have to make five journeys from one end of the route to the other before they are released, and that they make four of these journeys without showing any expectation of being released, but begin to bray towards the end of the fifth.[2] Lastly, the keeper of the eared seals now in the Menagerie has recently taught one of these animals to "count" as far as five. His method is to throw pieces of fish in regular succession, which the animal catches one by one. He throws them in series of fives, and, before the commencement of any series, he tells the seal to miss the first, the second, the third, the fourth, or the fifth, as the on-lookers may dictate: the seal thereupon makes no attempt to catch the member of the series thus verbally indicated. It is only a day or two ago, however, that I witnessed this performance, and as yet I am not satisfied that the seal really "counts," because it appears to me probable that the keeper may unintentionally throw, with some slight difference in his manner of throwing, the piece of fish which he expects the seal to miss, and that it is really this slight difference in the manner of throwing which the seal perceives and acts upon. Therefore, I intend to get an arrangement fitted up whereby the pieces of fish shall be thrown mechanically. But, whatever the result of this experiment may be, I think there can now no longer be any question that it lies within the capacity of animal intelligence to "count" correctly (in the sense already explained) as far as five, and even to show a well-marked appreciation, although progressively a more and more uncertain one, of numbers lying between five and ten.

The only other direction in which I have thus far subjected the Chimpanzee to psychological experiment has been in that of attempting to teach her the names of colours. It appeared to me that if I could once succeed in getting her thoroughly well to know the names of black, white, red, green, and blue, a possible basis might be laid for many further experiments wherein these five colours could be used as signs of artificially associated ideas. The result, however, of attempting to teach her the names of colours has been so uniformly negative, that I am disposed to think the animal must be colour-blind. It is perhaps desirable to state the facts which have led me to entertain this as their most probable interpretation.

The method adopted in these experiments was to obtain from the importers of Oriental matting a number of brightly and uniformly coloured pieces of straw—each piece being either white, black, red, green, or blue. Taking the straws two by two of different colours, on each occasion the ape was invited to choose the straw of the colour named from the one whose colour was not named, and, of course, on choosing correctly she was rewarded with a piece of fruit. In this way she quickly learnt to distinguish between the white straws and the straws of any other colour; but she never could be taught to go further. Now the distinction between the white straws and the straws of any other colour is a distinction which could have been drawn by an eye that is colour-blind; and from the fact that the ape is always able to perceive this distinction (she will search long and patiently for a straw of any colour when told that it occurs somewhere in the general litter of white straws constituting her bed,

[1] See, for instance, Galton, "Tropical South Africa," p. 213

[1] "Letters, &c." [2] "Fac. Ment. des Anim.," tom. ii. p. 207.

and eventually picks it out), while she cannot be taught to distinguish any of the others, I conclude that her failure in this respect is not due to any want of intelligence, but to some deficiency in her powers of colour-perception.

NOTES.

THE annual meeting for the election of Fellows of the Royal Society was held at the Society's rooms in Burlington House, on June 6, when the following gentlemen were elected:—John Aitken, Dr. Edward Ballard, Alfred Barnard Basset, Horace T. Brown, Latimer Clark, Prof. David Douglas Cunningham, Lazarus Fletcher, William Botting Hemsley, Charles Thomas Hudson, Prof. Thomas McKenny Hughes, Edward B. Poulton, Prof. William Johnson Sollas, Charles Todd, Herbert Tomlinson, Prof. Gerald F. Yeo.

THE statue of Le Verrier is to be unveiled in the court of the Paris Observatory on June 25.

HERR VICTOR APFELBECK, the entomologist, will shortly start, in behalf of the Bosnian Government, on a journey of research in Herzegovina. Last year he discovered in Southern Bosnia five new species of eyeless cave beetles, and his investigations excited much interest among entomologists.

ACCORDING to the *British Medical Journal*, the programme of the Leeds meeting of the British Medical Association in August next "is developing in such manner as to afford the ample promise of a meeting of great scientific as well as social interest, and one which will be worthy of the traditions of this great medical centre."

MR. JOHN FREDERICK LA TROBE BATEMAN, F.R.S., died on Monday morning at Moor Park, Farnham, at the age of seventy-nine, after a severe illness. Mr. Bateman was well known as the engineer who supplied Glasgow with water from Loch Katrine.

THE death of Eugen Ferdinand von Homeyer, the eminent ornithologist, is announced. He had been President of the Ornithological Society at Berlin, was the author of several works, and possessed the largest existing collection of European birds. He was born at Herdin, near Anklam, in 1809, and died at Stolp, in Prussia, on June 1.

INFORMATION has been received in Berlin of the death of Dr. Bernhard Weissenborn, the zoologist to the German Cameroons Expedition, from a fever contracted through the hardships of the work and the bad climate.

GERMAN papers record the death of Dr. C. Jessen, the naturalist, formerly Professor at Greifswald, and lately at the Berlin University. He was sixty-eight years of age.

AT a meeting of the Royal Horticultural Society on Tuesday, a paper on orchids was read by Mr. H. Veitch. In the discussion which followed the reading of this paper, various speakers referred with regret to the death of Prof. Reichenbach, and to the strange provisions of his will, by which botanists of the present generation will be prevented from studying his fine collection of orchids. Mr. Thiselton Dyer invited those interested in the nomenclature of orchids to put themselves in communication with the Kew Herbarium, and it was stated that Messrs. Veitch and Sander could furnish many duplicates of the examples which were to be locked up under the will of Reichenbach. Sir T. Lawrence spoke of an orchid which had been in this country to his knowledge for fifty years.

THE June number of the *Kew Bulletin* opens with an instructive paper on Jamaica cogwood. This is one of the most valuable timber-trees in Jamaica, yet until recently its flowers and fruit had not been received in this country, so that, as the writer points out, the position of the plant in botanical classification had been left in doubt. Good herbarium specimens, including flowers and fruit, have lately been sent to Kew by Mr. W. Fawcett, Director of Public Gardens and Plantations in Jamaica; and from this material Prof. Oliver has determined the cogwood to be a species of *Zizyphus*, a genus not previously recorded from Jamaica. *Zizyphus* is the Jujube or Lotus genus of *Rhamneæ*, and the fruits of several species, such as *Z. vulgaris* and *Z. Jujuba*, have an agreeable flavour, and are commonly eaten. Besides this paper, there are contributions on cocoa-nut coir from Lagos, a wheat pest in Cyprus, patchouli, P'u-êrh tea, and agricultural industries at the Gambia.

WE take the following from *Allen's Indian Mail*:—"The appointment of Mr. A. Hartless from the Royal Gardens, Kew, to fill the vacancy in the staff of the Botanic Gardens at Shippur has given much satisfaction. This gentleman is a first-class botanist, and will no doubt contribute hereafter many original and important observations on the flora of India."

IN addition to the papers announced to be read at the ordinary meeting of the Royal Meteorological Society on June 19, a communication will be made on the recent thunderstorms, and a number of photographs of lightning will be exhibited.

A VIOLENT shock of earthquake, accompanied by local subterranean rumblings, was felt at Brest on June 7 at a quarter past one o'clock, its direction being from north to south. The shock is said to have resembled the vibration caused by the firing of a gun of large calibre. On the same day a shock of earthquake was felt at New Bedford, in Massachusetts.

ON April 13 and 14 a volcanic eruption occurred on Oshima Island, Japan. It is said that upwards of 300 houses were destroyed, and that 170 persons were killed by being buried beneath the ruined buildings.

ACCORDING to the *Japan Weekly Mail*, an earthquake of a most unusual character was recorded at 2h. 7m. 41s. p.m., on Thursday, April 18, in the Seismological Observatory of the Imperial University, Tokio. The peculiarity lies, not in its violence, but in the extreme slowness of its oscillations. The beginning of the shock had all the characteristics of the ordinary earthquake, but gradually the motion augmented, until at a certain stage of the shock it reached 17 millimetres, but the ground swayed so gently that the house did not vibrate visibly, nor were the senses alive to it. It took from four to seven seconds to complete one oscillation—a most unusual phenomenon, and one never before noted in the Observatory. The motion was almost entirely confined to the horizontal plane, and mostly south to north, but there were a few vertical motions of equally slow periods. This state of things lasted for 10 minutes 36 seconds. Prof. West, of the Engineering College, observed the water in a small pond to oscillate gently from north to south. At one time the water-level fell about 2 inches on one side of the pond, and exposed the bank, while, a few seconds later, the water immersed it nearly to the same depth, exposing the opposite bank, and this process continued for a quarter of an hour. "Slow oscillations of this nature have been called earth-pulsations, and these usually take place where there is a destructive earthquake or a submarine disturbance going on at a great distance. Earth-pulsations are known to have caused slow oscillations of the water in lakes. From this fact it may not be unreasonable to conjecture that a terrestrial or submarine agitation of unusual

magnitude has taken place somewhere. The authorities of the Science College have sent to the Hydrographical Bureau of the Naval Department, asking for information as to the state of the tide and seas. It may be as well to remark that it is not certain whether the maximum motion of 17 millimetres, as given by the seismograph, is perfectly accurate, as it is very difficult to measure slow oscillation like this with absolute certainty." It is now known as a fact that Vries Island, outside Yokohama Bay, and possibly sixty miles off, was in a state of violent volcanic eruption.

THE Admiralty has published an interesting Report on the bore of the Tsien-Tang Kiang, by Captain W. U. Moore, of H.M.S. *Rambler*, as a fitting termination to a long series of tidal observations made on that vessel in Chinese waters. Scarcely anything was before known about this phenomenon, although it occurs twice a day, seventy miles from Shanghai. The bore was found to originate, not at the mouth of the river, as was expected, but twelve or fifteen miles outside it. Captain Moore states that the bore cannot be accurately described as a wave, there being no undulation, nor any depression after it has passed. It is divided into two branches, which join together four miles from Haining, making a continuous white line two miles in length. It shortly afterwards contracts in width, and increases in speed and height, rising 8 to 11 feet high, and travelling between 12 and 13 knots an hour. The three cutters employed in making the observations were at times in considerable danger, and the Hydrographer pays a high compliment to the skill with which the boats were brought safely out of their dangerous situation.

THE meteorological observations for the year 1888, made at the Rousdon Observatory, Devon, under the superintendence of Mr. Cuthbert E. Peek, have been published. They are a continuation of those issued last year. The instruments continue to perform to Mr. Peek's satisfaction, and have been regularly read by his assistant, Mr. C. Grover. The observatory is a second order station of the Royal Meteorological Society.

MR. THOMAS SCOTT, of the Scientific Department, Scottish Fishery Board, recently fertilized ripe ova of the common gurnard (*Trigla gurnardus*) with milt of the whiting (*Gadus merlangus*). Segmentation soon set in, and development proceeded for about a day and a half; but the ova then gradually sank, showing that death had supervened, this being attributed to an imperfect supply of fresh sea-water. An attempt to fertilize gurnard ova with milt of the common dab (*Pleuronectes limanda*) failed; but ova of the lemon sole (*P. microcephalus*) were successfully fertilized by milt of the same species, and floated buoyantly.

A SHARK 10 feet long and 4 feet in girth was caught on the morning of June 7, about twenty-four miles south-east of Ventnor by the mackerel nets of the smack *Pioneer*, of Brighton. It has three rows of teeth, and is supposed to be three years old.

TRACES of glacial action have been discovered on the Thomasberg, which is over 800 metres high, near St. Margarethen, in the Rosenthal in Carniola.

MESSRS. MACMILLAN AND CO. have issued a new edition of Prof. T. H. Core's "Questions on Stewart's Lessons in Elementary Physics." The late Prof. Balfour Stewart, writing of the first edition of this useful little volume, said that Prof. Core had made his questions "at once simple and suggestive, leading on in some cases to higher results, so as to encourage students to proceed with the subject."

ALL students of ethnology and anthropology will welcome the first number of *Veröffentlichungen* from the Berlin Museum für Völkerkunde. This periodical, which is clearly printed on good paper, takes the place of the *Original-Mittheilungen aus der Ethnologischen Abtheilung der Königlichen Museen*. The first number consists of plates illustrating American antiquities, with full descriptions and explanations. In some instances analogous objects from other parts of the world are represented along with those from America. The text is by Dr. Uhle, and Dr. Bastian contributes a brief prefatory note.

AN interesting paper on Palæolithic man in America, by Mr. W. J. McGee, of the United States Geological Survey, has been reprinted from the *Popular Science Monthly*. Mr. McGee holds that there is definite and cumulative evidence of man's existence in America during the latest ice epoch, with a strong presumption against an earlier origin than the first Quaternary ice-invasion; and that the primitive American "haunted the ice front rather than the fertile plain, and must have been hunter or fisherman."

AMONG the antiquities recently acquired by the Christiania Museum are some from the middle Iron Age, found in two barrows at Larvik. They consist of fragments of a lance, a shield with iron handle, a pair of shears or scissors, and a buckle of silver, besides a number of vessels, among which the most remarkable is a glass beaker, ornamented with threads of glass fused on to the exterior, a wooden bucket caulked with tar, and many urns. Among the latter is a large handsome one with a long neck. The graves in the barrows were made of stones. On a farm in the parish of Tjölling, also on the west coast of the Christiania fjord, a barrow, which had been formerly disturbed, has been excavated. Round it is a ring of raised stones. It dates from the early Iron Age. On the eastern and western side a *Bautasten*, or memorial stone, is raised. The funeral chamber is built of stone. Only three buckles of bronze, with silver ornaments, a plain ring made from an alloy of gold and silver, and the jaw-bone of a man with teeth remaining, were found. The body had not been burned. A yard further to the east a grave with calcined human remains was also found.

THE fourth issue of the *Jahrbuch der Naturwissenschaften* has just made its appearance. It is published by the Herderschen Verlagshandlung at Freiburg im Breisgau, and it remains under the editorship of Dr. Max Wildermann. It contains about 570 octavo pages, with an introduction. The subdivisions are under the control of different competent authorities. The section on physics occupies seventy-six pages, and is under the care of the editor; chemistry, with forty-six pages, and several sub-heads, under that of Dr. Hovestadt; applied mechanics, forty-six pages, under Dr. van Muyden; astronomy, thirty pages, under Dr. Franz; meteorology, under Dr. Pernter, forty-four pages; zoology, under three different editors, thirty-two pages; and similarly with botany, forestry, and agriculture, mineralogy and geology, anthropology, physiology, medicine and sanitary matters, geography, and ethnography. An appendix contains obituaries of eminent scientific men, and a report of the proceedings of the sixty-fourth meeting of the Association of German Naturalists and Physicians.

NAPHTHA is now much used as fuel in Middle Russia. Last year, 880,000 tons of it were sent up the Volga for fuel purposes; and it is expected that the export for the same purpose will this year reach no less than one million tons.

THE province of St. Petersburg is very rich in marshes covered with a thick carpet of vegetation, which conceals water to the depth of several feet—sometimes 25 feet and more. Small lakes and branches of rivers are continually being transformed into such marshes, and M. Tanfilieff, who has studied the way in which the transformation goes on, comes to the following conclusions (*Mémoires* of the St. Petersburg Society of Naturalists, vol. xix.). The pioneers of the transformation of a lake into

a marsh invariably are flowering plants, such as *Menyanthes*, *Comarum*, *Cicuta*, *Equisetum*, *Carices*, and the like. Their roots and underground stems make a thickly-woven floating carpet, which soon totally conceals the water. The *Sphagnum* invades this floating carpet, while the water beneath becomes filled with *débris* of decaying plants, transformed later on into peat-bog. In shallow basins the transformation goes on at a much speedier rate, as their bottoms are invaded by plants like *Phragmites* and *Scirpus lacustris* which reach a considerable height, and thus supply, after their decay, a good deal of additional material for the filling up of the basin. A mass of smaller plants, such as *Lemna*, *Hydrocharis*, *Callitriche*, *Utricularia*, *Hypnum fluitans*, and several others, usually grow also amidst the rushes. Of course, the streamlets which flow into the basin contribute also to fill it up by bringing in sand and loam. As soon as the floating carpet has reached a certain thickness, and the *Sphagnum* has still more increased its bulk, various plants, such as *Drosera*, *Vaccinium*, *Eriophorum*, the dwarf birch, and other bushes, begin to grow upon it, although the space beneath still remains filled with water. As the *Sphagnum* does not grow upon ponds containing a chalky water, its place in such ponds is mostly taken by the *Hypnum*, and in these cases a variety of other plants, such as *Typha*, *Stratiotes*, *Butomus*, *Ranunculus divaricatus*, and *Chara fragilis*, make their appearance. As to the *Sphagnum*, it invades wet meadows as well.

AT a recent meeting of the French Academy of Sciences, M. de Malarce, speaking of the extension of the metric system of weights and measures, gave some interesting figures. In 1887 the aggregate population of the countries in which the metric system was compulsory was over 302,000,000, being an increase of 53,000,000 in ten years. In 1887, in countries with a population of close on 97,000,000, the use of the system was optional ; and the countries where the metric system is legally admitted in principle and partially applied (as in Russia, Turkey, and British India) had in 1887 a population of 395,000,000, being an increase of 54,000,000 in ten years. The increase is due to the growth of population in the countries which had already adopted the system, and to its adoption by new countries. The systems of China, Japan, and Mexico, are decimal, but not metric. The metric system is thus legally recognized by 794,000,000 of people, and the three last-named countries have a population of about 474,000,000. So that only about 42,000,000 of inhabitants of the civilized world have systems which are neither metric nor decimal.

SIR ARTHUR NICOLSON, the British Consul at Buda-Pesth, in his last Report on Hungary, referring to technical education in that country, says that it will afford an indication of the attention which is being paid to this important question to instance the steps which have been taken in Buda-Pesth in regard to primary technical education. By paragraph 80 of the Trade Law of 1884, every *commune*, where there are fifty or more apprentices, is bound to provide for their education, and to afford special courses of instruction. The apprentice schools in Buda-Pesth contain a preparatory class, provide a course of three years, and are chiefly destined to educate apprentices for the higher trade schools. Each district of the town must have at least one apprentice school. No class is to comprise more than fifty pupils, or at most sixty pupils ; and should the number of pupils be larger, parallel classes can be established. A pupil passes at the end of each year into a higher class if he can show proficiency and good progress. Theoretical instruction is given six hours in the week, and drawing and modelling are taught five hours weekly, on Sundays. The first schools were established in 1887, and numbered 12 with 125 teachers. There were 42 classes, or, including the parallel classes, 93, attended by 5173 pupils. In 1888 the number of schools had risen to 16, the number of classes to 127, the staff of teachers 151, and the number of pupils to 6459. In the other towns and counties of Hungary there were 229 apprentice schools, with 1237 teachers, and 38,081 pupils. For all these schools, including those of the capital, the *communes* contribute in florins 214,302 ; private individuals, 1387 ; Chambers, 680 ; counties, 9080 ; State, 35,806 ; fees and fines, 129,488 ; making a total of 390,843 florins.

THE British Consul at Ancona, in his last Report, refers to a School of Practical Agriculture established in Fabriano in 1882. It is subsidized by the Government, the province of Ancona, the municipality of Fabriano, and the local Chamber of Commerce. The school has a Director, two Professors, and a Teacher of Practical Agriculture. The course of study is spread over three years as follows : first year, Italian, geography, elements of natural history, elementary arithmetic, agronomy, and writing ; second year, Italian, geography, elements of natural philosophy and chemistry, agriculture, and rural accounts ; third year, horticulture, rural direction and management of a farm, technical agriculture, and arithmetic. The school at present has thirty-six scholars, of whom nineteen are in the first year, nine in the second, and eight in the third. Of these, twelve are agriculturists, ten sons of land stewards, eleven sons of gentlemen, and three sons of tradesmen. The day's work begins at 5.30 a.m. in winter, and is over at 8 p.m. Seven hours are devoted to practical work, five to study, the remainder being allowed for meals and recreation. In summer the students rise at 4.30 a.m. ; otherwise, with the exception of an extra hour and a half for recreation, the studies are carried on as in winter.

THE additions to the Zoological Society's Gardens during the past week include two Australian Thicknees (*Œdicnemus grallarius*), an Eyton's Tree Duck (*Dendrocygna eytoni*) from Australia, two Lineated Parrakeets (*Bolborhynchus lineolatus*) from Mexico), two Senegal Touracous (*Corythaix persa*) from West Africa, purchased ; two Elliot's Pheasants (*Phasianus ellioti* ♂ ♀) from China, deposited ; a Hog Deer (*Cervus porcinus* ♀), two Mule Deer (*Cariacus macrotis* ♀ ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

STONYHURST COLLEGE OBSERVATORY.—The results of the observations made during the year 1888 at this Observatory have recently been published in the ususal form. The bulk of the volume is occupied with the routine magnetic and meteorological observations, and an appendix gives the meteorological results for St. Ignatius College, Malta. The weather in 1888 was less favourable for the daily delineation of the solar surface than in 1887, but 223 full-sized drawings were secured. The daily areas of sun-spots derived from these show very strikingly, especially as given in graphical form, the nearness of our approach to minimum. The chromosphere was completely examined on eighty-four days, and partly on three other dates. The most important event of the year in connection with the Observatory has been the installation of a large grating-spectroscope for the especial purpose of photographing the solar spectrum, and the spectra of sun-spots in particular—a work which, in the present state of solar physics, greatly needed to be undertaken, and carried out with persevering regularity. The grating is a flat one, by Rowland, of 14,438 lines to the inch, and 3½ inches in length. It is to be used in connection with a heliostat and a 5½-inch object-glass by Alvan Clark. The preliminary experiments promise well for its efficiency, and the Director of the Observatory is to be greatly congratulated on so valuable an addition to his equipment.

The Rev. E. Colin, S.J., who spent the last year at Stonyhurst Observatory, has just been appointed Director of the French Government Observatory at Antananarivo.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 JUNE 16–22.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on June 16

Sun rises, 3h. 44m. ; souths, 12h. 0m. 26·5s. ; daily increase of southing, 12·8s. ; sets, 20h. 17m. : right asc. on meridian, 5h. 40·2m. ; decl. 23° 22′ N. Sidereal Time at Sunset, 13h. 58m.

Moon (at Last Quarter on June 20, 8h.) rises, 22h. 31m.* ; souths, 2h. 35m. ; sets, 6h. 44m. : right asc. on meridian, 20h. 13·2m. ; decl. 21° 39′ S.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.
	h. m.	h. m.	h. m.	h. m. ° ′
Mercury..	4 25 ...	12 20 ..	20 15 ...	5 59·8 ... 20 14 N.
Venus ...	1 55 ...	9 4 ..	16 13 ...	2 43·7 ... 12 45 N.
Mars ...	3 41 ..	12 2 ...	20 23 ...	5 42·1 ... 24 4 N.
Jupiter ...	20 47*...	0 42 ...	4 37 ...	8 19·6 ... 23 11 S.
Saturn ...	8 5 ...	15 38 ...	23 11 ...	9 18·1 ... 16 55 N
Uranus...	13 55 ...	19 26 ...	0 57*...	13 7·0 ... 6 27 S.
Neptune..	2 37 ..	10 25 ...	18 13 ...	4 4·7 ... 19 11 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

June. h.
18 ... 2 ... Mars in conjunction with the Sun.
19 ... 11 ... Mercury in inferior conjunction with the Sun.
21 ... 6 ... Sun at greatest declination north ; longest day in northern latitudes.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·5 ...	81 17 N. ...	June 19,	22 47	*m*
V Bootis	14 25·3 ...	39 21 N. ...	,, 16,		*m*
δ Libræ	14 55·1 ...	8 5 S. ...	,, 17,	21 15	*m*
V Ophiuchi	16 20·6 ...	12 10 S. ...	,, 16,		*M*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,, 17,	0 53	*m*
		and at intervals of		20 8	
X Sagittarii... ...	17 40·6 ..	27 47 S. ...	June 16,	22 0	*M*
			,, 21,	1 0	*m*
W Sagittarii ...	17 57·9 ...	29 35 S. ...	,, 19,	0 0	*m*
Y Sagittarii... ...	18 14·9 ...	18 55 S. ...	,, 18,	1 0	*m*
T Serpentis	18 23·4 ...	6 14 N. ...	,, 22,		*M*
R Scuti	18 41·6 ...	5 50 S. ...	,, 18,		*m*
η Aquilæ	19 46·8 ...	0 43 N. ...	,, 21,	2 0	*m*
T Vulpeculæ ...	20 46·8 ...	27 50 N. ...	,, 20,	22 0	*m*
			,, 22,	0 0	*M*
δ Cephei	22 25·1 ...	57 51 N. ...	,, 17,	2 0	*M*

M signifies maximum ; *m* minimum.

Meteor-Showers

	R.A.	Decl.	
Near β Ursæ Majoris ...	170° ...	55° N.	
From Vulpeculæ	285 ...	23 N. ...	Rather slow.
Near ε Cephei	335 ...	57 N. ...	Swift.

GEOGRAPHICAL NOTES.

SIG. GIULIO BORELLI writes from Cairo to the May number of the Italian Geographical *Bollettino*, on the outflow of the River Omo, in connection with Count Teleki's recent discovery of Lake Rudolf (Samburu). Combining the data supplied by this explorer and his comrade, Lieutenant Hoenel, with his own observations further north, he finds that the Omo is a tributary neither of the White Nile nor of the Juba, as hitherto supposed, but almost certainly flows south to Lake Rudolf. But at its confluence with the Gojieb, south of Shoa, the Omo flows at an altitute of 1100 metres, about the same or very little more than that of Victoria Nyanza ; and as beyond the confluence it has still a very long and rapid course, it follows that it cannot be a tributary of the great equatorial lake. Lake Rudolf stands at an elevation of about 550 metres, showing a fall of over 500 metres from the Gojieb confluence in a space of four degrees of latitude. Hence this basin, with its Omo feeder, can have no connection with the Nile, and, as asserted by its discoverers, is in fact a flooded depression without any outlet. Thus would appear to be solved one of the last hydrographical problems on the African continent.

AT the last meeting of the Russian Geographical Society it was definitely announced that the Society had decided to take part in the Geographical Congress which is to be held at Paris during the Exhibition. At the same meeting, Colonel Nadaroff communicated some interesting facts about the South Usuri region. It appears that the level of the great Lake Khangka, at the sources of the Usuri, has fallen to a considerable extent since the Russian occupation of the country thirty years ago. Even a hasty glance over the region of the Lower Amur and its tributaries, surrounded by numberless lakes, shows that the river-beds of the region belong to what Peschel described as "young rivers"—that is, rivers which have not yet completed the excavation of definite beds. It is natural, therefore, to suppose that the lakes which surround the Lower Amur must by and by be emptied into the channel of the great river, and thus in the meantime gradually diminish in size. M. Nadaroff's statement tends to confirm this view, and adds new facts in support of the theory of the rapid desiccation of Northern Asia.

AT the meeting of the Physical Section of the Russian Geographical Society on May 10, General Tillo made a communication about his remarkable hypsometrical map of European Russia, for which he has collected all available data obtained by levellings for the building of railways and along Russian rivers, as well as for the draining of marshes, together with data furnished by the trigonometrical survey of Russia and by individual explorers.

THE PRIORITY OF CHINESE INVENTIONS.

A WRITER in the *North China Herald* of Shanghai, referring to the Chinese claims to have originated many modern Western scientific inventions, says that Chinese patriotism has exhibited itself in an ardent desire to claim priority over Europeans in this respect. They are a very ingenious people, and, in past times having invented many valuable implements, it has always seemed to them a fair hypothesis that as every machine is an improvement on something that preceded it, the machinery and telescopes of the West may have originated at first in something Chinese. Yuen-yuen, a former Governor-General of Canton, in his "History of Astronomers," written at the beginning of this century, again prominently brought forward the idea that European mathematics came from China, and many subsequent writers have made the same claim. Not only is this the case in mathematics, but the Chinese say that our telescopes, steam-engines, firearms, and cannons are owing to them. Ever since China first saw steamers, fifty years ago, and since she came to know of the existence of European mathematics three hundred years ago, she has, from time to time, with more or less eagerness shown herself bent on claiming that the knowledge and skill shown in the West began in the first place with China. Mei-wen-ting, a great Chinese scholar, who died at an advanced age in the year 1722, after considering the whole question from the Chinese point of view, came to the conclusion that Europeans had got their mathematics and science from China. Amongst other reasons for this belief he states that in the "Chon-pi," a mathematical work of about B.C. 1100, although not expressly stated, the rotundity of the earth is implied. In the same book are to be found, he says, the properties of a right-angled triangle, as, for instance, that the square of the hypotenuse is equal to the sum of the squares of the other two sides. Since this is a fundamental problem, Mei-wen-ting claims that Western geometrical and trigonometrical knowledge is due to China. He accounts for the spread of Chinese astronomy to us by the scattering of the schools of astronomy in China, which, according to Szu-ma-chien, an historian who wrote a century before the Christian era, took place about B.C. 760. The fugitive astronomers, flying from the tyranny of the early Chow dynasty, diffused Chinese learning amongst the barbarians. Similarly in other matters the Chinese claim that the metaphysics of Indian Buddhism are due to the journey of Lao-tse to the West. The writer concludes his interesting discussion as follows :—"We need not trouble ourselves much respecting the Chinese claim to have originated Western science : they only claim to have started the preliminary ideas. As to the Chinese having always had enlightened views on many scientific and political subjects, we may frankly admit it. They speak 2200 years ago of concave and convex mirrors being able to magnify objects. Four thousand years ago they had instruments for observing the stars. In the year A.D. 1122 they made use of the magnet pointing to the south on board ship to guide the vessel on her course. With the proviso that they may have derived some of their early knowledge in these things and in others, such as the manufacture of fireworks, from foreign

countries, these and many like facts we may allow. But we would be glad for them to study the history of Western inventions, and show a willingness to recognize the ingenuity, knowledge, and intellectual power of other nations wherever they are found. Let them also enter on a rivalry in inventions. Let them make new discoveries and advance in the arts in new ways such as may be of benefit in the world. The Western nations will not be slow to acknowledge any efficient aid they may give in science, politics, or the arts."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Nearly twenty courses of scientific and medical instruction for medical students will be carried on in the Long Vacation, including, besides chemical, botanical, anatomical, and physiological courses, Dr. Anningson and Mr. Robinson on the examination of water, air, and foods, chemically and microscopically, and Prof. Roy and Mr. Adami on pathology, morbid histology, and bacteriology.

The Museums and Lecture Rooms Syndicate have recommended the erection of the buildings required for human anatomy, together with the joint anatomical and physiological lecture-room, at a cost which will fall within the £10,000 reported to be available for the purpose.

The honorary degree of Doctor in Science has been conferred on Prof. Mendeleeff, of St. Petersburg; and the honorary M.A. on Baron A. von Hügel, Curator of the Museum of Archæology here.

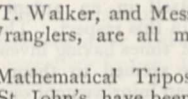
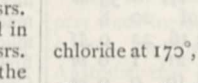
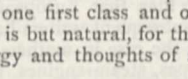
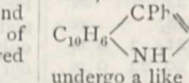
The Senior Wrangler, Mr. G. T. Walker, and Messrs. Dyson and Gaul, bracketed Second Wranglers, are all members of Trinity College.

In the second part of the Mathematical Tripos, Messrs. Brunyate, of Trinity, and Orr, of St. John's, have been placed in the first division of Class I., in alphabetical order; and Messrs. Buchanan, of Peterhouse, and Sampson, of St. John's, in the second division of the first class.

The Moral Sciences Tripos seems in a state of rapid progress towards obliteration. This year one first class and one second class represent the men; and this is but natural, for the range of work is such as to task the energy and thoughts of a matured thinker.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, May 16.—Dr. W. J. Russell, F.R.S., President, in the chair.—The following papers were read:—The magnetic rotation of nitrogen compounds, by Dr. W. H. Perkin, F.R.S. In previous communications the author has shown that in the magnetic field the plane of polarization of light is rotated to a greater extent in unsaturated than in saturated carbon compounds, and it is now shown that in the case of nitrogen compounds the magnetic rotation is in like manner correlated with changes in the valency of the nitrogen. From the discussion of his results generally the author concludes that in compounds of unsaturated triad nitrogen, the nitrogen has a greater influence than when it is present in the saturated condition, the difference in the values being about 0·5; this is only about half the difference usually observed on comparing the rotations of carbon compounds differing by two atoms of hydrogen. In the discussion which followed the reading of the paper, Dr. Gladstone, F.R.S., said that the general result of Dr. Perkin's work, establishing a difference in nitrogen according as it is present in the saturated or unsaturated condition, was in accordance with the conclusion which he had arrived at from the study of refractive power; the peculiarities brought out by the study of the magnetic behaviour, however, were chiefly indicated by peculiarities in dispersive power, being less obvious in the refraction equivalents.—The nature of solutions as elucidated by a study of their densities, electric conductivities, heat capacity, and heat of dissolution, by Mr. S. U. Pickering. The solutions examined were those of calcium chloride, calcium nitrate, and sulphuric acid, and the various hydrates which are proved to exist in solution are numerous and complex. The hydrates which calcium chloride forms contain 6, 7, 8, 10, 13, 18, 28, 86, and 1500 H_2O; calcium nitrate gives hydrates with 3, 3·5, 4·5, 5, 6, 10, 17, 51, 265, and 1810 H_2O; while with sulphuric acid hydrates are found containing $\frac{1}{4}$, $\frac{1}{3}$, $\frac{2}{3}$, 1, $\frac{3}{2}$, 2, 4, 5, 9, 13, 24, 52, 135, 510, 1430, and 4950 H_2O. The existence of these is, naturally, more doubtful in some cases than in others, and it is impossible to determine the exact molecular composition when more than about $10H_2O$ is present. In some cases the hydrates of sulphuric acid were established by six independent sets of results obtained from the study of four distinct properties. The excessively large amount of water present in the highest hydrate is a matter of especial interest, and the existence of such compounds explains the influence which mere traces of one substance may have on another substance (*e.g.* impurities in metals). The final conclusion which the author deduces from his work is the absolute rejection of any theory of dissolution other than the hydrate theory.—The expansion of water and other liquids, by the same. The author gives some determinations of the density of water at different temperatures, which indicate sudden changes in the expansion at about 10° and 18°. On examining the results obtained by Pierre, Kopp, Rosetti, Matthiessen, Solly, Despretz, and Hagen, he obtained further evidence of these changes, as well as of another change at 50°-60°. Pierre's results also show marked changes at 0° and 2°·5. Pierre's results with eleven organic liquids were also examined, and in most of them there appeared to be sudden changes of density at certain temperatures, which temperatures were different for different liquids. Nearly all of these results show that the densities of liquids when plotted against temperature form a series of parabolic curves of the second order, not meeting tangentially, and differentiating, therefore, into a series of straight lines which do not meet at the points where the breaks occur.—The formation of phenylindoles by isomeric change, by Dr. W. H. Ince. It is known that the phenylindole  when heated with zinc chloride at 175°, is converted into the isomeride  (Fischer and Schmitt, *Ber. der deut. chem. Gesellsch.*, 1887, 1071, 1811). The author finds that the corresponding naphthindole,  and methylphenylindole,  undergo a like change under similar conditions, although action takes place neither so easily nor so completely as in the simpler case.—An improved Soxhlet extractor, and vacuum distilling apparatus, by Dr. I. Lewkowitsch.

Institution of Civil Engineers, May 28.—Annual General Meeting.—Sir George B. Bruce, President, in the chair.—After the reading and adoption of the Report, hearty votes of thanks were passed to the President, to the Vice-Presidents, and other Members of the Council, to the Auditors, to the Secretaries and Staff, and to the Scrutineers.—The ballot for the Council resulted in the election of Sir John Coode, K.C.M.G., as President; of Mr. G. Berkley, Mr. H. Hayter, Mr. A. Giles, M.P., and Sir Robert Rawlinson, K.C.B., as Vice-Presidents; and of Mr. W. Anderson, Mr. B. Baker, Mr. J. W. Barry, Mr. E. A. Cowper, Sir James N. Douglass, F.R.S., Sir Douglas Fox, Mr. J. C. Hawkshaw, Mr. C. Hawksley, Sir Bradford Leslie, K.C.I.E., Mr. G. F. Lyster, Mr. J. Mansergh, Mr. W. H. Preece, F.R.S., Sir E. J. Reed, K.C.B., F.R.S., M.P., Mr. W. Shelford, and Mr. F. W. Webb, as other Members of the Council.—The session was then adjourned until the second Tuesday in November, at 8 p.m.—The Council have awarded the following premiums in respect of the original communications submitted during the session 1888-89:—For papers read and discussed at the ordinary meetings: a Telford Medal and a Telford Premium to Gisbert Kapp, for his paper on alternate-current machinery; a Watt Medal and a Telford Premium to William Henry Greenwood, for his paper on the treatment of steel by hydraulic pressure, and the plant employed for the purpose; a George Stephenson Medal and a Telford Premium to Edgar Worthington, for his paper on the compound principle applied to locomotives; a Watt Medal and a Telford Premium to Charles Edward Emery, for his paper on the district distribution of steam in the United States; a Telford Premium to John Audley Frederick Aspinall, for his paper on the friction of locomotive slide-valves; a Telford Premium to John Oliver Arnold, for his paper on the influence of chemical composition on the strength of Bessemer steel tires. For papers printed in the Proceedings without being discussed: a Watt Medal and a

Telford Premium to Robert Runeberg, for his description of steamers for winter navigation and ice-breaking; a Telford Premium to Bryan Donkin, Jun., for his account of experiments with gas-flame jackets; a Telford Premium to Prof. Victor Auguste Ernest Dwelshauvers Dery, for his reduction of experiments on the effect of superheating, steam-jacketing, and gas-flame jackets on cylinder-condensation; a Telford Premium to Robert Henry Smith, for his paper on stress diagrams of solid structures; a Telford Premium to Leveson Francis Vernon-Harcourt, for his paper on Alpine engineering; a Telford Premium to George Lopes, for his account of the reparation of Betchworth Tunnel, Dorking, on the London, Brighton, and South Coast Railway; a Telford Premium to Neil Kennedy, for his paper on the tacheometer and its uses. For papers read at the supplemental meetings of students: a Miller Scholarship to Edward Carstensen de Segundo, for his account of experiments on the strain in the outer layers of cast-iron and steel beams; a Miller Prize to Henry Byrom Ransom, for his paper on the cyclical velocity-variations of steam and other engines; a Miller Prize to William Wade Fitzherbert Pullen, for his account of water-softening and filtering apparatus, for locomotive purposes, at the Taff Vale Railway Company's Penarth Dock Station, near Cardiff; a Miller Prize to James Denis Twinberrow, for his paper on flexible wheel-bases for railway rolling-stock; a Miller Prize to Samuel Joyce, Jun., for his paper on electrical measuring-instruments, their properties and calibration; a Miller Prize to Richard John Durley, for his paper on moulding and casting cylinders for marine engines; a Miller Prize to Julian James King-Salter, for his description of the 26-knot Spanish torpedo-boat *Ariete*; Miller Prizes to Charles Henry Gale and Vernon Warburton Delves-Broughton, for their joint paper on photography for engineers.

Geological Society, May 22.—Mr. W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—Note on the hornblende schists and banded crystalline rocks of the Lizard, by Major-General C. A. McMahon. The reading of this paper was followed by a discussion, in which the President, Dr. Geikie, Mr. Teall, Prof. Bonney, Mr. Rutley, and Dr. Hicks took part.—The Upper Jurassic clays of Lincolnshire, by Mr. Thomas Roberts. In Lincolnshire it has generally been considered that the Oxford and Kimeridge clays come in direct sequence, and that the Corallian group of rocks is not represented. The author, however, endeavoured to show that there is between the Oxford and Kimeridge a zone of clay which is of Corallian age. Six palæontological zones were recognized in the Oxford clay. The clays which come between the Oxford and Upper Kimeridge the author divided into the following zones: (1) black selenitiferous clays; (2) dark clays crowded with *Ostrea deltoidea*; (3) clays with *Ammonites alternans*; and (4) clays in which this fossil is absent. The black selenitiferous clays (1) are regarded as Corallian, because: (*a*) they come between the Oxford clay and the basement bed of the Kimeridge; (*b*) out of the twenty-three species of fossils collected from this zone, twenty-two are Corallian; (*c*) *Ostrea deltoidea* and *Gryphæa dilatata* occur together in these clays, and also in the Corallian, but in no other formation. The zones (2), (3), and (4) are of Lower Kimeridge clay age. The lowest zone, (2), is very persistent in character, and is met with in Yorkshire, Cambridgeshire, Oxfordshire, and the south of England. The remaining zones, (3) and (4), are local in their development. Some remarks on this paper were offered by Prof. Blake and Mr. Hudleston.—Origin of movements in the earth's crust, by Mr. James R. Kilroe. Communicated by Mr. A. B. Wynne.

Zoological Society, May 21.—Prof. Flower, F.R.S., President, in the chair.—Mr. Sclater exhibited and made remarks on a mummied Falcon from Egypt; and some photographs of groups of Sea-birds and Seals taken on the shores of Antipodes Island, Antarctic Ocean.—Mr. Sclater also called attention to a specimen of Leaf-insect, living in the Society's Insect House, which had been received from the Seychelles, and presented by Lord Walsingham. It was not quite fully developed, but was believed to be referable to *Phyllium gelonus*, Gray.—Mr. Martin Jacoby read a list of the species of Coleoptera of the families Crioceridæ, Chrysomelidæ, and Galerucidæ, of which specimens had been collected in Venezuela by M. Simon, and gave descriptions of the new species.—A communication was read from Mr. A. G. Butler containing the description of a new extinct genus of Moths belonging to the Geometrid family Euschemidæ, based on a fossil specimen obtained from the Eocene Freshwater Limestone of Gurnet Bay, Isle of Wight. This insect was named *Lithopsyche antiqua*.—Mr. W. F. Kirby read a paper containing descriptions of new genera and species of Dragonflies in the collection of the British Museum, chiefly from Africa.—Dr. Hans Gadow read a paper on the taxonomic value of the intestinal convolutions in birds. After pointing out the different forms assumed by the intestinal convolutions in this class of animals, and suggesting a nomenclature for them, the author proceeded to give the outlines of a classification of birds based solely on this part of their structure, and to show the differences and resemblances of the various groups.

EDINBURGH.

Royal Society, June 3.—Sheriff Forbes Irvine, Vice-President, in the chair.—Some photographs of mirage were exhibited.—Prof. T. R. Frazer communicated the remainder of his paper on the natural history, chemistry, and pharmacology, of *Strophanthus hispidus*.—Prof. Tait read a note on the compressibility of mercury.—Dr. E. Sang gave a notice of fundamental tables in trigonometry and astronomy arranged according to the decimal division of the quadrant.—Prof. Tait communicated a note on the inscription, in a sphere, of a closed polygon, each of whose sides shall pass through a given point, and he also discussed the problem of the non-oscillating pendulum.—A paper, by Sir W. Thomson, on the Bravais' uniform distribution of points, was submitted.

PARIS.

Academy of Sciences, June 3.—M. Des Cloizeaux, President, in the chair.—Heat of combustion of carbon under its various forms of diamond, graphite, and amorphous carbon, by MM. Berthelot and Petit. By means of the new methods based on the employment of the calorimetric bomb, the authors have determined the molecular heat of combustion of amorphous carbon at 97·65 calories; of crystallized graphite at 94·81; of the diamond at 94·31; and of bort (uncleavable diamond) 94·34. The old values, hitherto accepted, must consequently be considerably increased, and this again involves an increase of the heats of formation for all organic compounds, from their elements upwards, so far as they have yet been calculated.—Note on the spectrum of Uranus, by Mr. J. Norman Lockyer.—On the surface-currents of the North Atlantic, by Prince Albert of Monaco. Of the 1675 floats cast into the sea during the recent explorations of the *Hirondelle*, as many as 146 have already been recovered at various points of the seaboard, apparently demonstrating a circular movement of the surface-waters round a point situated somewhere to the south-west of the Azores. The outer edge of this current sets east-north-east to the neighbourhood of the English Channel, where it is deflected southwards along the coasts of Europe and Africa to the Canaries, thence trending south-east to the equatorial current, thus completing the circuit by merging in the Gulf Stream.—On Prof. Charles Sumner Tainter's graphophone, by M. Georges R. Ostheimer. The essential feature of this instrument, which solves the problem of the storage of sound, is the employment of wax, or a pasteboard cylinder coated with wax. The process, devised by Prof. Tainter after the original phonograph had been discarded by Mr. Edison as of no immediate practical utility, has since been so highly approved of by the American inventor that he has adopted it for what he now calls his "improved phonograph."—Observations of the new planet discovered on May 29 at the Observatory of Nice, by M. Charlois. The observations are for the period May 29-31, when the planet appeared to be of the twelfth magnitude.—On the stability of the solar system, by M. D. Eginitis. The authors here study the nature of the slight perturbations usually neglected in planetary theories, and endeavour to determine their more important general analytical forms. The results are given for the earth and Saturn, showing that the long axes of their orbits are subject to extremely slight secular perturbations of the third order. These irregularities are periodical, the periods being excessively long, but of such a nature as to imply that both Saturn and the earth are at present approaching the sun.—Apparatus for determining melting-points under ordinary conditions and variable pressures, by M. B. C. Damien. The apparatus here described will be found useful in determining the melting-points of various mixtures of spermaceti and ether, of gum-lac and alcohol, and in general of solidified solutions of various solids.—The electric conductivity of saline solutions, applied to the problems of chemical mechanics, by M. P.

Chroustchoff. In continuation of his previous paper on this subject the author here gives in tabular form the measurements of the conductivity of neutral saline mixtures capable of double decomposition. In a supplementary paper, MM. Chroustchoff and V. Pachkoff deal with the electric conductivity of saline solutions containing mixtures of neutral salts. The chief object of this research is to confirm by experiment the assumption that a partial formation of double salts in solutions is a general phenomenon. — On some substances derived by polymerization from ethyl cyanide, by MM. M. Hanriot and L. Bouveault. The preparation and properties are described of two bodies of which the formulæ are respectively $C_2H_5 . CO . C(CH_3)_2CN$ and $C_2H_5 . CO . C(C_2H_5)(CH_3)CN$, the former obtained by the action of methyl iodide, the latter by that of ethyl iodide.—On some rocks of the Maures district, by M. A. Le Verrier. Of the old eruptive rocks here described the most interesting is a lherzolite consisting of olivine and hypersthene (labrador schiller spar), the first associated with serpentine, the second with talc.—On the toxic property of meteoric waters, by M. Domingos Freire. An epidemic presenting some hitherto unknown symptoms having broken out at Rio de Janeiro last March, the author, with a view to determining its origin, made some experiments on the character of the aqueous vapour suspended in the atmosphere. The result of these experiments was a strong suspicion, if not certainty, that the disorder was due to a toxic principle diffused in the atmosphere, and belonging perhaps to the cyanic series (hydrocyanic acid?).—Papers were contributed by M. G. André, on some ammonio-chlorides of mercury; by M. E. Péchard, on the combinations of metatungstic acid with the alkaline bases and the resulting thermic phenomena; by M. Léon Bourgeois, on the preparation of the crystallized orthosilicates of cobalt and nickel; by M. Trouessart, on the marine Acarians of the French seaboard; by M. Flammarion, on the earthquake of May 30; and by M. Th. Moureaux, on the possible connection of magnetic disturbances with the same earthquake.

BERLIN.

Physical Society, May 24.—Prof. du Bois Reymond, President, in the chair.—Prof. Börnstein exhibited a photograph which he had taken during the recent heavy thunder-storms. Two flashes could scarcely be distinguished on the photograph owing to the marked occurrence of sheet lightning; they appeared as simply very sinuous lines without any zig-zags.—Dr. Pringsheim had carried out a series of researches with the phonautograph in order to determine by physical methods upon what the French accent is dependent, whether it is due to the duration, pitch, or intensity of the tones. Several Frenchmen spoke single words and short sentences slowly into the funnel of the instrument so as to impinge upon a membrane, made of the thinnest india-rubber, whose vibrations were recorded on a smoked rotating drum by means of a fibre of glass. The somewhat troublesome analysis of the minute curves brought to light very characteristic waves for the consonants, but these differed considerably according as they were spoken at the beginning or end of a word. The vowels showed a considerable difference from the consonants chiefly in respect of their pitch. The speaker exhibited and explained a number of the curves; but further researches are necessary before any general conclusions can be arrived at, or the question as to the real nature of "accent" can be decided.—Dr. Dieterici gave an account of his researches on the determination of the specific volume of saturated aqueous vapour at 0° C. On account of the difficulties which presented themselves in connection with the measurements necessary in the methods of research hitherto employed, he had devised a new method. He measured the amount of water which must be converted into vapour at 0° C. in order to completely fill a known space with saturated vapour, by means of the heat which becomes latent during its evaporation. The vessel containing the water was immersed in an ice-calorimeter, and was connected with a large space which could be rendered both vacuous and dry. The water, or dilute saline-solution which behaves like water, was then allowed to evaporate until the space was filled with saturated vapour; the amount of heat requisite to produce the observed evaporation was determined from the amount of mercury which was expelled from the calorimeter, and this then gave the amount of water evaporated. From among the experimental details, which the speaker described in full, the only points which may here be mentioned are that a small residual quantity of air in the vacuum has no effect on the total amount of water which evaporates, but only slows the rate of evaporation to a slight extent; on the other hand, the pellicle of water which is condensed on the inner surface of the vacuous space was found to exert a quantitative influence on the evaporation, and necessitated special modifications of the methods of experiment for its exclusion. As one outcome of the experiments may be mentioned that Gay Lussac's law holds good almost up to the temperature of saturation, and that the mass of water which must be evaporated in order to saturate a space of 1 litre capacity at 0° C. is 4·886 mgr.; hence the specific volume of aqueous vapour saturated at 0° C. is 204·7 litres, and its pressure is 4·62 mm. The speaker had deduced a considerable number of other important constants from the results of his experiments; and he further intends to determine the above for other fluids and at other temperatures in a subsequent research.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

An Essay on Asphyxia: G. Johnson (Churchill).—The Working and Management of an English Railway: G. Findlay (Whittaker).—Scientific Memoirs by Medical Officers of the Army of India, Part 4, 1889: edited by Sir B. Simpson (Calcutta).—Método de los Cuadrados Mínimos: Libro de Texto por M. Merriman; traducido del Inglés por V. Balbin (Buenos Aires, Biedma).—Blackie's Modern Cyclopedia, vol. ii. (Blackie).—Life Lore, vol. i. (Mawer).—Kant's Critical Philosophy, a new and completed edition, vol. i., the Kritik of Pure Reason Explained and Defended: J. P. Mahaffy and J. H. Bernard (Macmillan).—An Elementary Treatise on Heat: H. G. Madan (Rivingtons).—Transactions of the Linnean Society of London, vol. v., Part 3, the Zoology of the Afghan Delimitation Commission: J. E. T. Aitchison (Longmans).—A Grammar of the Kwagiutl Language: Rev. A. J. Hall (Montreal, Dawson).—Rapporteur Esthétique: M. C. Henry (Paris, Seguin).—Cercle Chromatique: M. C. Henry (Paris, Verdin).—The Mineral Wealth of British Columbia: G. M. Dawson (Montreal, Dawson).

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