

A GLANCE through the new edition of the catalogue of physiological instruments manufactured by the Cambridge Scientific Instrument Company shows the importance of a knowledge of physics to physiologists and biologists, for without an acquaintance with physical principles it would be impossible to design or use many of the instruments described. Special attention may be called to the completeness of the list as regards recording drums and motors, apparatus for blood analysis, and anthropometric apparatus.

SEVERAL important papers appear in volume x. of the *Bulletin* of the American Museum of Natural History, just received from New York. Among the subjects dealt with are: Mexican birds; native tribes of Mexico; new mammals from Western Mexico and Lower California; complete skeletons of *Teleoceras fossiger* and *Coryphodon radians*, with notes upon the locomotion of these animals; extinct Camelidæ of North America and some associated forms; evolution of the amblypoda, revision of the species of *Euchlœ* inhabiting America; the Chickarees, or North American red squirrels; vertebrate fauna of the Hudson Highlands; and the Bombycine Moths, found within fifty miles of New York City.

A THIRD edition, revised and enlarged, of Prof. J. Arthur Thomson's "Outlines of Zoology" has been published by Mr. Young J. Pentland, Edinburgh. The volume, which contains more than eight hundred pages and 332 illustrations, is an inspiring text-book which students of zoology may use in the lecture-room, museum, and laboratory.—The seventh edition of "A Treatise on Practical Chemistry and Qualitative Analysis," by Prof. Frank Clowes, has been published by Messrs. J. and A. Churchill. The new edition of this successful volume has undergone a thorough revision, and some additions have been made. The organic portion of the book will now meet the needs of many medical students.—Messrs. A. and C. Black have published a second edition of Mr. C. M. Aikman's instructive little book on "Milk: its Nature and Composition." The volume provides students of agricultural science with a capital manual on the chemistry and bacteriology of milk, butter, and cheese.

MESSRS. WILLIAMS AND NORGATE'S latest *Book Circular* (Scientific Series, No. 71, May) contains a number of useful descriptive notes on recent and forthcoming scientific books, as well as the usual particulars. Among the announcements, we notice the following:—A new monthly periodical devoted to biological sciences is announced from Italy. The title will be "Revista di Scienze Biologiche," and it will be edited by Enrico Morselli.—The third edition of Beilstein's "Handbuch der organischen Chemie" is now fast approaching its completion, and the final part of the fourth volume will probably be published in the course of the coming summer. The first volume, consisting of 1586 pages, was published in 1893; the second volume, of 2211 pages, in 1896; and the third, of 1020 pages, in 1897.—The new edition of Richter's "Lexikon der Kohlenstoffverbindungen," which is at present in the press, will contain over 60,000 formulæ. The whole of the 56,000 formulæ which appear in Beilstein's Handbook will be indexed in the work, so that reference from it to Beilstein will be easy.—"Chimie végétale et agricole" is the title of a work by M. Berthelot which is in the press, and will be issued very shortly. It will be in four volumes.—The first volume of a fourth revised and enlarged edition of Dr. G. Lunge's "Chemisch-Technische Untersuchungsmethoden" is in the press, and will be published very shortly. The work will be complete in three volumes.—"Die Einrichtungen zur Erzeugung von Röntgenstrahlen und ihr Gebrauch" is the title of a work by Dr. B. Donatti which is in the press, and will be issued very shortly.—Towards the end of this month, the fourth and final volume of Prof. P.

Duhem's "Traité élémentaire de mécanique chimique fondée sur la Thermodynamique" will be issued. The following is a list of its contents: "Les melanges doubles. Statique chimique générale des systèmes hétérogènes." The volume will also contain a complete index.

THE additions to the Zoological Society's Gardens during the past week include two Green Monkeys (*Cercopithecus callitrichus*, ♂ ♀) from West Africa, presented respectively by Mr. J. B. Robinson and Mr. H. Gifford; a Yellow-whiskered Lemur (*Lemur xanthonomystax*, ♂) from Madagascar, presented by Mr. C. B. Ayerst and Miss Mary F. Ayerst; a Common Duckler (*Cephalophus grinnii*, ♂), a Banded Ichneumon (*Crossarchus fasciatus*) from South Africa, presented by Mr. W. Champion; a Cinereous Vulture (*Vultur monachus*), South European, presented by H.G. the Duchess of Marlborough; a Black Kite (*Milvus migrans*), European, presented by Mr. G. H. Walker; a Chilian Sea Eagle (*Geranoaetus melanoleucus*), captured off Cape Horn, presented by Captain Bate; six Derbian Zonures (*Zonurus giganteus*) from South Africa, presented by Mr. W. L. Slater; two Common Snakes (*Tropidonotus natrix*) British, presented by Mr. E. Haig; a Chimpanzee (*Anthropopithecus troglodytes*, ♀) from West Africa, deposited.

#### OUR ASTRONOMICAL COLUMN.

NEW STAR IN SAGITTARIUS.—The *Astrophysical Journal* for April 1899 (vol. ix.) contains a reproduction of a photograph of the spectrum of this star taken at Harvard College Observatory, together with a picture of a chart plate showing the position of the star on April 29, 1898, when its magnitude was 8.4.

The photograph of the spectrum shows the changes in the spectrum by a comparison of its appearance on April 19 and April 21, 1898. The first shows H $\beta$ , H $\gamma$ , H $\delta$ , H $\epsilon$ , H $\zeta$ , H $\eta$ , and possibly H $\theta$ , as bright lines. A broad band at  $\lambda$  4643 is also bright, with several other narrow bright bands. These are probably coincident with corresponding lines in spectrum of Nova Aurigæ. The plate taken on the later date shows several important changes, chiefly the appearance of a narrow bright line at  $\lambda$  5005, possibly coinciding with the chief nebular line at  $\lambda$  5007.

COMET 1899 a (SWIFT).—

Ephemeris for 12h. Berlin Mean Time.								
1899.	R.A.			Decl.	Br.			
	h.	m.	s.					
May 25	...	20	48	31	...	+ 54 41.8	...	1.77
26	...	20	26	33	...	55 47.5	...	
27	...	20	3	7	...	56 38.4	...	1.71
28	...	19	38	21	...	57 11.4	...	
29	...	19	12	56	...	57 26.1	...	1.61
30	...	18	47	26	...	57 20.2	...	
31	...	18	22	26	...	56 55.6	...	1.49
June 1	...	17	58	35	...	+ 56 13.1	...	

The comet is now moving very rapidly in R.A., and becoming more favourably situated for observation. During the week it passes in a north-westerly direction through Cygnus into Draco. On the 25th it will be about 10° due north of  $\alpha$  Cygni, and on June 1 4° north of  $\gamma$  Draconis. It reaches its maximum northern declination on the 29th. Although its brightness has been steadily declining, it is still easily visible to the unaided eye when its position has been ascertained.

#### THE REGISTRATION OF OPTICIANS.

OBSERVERS of the undercurrents of scientific progress in this country cannot have failed to note during the past twelve months a very remarkable movement at work amongst the opticians, especially amongst the younger men in the optical trades. An intelligent scientific study of the principles of optics has hitherto never been required of the optician, who from the first day of his apprenticeship might grow up in the business entirely untrained in everything save the mere buying and sell-

ing of optical goods. All this is rapidly changing, as indeed was to be desired. Half a century ago, the qualification for practising as a surgeon was practically a mere serving of indentures, while the trade of druggist might be practised by one who had never had any instruction in even the elements of chemistry. There was no organisation to examine the candidates, or to certify them if qualified; there was little stimulus to study. Hence, in the absence of any controlling body, the young men growing up in the optical trades have had little inducement to acquaint themselves with even the elements of the science on which their industry is based. Even those who might be studiously inclined found little to encourage them; for, strange to say, the existing text-books of optics are of little or no use to such. They are written mostly from a different standpoint, to enable University candidates to pass academical examinations, and fail to deal with many of the problems that present themselves to the practical optician. Further, great examining bodies, such as the Science and Art Department and the City and Guilds of London Institute, have never formulated any examinations in optics or optical instrument making.

The present salutary movement has originated quite outside academic circles, having arisen in the ancient London guild called the Spectacle-makers' Company, which, like so many of the old London guilds—the Clothworkers', the Leathersellers', the Carpenters', and the Plumbers' Company—has most laudably devoted of its funds to the promotion of the industry from which it takes its name. The Spectacle-makers' Company is not one of the twelve great Companies holding landed property nor possessed of great wealth. Relatively to the great City Companies, such as the Mercers, Goldsmiths, Fishmongers, Drapers, it is poor. But it has shown much energy and enterprise in organising the certification of opticians. Briefly, what the Spectacle-makers' Company has done is this: it holds at least twice a year examinations in optics, open only to those who have entered the optical trades; and on those who have thus shown a real acquaintance both with the theory and the practice of their trade, it confers a diploma or certificate, and registers them as qualified in optics. It further admits them to the freedom of the guild. The stimulus thus afforded to those in the optical industry in this country has been undeniably very great. Optical classes have been eagerly sought in London, and have also been held in many provincial towns, and a widespread demand for optical literature has sprung up.

The scope of this movement may best be understood by a reference to the official syllabus put forward by the Spectacle-makers' Company. It states that when the Company was granted a Royal Charter in 1629, spectacles were practically the only optical instruments dealt in; but with the progress of science as other instruments were invented, the spectacle-maker became a general optician. With the division of labour which arose, the trade became divided. It is the object of the Spectacle-makers' Company to re-associate with the guild all who possess the necessary technical ability. A theoretical and practical examination must be passed by those candidates who are recommended as eligible by two established members of the craft. The full examination comprises arithmetic, algebra, trigonometry, elementary heat and light, as well as general optics, optical instruments, and spectacles, practical tests in optical work, in visual optics so far as instruments are concerned, and in matters connected with one of the following instruments: the camera, the microscope, and the sextant, at the choice of the candidate. The part of the examination relating to visual optics deals with the general anatomy of the human eye; the course of light passing through the eye and modified by lenses, cylinders, and prisms. It deals also with the simple "errors of refraction," otherwise called hypermetropia, myopia, presbyopia, and astigmatism. It requires a knowledge of trial lenses, test types, astigmatic charts, and the optometer, &c. In the practical tests, candidates are required to execute measurements of focal length, and to verify cylindrical and prismatic lenses; to use the spherometer; to determine the axis of a cylinder and the deviation of a prism; to neutralise simple and combined lenses; to transpose lens combinations; and to centre and adjust lenses and frames, &c. It has been the practice, at the inauguration of similar schemes, to make some exceptions by admitting without examination those men who had long been in practice. But the Committee of the Spectacle-makers' Company decided that even such should be examined; it conceded, however, that down to July 1, 1899, all who had spent seven years in the optical business might be

accepted, provided they succeeded in passing that part of the examination which relates specially to spectacles.

The Optical Committee has itself organised classes for optical instruction, and has carefully limited the training so as not to trench on the province of the ophthalmic surgeon. As examples of this case, it may be stated that students are specially instructed that they are not to treat disease, or any case of myopia above seven *dioptries*, but refer such to an ophthalmic surgeon; and so also the cases of children whose punctum proximum is beyond 10 centimetres, or any persons who cannot, when corrected for a simple error of refraction, see 20/20 print.

The first examinations under this scheme were held in November 1898, and they were followed by a second series in March 1899. The examiners selected by the Optical Committee of the Company were Prof. Silvanus Thompson, F.R.S., Dr. Lindsay Johnson, and Mr. G. Paxton of the well-known firm of Curry and Paxton, the latter being assisted in the practical examination by Messrs. A. A. Wood and W. A. Dixey. At each of these examinations over a hundred candidates presented themselves. The examinations were strictly on the lines indicated, no questions being set as to the diseases of the eye, or in retinoscopy, or on matters outside the province of optics proper.

At the outset, it was necessary to guard against any misapprehension as to the scope and nature of the examination scheme, which might have led to difficulties between opticians and ophthalmic surgeons, such as those which in time past have arisen between pharmacists and qualified medical practitioners. Very wisely, it was decided that the examination should be confined to optical matters, and should not treat of disease, nor even of the eye at all save as an optical instrument. The examination is to test candidates solely in matters of optics, so as in no way to interfere in things that lie within the exclusive province of the ophthalmic surgeon. In pursuance of this policy, the application of the ophthalmoscope to the eye, which is a matter for the ophthalmic surgeon, is excluded from the subjects of the examination. On the other hand, the principle of construction of the ophthalmoscope, which is a matter within the province of the optical instrument maker, is included. Recognising that the use of drugs, such as cocaine and homatropine in retinoscopy, is purely a matter for the ophthalmic surgeon, the Spectacle-makers' Company not only excludes from its syllabus of examinations all optical tests implying or requiring their use, but it sternly discourages the idea that an optician should go out of his sphere to meddle with such matters. Nay, further, it requires, amongst the conditions upon which its diploma is held, that the holder shall sign a declaration that he will not use any drugs for the purpose of dilating the pupil.

It is believed that the firm stand thus made officially by the Spectacle-makers' Company will have a beneficial effect in stamping out a practice which—particularly in certain provincial centres—had been growing up of opticians, devoid of any medical qualification, administering drugs such as homatropine, and pretending to make retinoscopic tests that ought to be left to the ophthalmic surgeon. In yet one other direction the certification and registration of opticians will, as it becomes general, promote the interests of the public. There are, unfortunately, in many towns advertising opticians absolutely unqualified scientifically who deceive the public by pretending to impossibilities such as the curing of cataract without operation, and the like. The Medical Acts are unfortunately powerless to reach these; and hitherto the public has had no means of distinguishing between them and the really qualified opticians, since until now there has been no organisation to register the properly-qualified optician. But as the certification of really qualified opticians becomes general, it will be possible to detect and eliminate the quack, whilst the qualified optician will be deterred, at the risk of being disbarred, from issuing advertisements that would mislead the public. Already, even at this early stage, the advantages of organisation have become apparent, the Committee of the Company having already several times been called upon to intervene to insist on the withdrawal of advertisements which might be thought misleading to the public or unfair to other opticians.

The impulse to optical studies has been undeniable, and is certain to spread. The demand of the younger men in the optical industry for optical teaching that will be of service to them will certainly modify the abstract and jejune courses of scholastic optics offered to them in some of the provincial University colleges, where the optics of the workshop, and even

the methods of optical testing in use in the industry, are practically unknown, and science as well as the public will be gainers by the movement. A debt of gratitude is owing to the Court of the Spectacle-makers Company, and to its Master (Mr. W. E. Thornthwaite) for their efforts. The Company has lately received notable accessions of strength in having admitted to its freedom several of the highest names in science, including the Astronomer Royal, Captain W. de W. Abney, Sir William Crookes, and, last but not least, Lord Kelvin.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The seventh "Robert Boyle" lecture of the Junior Scientific Club will be delivered by Prof. J. G. McKendrick, F.R.S., in the large lecture theatre at the University Museum, on Tuesday, June 6, at 8.30. The subject will be "The physiological perception of musical tone."

The 201st meeting of the Junior Scientific Club was held on Wednesday, May 17. After private business, Prof. E. B. Tylor, F.R.S., read a paper on the survival of the palæolithic condition of man in the South Pacific region. Mr. R. D. MacGregor (Exeter) also read a paper on Indian butterflies.

CAMBRIDGE.—The subject of the Rede Lecture, to be delivered by Prof. Cornu on June 1, is "The Wave Theory of Light: its Influence on Modern Physics."

Admission to the ceremonies in the Senate House, in connection with the jubilee of Sir G. G. Stokes on June 2, will be by ticket. Applications must be made through members of the Senate not later than May 26.

The General Board have proposed the detailed regulations for the Board of Agricultural Studies in connection with the new Department of Agriculture. County and Borough Councils who contribute annual grants to the funds of the Department are to nominate members of the Board.

Honorary degrees are on June 2 to be conferred on Profs. Cornu and Darboux of Paris, Kohlrausch of Berlin, Michelson of Chicago, Mittag-Leffler of Stockholm, Quincke of Heidelberg, and Voigt of Göttingen.

Prof. Newton, who has recently been somewhat out of health, is to depute his lectures in zoology during the ensuing academical year to Mr. W. Bateson, F.R.S., of St. John's College.

Mr. Neville, F.R.S., of Sidney, has been appointed an elector to the chair of Chemistry; and Mr. Larmor, F.R.S., of St. John's, an elector to the Jacksonian professorship, in place of the late Mr. P. T. Main.

THE endowment of a quarter of a million for the University of Birmingham has been secured. At a meeting of the canvassing committee on Thursday last, it was announced that since the previous meeting 24,000*l.* had been promised, and that this, added to the sum previously promised, including the 50,000*l.* from Mr. Carnegie and the 37,500*l.* from the anonymous donor, brought the total up to 254,580*l.*, or 4580*l.* in excess of the amount originally fixed upon. The anonymous donor, recognising that the endowment of 250,000*l.*, although sufficient for a starting point, must soon be largely augmented, has offered, if the fund is raised to 300,000*l.* by the end of June, to contribute the last 12,500*l.* The committee have now to find 33,000*l.* to secure the additional 12,500*l.* from the anonymous donor. If this is obtained, it will make 50,000*l.* altogether subscribed by Mr. Chamberlain's friend.

THE following additional endowments and gifts to educational institutions in the United States are recorded in *Science*.—An Appropriation Bill recently passed by the Illinois Legislature gives to the University of Illinois about 600,000 dollars. The Wisconsin Legislature has appropriated for the University of Wisconsin 151,000 dollars, of which 100,000 dollars is for an engineering building. The Colorado Legislature, besides passing a Bill giving its State University an income of one-fifth of a mill on each dollar of assessed valuation, has made grants amounting to about 110,000 dollars. In Nebraska, the State University has been given a one-mill tax, which will, it is estimated, yield about 168,000 dollars yearly.—Columbia University has recently received a gift of 10,000 dollars, to be known as the Dyckman Fund for the encouragement of

biological research, the interest of which will be granted to post-graduate students.

THE subjoined table, showing the ratio of the teaching staff to the number of students in ten of the largest universities of the United States, is printed in *Science*. The first column gives the number of persons composing the faculty, including instructors of all grades; the second gives the total number of students enrolled in the institution; the third, the proportion students to teachers.

	Faculty.	Students.	Ratio
Johns Hopkins ...	123	641	5.2
Cornell ...	328	2038	6.2
Columbia ...	303	2185	7.2
California ...	286	2391	8.3
North-western ...	222	2019	9.1
Harvard ...	411	3901	9.4
Yale ...	255	2500	9.7
Chicago ...	212	2307	10.9
Pennsylvania ...	258	2834	10.9
Michigan ...	222	3192	14.4
Total ...	2620	24,008	9.1

### SCIENTIFIC SERIALS.

*American Journal of Mathematics*, vol. xxi. No. 2, April.—On systems of multiform functions belonging to a group of linear substitutions with uniform coefficients, by E. J. Wilczynski. In this memoir, the author attempts to prove the existence of certain general functions, studied herein, he believes, for the first time. The existence of a large and important class of these functions is demonstrated by an indirect method, which consists essentially in generalising the hypergeometric functions in a proper manner. The work is connected in a way with the researches of Fuchs, Schwarz and Neumann (on Riemann's theory of Abelian functions, and of Klein (*Math. Ann.*, Bd. 41). Oskar Bolza states that his principal object, in his paper on the partial differential equations for the hyperelliptic  $\theta$  and  $\sigma$  functions, is to replace part of Wiltheiss's work (*Crelle*, Bd. 99, and *Math. Ann.*, Bd., 29, 31 and 33) by simpler and more direct proofs.—E. B. Van Vleck contributes an article on certain differential equations of the second order allied to Hermite's equation. The treatment is thorough, and the work is accompanied with numerous diagrams.—Note on differential invariants of a system of  $m$  points by projective transformation, by E. O. Lovett, shows that to generalise a theorem of Henry Smith's relative to tangent curves (*cf.* on the focal properties of homographic figures (*Proc. London Math. Soc.*, vol. ii.) and the theorem relative to parallel curves, it is only necessary to substitute "surface" for "curve" and "measure of curvature" for "radius of curvature." A second (short) paper by Bolza is entitled "Proof of Brioschi's recursion formula for the expansion of the even  $\sigma$  functions of two variables." The author believes that no proof of these theorems has hitherto been published. Brioschi merely stated them in a note (*Goettingen Nachrichten*, 1890, p. 237).—E. Jahnke supplies a two-page note to Prof. Craig's memoir, "Displacements depending on one, two and three parameters in a space of four dimensions."—There is an interesting prefatory notice, from which we learn that Prof. Craig, after seventeen years' connection with the editorial work of the *Journal*, is succeeded by Prof. Simon Newcomb, who writes this exceedingly modest notice.

*Symons's Monthly Meteorological Magazine*, May.—Ozone, by D. A. van Bastelaer. Since 1886, the author has persistently registered the amount of ozone and submitted reports to the Royal Society of Public Health of Belgium, and has also published five-day means throughout the year, with the idea of their being used in connection with the death-rate. Although at individual stations the amount of discoloration varies greatly from day to day, the means remain very steady both for months and for years. Some places, especially Flanders and the neighbourhood of the Ardennes, have constantly much higher means than others. Mr. Symons remarks that it has sometimes been objected that the discoloration of ozone papers is not solely due to the presence of ozone, so that the subject is generally neglected, but there is probably no equally simple and trustworthy indication of the freshness of the atmosphere, and he therefore urges that such records should be kept.