THURSDAY, JUNE 30, 1892.

## THE LONDON UNIVERSITY OF THE FUTURE.

AMONG the many points discussed in relation to the schemes for providing London with a University which have been under consideration during the last few years, scarcely any reference has been made to the higher teaching which ought to be at the disposal of the citizens of the most important and largest city in the world. Attention has been almost exclusively directed to the class teaching necessary to pass certain examinations which open the door to professional employment.

It is not necessary to enlarge upon this remarkable omission, although the reason for it is not far to seek, but we think it may be desirable, in order to show that such teaching is not Utopian, and that other nations freely provide what is so conspicuous by its absence in London, to give an indication of the quantity and quality of the teaching in the metropolis nearest our own.

The indications, to be exhaustive, would occupy several pages of NATURE, we must perforce content ourselves by giving the courses open to the citizens of Paris at the Sorbonne and the Collège de France.

The question does not concern science alone. We have not, therefore, limited ourselves to the scientific subjects; and it will be understood that, besides the undergraduate and graduate courses, there are special courses connected with the many other institutions in Paris allied either with the various professions directly, or with the national culture generally.

Among the former we may content ourselves at present with referring to the École Normal and the École Polytechnique; among the latter are the Museums of Natural History, of Physical Science, of Antiquities, Art and Archæology, each of these with lectures on the subjects which are illustrated by their contents.

We shall, if possible, take a subsequent opportunity of giving lists of these special courses, but the lectures at the University and College alone exhaust our space for this week. Comment on the breadth of the teaching and of the men to whom it is confided in Paris, and on the absence of anything approaching it here, is needless.

SORBONNE: FACULTY OF SCIENCES.

1892—*Second Scholastic Term.*

| Day | Hour | Subject | Professor |
|---|---|---|---|
| MONDAYS. | 8.30 | Differential and Integral Calculus: Ordinary Differential Equations and Equations with Derived Partials ... ... ... ... | Picard. |
| | 8.45 | Lectures on Geology: General ... | Vélain. |
| | 9 | Lectures on Chemistry: Manipulations for the Licentiate ... | Riban. |
| | 10 | Lectures in Natural Science ... | Chatin. |
| | 10.30 | Calculus of Probabilities: Mathematical Theory of Hydrodynamic Vortices and Application to Electrodynamics ... ... | Poincaré. |
| | 11 | Lectures on Chemistry: Theoretical and Practical Qualitative Analysis ... ... ... | Riban. |
| | 1.30 | Lectures on Physical Sciences: Thermodynamics ... ... | Pellat. |
| | 2.45 | Mineralogy and Crystallography: Principal Mineral Species ... | Hautefeuille. |
| | 3 | Lectures on Mathematical Sciences ... ... ... ... | Puiseux. |
| | 5 | Lectures on Chemistry ... ... | Joly. |
| TUESDAYS. | 8.30 | Astronomy: Programme for the Licentiate's Degree ... ... | Wolf. |
| | 8.30 | Lectures on Natural Sciences: Botany ... ... ... ... | Vesque. |
| | 8.30 | Lectures on Mineralogy ... ... | Jannettaz. |
| | 9 | Lectures on Natural Sciences: Identification of Rocks, &c. ... | Vélain. |
| | 10 | Mechanics and Experimental Physics: Properties of Elastic Solids, &c. ... ... ... ... | Boussinesq. |
| | 10 | Histology: General Character of Elementary Anatomy; Nervous and Muscular Tissue from an Histological Point of View: Zoology ... ... ... ... | Chatin. |
| | 10.30 | Lectures on Chemistry ... ... | Joly. |
| | 2 | Physics: Electricity ... ... | Lippmann. |
| | 2 | Lectures on Mathematical Sciences: Differential and Integral Calculus ... ... ... | Kaffy. |
| | 3 | Do. do. do. do. | Kaffy. |
| | 3.30 | Zoology, Anatomy, Physiology: Zoophites, &c. ... ... ... | Delage. |
| | 3.30 | Course on Spectroscopy and Photographic Chemistry ... ... | Salet. |
| WEDNESDAYS. | 8.30 | Mechanics. Dynamics of Systems | Appell. |
| | 8.45 | Lectures on General Geology ... | Velain. |
| | 9 | Lectures on Chemistry: Manipulations for the Licentiate ... | Riban. |
| | 10.15 | Higher Algebra: Theory of Euler's Integrals and Functions of a Variable ... ... ... | Hermite. |
| | 1.30 | Organic Chemistry: Compounds of the Aromatic Series ... ... | Friedel. |
| | 2 | Lectures on Mathematical Sciences | Blutel. |
| | 3 | Geology: Principal Characters of Geological Periods; Geological Formations ... ... ... | Munier-Chalma |
| | 3 | Lectures on Mechanics and Astronomy ... ... ... ... | Puiseux. |
| | 3.45 | Analytical Chemistry: Determination and Separation of Metals... | Riban. |
| | 4 | Lectures on Physical Sciences: Questions on the Subjects of Prof. Lippmann's Cours ... | Foussereau. |
| THURSDAYS. | 8.30 | Lectures on Physical Sciences. Thermodynamics ... ... | Pellat. |
| | 8.30 | Differential and Integral Calculus, &c. ... ... ... ... | Picard. |
| | 9 | Lectures on Natural Science: Identification of Rocks and the Principal Characteristic Fossils ... ... ... ... | Velain. |
| | 9 | Lectures on Chemistry: Manipulations for the Licentiate ... | Riban. |
| | 10 | Lectures on Natural Science ... | Chatin. |
| | 10.30 | Calculus of Probabilities and Mathematical Physics: Theory of Vortices. Hydrodynamics: Application to Electrodynamics | Poincaré. |
| | 1 | Chemistry Lectures and Manipulations for Professors of Colleges ... ... ... ... | Riban. |
| | 1.30 | Lectures on Physical Sciences: Reflection and Refraction of Light ... ... ... ... | Foussereau. |
| | 1.30 | Lectures on Mathematical Sciences as a Whole ... ... ... | Kœnigs. |
| | 2.30 | Do. do. do. do. | Kœnigs. |
| | 2.45 | Mineralogy and Crystallography, &c. ... ... ... ... | Hautefeuille. |
| | 4 | Lectures on Physical Sciences ... | Pellat. |
| | 5 | Lectures on Chemical Sciences ... | Joly. |

| Day | Hour | Subject | Professor |
|---|---|---|---|
| FRIDAYS. | 8.30 | Lectures on Physics ... ... | Pellat. |
| | 8.30 | Mechanics: Dynamics of Systems | Appell. |
| | 8.30 | Lectures on Botany ... ... | Vesque. |
| | 9 | Lectures on Chemistry and Manipulations for the Licentiate ... | Riban. |
| | 9 | Lectures on Geology: Identification of Rocks and the Principal Characteristic Fossils ... ... | Velain. |
| | 10 | Mechanical and Experimental Physics, &c. ... ... ... | Boussinesq. |
| | 10.30 | Organic Chemistry: Compounds of the Aromatic Series ... ... | Friedel. |
| | 1 | Lectures on Chemistry and Manipulations... ... ... ... | Riban. |
| | 3 | Lectures on Mathematical Sciences: Differential Calculus ... ... | Kaffy. |
| | 3 | Geology: Geological Periods; Secondary Formations ... ... | Munier-Chalma. |
| | 4 | Lectures on Physical Sciences: Subjects of Prof. Lippmann's Course ... ... ... ... | Foussereau. |
| | 5.30 | Lectures in Mathematical Sciences | Kaffy. |
| SATURDAYS. | 8.30 | Astronomy: Programme for the Licentiate ... ... ... | Wolf. |
| | 8.30 | Lectures on Mineralogy ... ... | Jannettaz. |
| | 10.15 | Higher Algebra: Euler's Integrals, &c. ... ... ... ... | Hermite. |
| | 10.30 | Lectures on Chemistry ... ... | Joly. |
| | 2 | Physics: Electricity ... ... | Lippmann. |
| | 3 | Lectures on Mathematical Sciences: Mechanics and Astronomy ... | Puiseux. |
| | 3.30 | Zoology, Anatomy, Comparative Physiology ... ... ... | Delage. |
| | 3.30 | Lectures on Organic Chemistry ... | Salet. |

FACULTY OF LETTERS. 1892—*Second Term.*

| Day | Hour | Subject | Professor |
|---|---|---|---|
| MONDAYS. | 9.30 | Lectures on French Literature ... | Gazier. |
| | 11 | Complementary Course in English Language and Literature ... | Beljame. |
| | 1.15 | Pedagogy Lectures (Historical Sciences), General Contemporaneous History ... ... ... | Seignobos. |
| | 1.30 | History of Ancient Philosophy: Moral and Political Doctrines of Aristotle ... ... ... ... | Waddington. |
| | 1.30 | Lectures on French Literature ... | Gazier. |
| | 1.30 | Lectures on German Language and Literature: History of the German Language ... ... ... | Lange. |
| | 1.30 | Lectures on Latin Language and Literature ... ... ... | Lafaye. |
| | 2 | History Lectures: General History of the Seventeenth and Eighteenth Centuries ... ... | Zeller. |
| | 2.30 | French Literature of the Middle Ages: History of the French Language: History of Literature in France in the Fourteenth Century. Froissart... ... ... | Julleville. |
| | 3 | Latin Language and Literature ... | Lafaye. |
| | 3 | Greek Eloquence: Greek Moralist Writers ... ... ... ... | Croiset. |
| | 3 | Foreign Literature: Æsthetic and Moral Literature of Goethe; General Character of Faust ... | Lichtenberger. |
| | 3 | Modern History: History of Legislation from the Sixteenth to the Eighteenth Centuries ... | Lemonnier. |
| | 3.30 | Literature of Southern Europe: Cervantes's Works ... .. | Gebhart. |
| | 4 | History of Philosophy: Modern Texts ... ... ... ... | Boutroux. |
| | 4 | Modern History: Practical Exercises | Lemonnier. |
| | 4.15 | Modern and Contemporaneous History: History of Russia in the Sixteenth Century ... ... | Rambaud. |
| | 5 | History of Modern Philosophy: Texts ... ... ... ... | Boutroux. |
| TUESDAYS. | 9 | French Literature: Practical Exercises ... ... ... ... | Larroumet. |
| | 8.45 | Ancient History: Commentary on a Text ... ... ... ... | Bouché Leclercq. |
| | 9 | Sanskrit, and Comparative Grammar of the Indo-European Languages, &c. ... ... ... | Henry. |
| | 9.45 | Ancient History: Greek and Roman Institutions ... ... | Bouché Leclercq. |
| | 10 | History of Ancient Philosophy ... | Waddington. |
| | 10-11 | Latin Poetry: Practical Exercises | Cartault. |
| | 10.15 | French Poetry: Explanation of one of the Authors from the Licentiate and Fellowship Programme ... ... ... ... | Lenient. |
| | 10.30 | History: Practical Exercises ... | Zeller. |
| | 1.30 | Discourses on Contemporaneous Philosophy ... ... .. | Janet. |
| | 1.45 | Ancient History: History of the Roman Empire from the Time of Nero ... ... ... ... | Guiraud. |
| | 2 | Letters of Southern Europe: Dante ... ... ... ... | Gebhart. |
| | 2 | Greek Language and Literature... | Hauvette. |
| | 3 | Geography: History of the Exploration of America since Columbus, &c. ... ... ... | Himly. |
| | 3 | French Literature: Practical Exercises ... .. ... ... | Larroumet. |
| | 3.15 | Latin Language and Literature: History of Latin Literature ... | Lafaye. |
| | 4.15 | Greek Language and Literature... | Hauvette. |
| | 4.45 | History of Philosophy: Systems of Spinoza and Malebranche ... | Brochard. |
| WEDNESDAYS. | 9 | French Eloquence... ... ... | Crouslé. |
| | 9.15 | Pedagogy (Historical Sciences) ... | Seignobos. |
| | 9.30 | Sanskrit: Relations of India with the West... ... ... ... | Levi. |
| | 10 | Archæology: History of Vase-painting in Greece ... ... | Collignon. |
| | 10.30 | Philosophy ... ... ... ... | Janet. |
| | 11 | Archæology: Practical Exercises in Archæology ... ... .. | Collignon. |
| | 1 | Latin Eloquence: on Roman Eloquence under the Republic ... | Martha. |
| | 1.30 | Ancient History ... ... ... | Guiraud. |
| | 1.30 | French Literature: French Literature in the Seventeenth Century | Gazier. |
| | 1.30 | Mental Philosophy ... ... | Seailles. |
| | 2.15 | History of French Colonization and Beginning of the French Restoration ... ... ... | Pigeonneau. |
| | 2.30 | Ancient History: Practical Exercises ... ... ... ... | Guiraud. |
| | 2.30 | Philosophy ... ... ... ... | Seailles. |
| | 2.45 | Philology and Metre: Written and Oral Exercises on Metre ... | Havet. |
| | 3.30 | History of the French Revolution: History of the National Constitution ... ... ... ... | Aulard. |
| | 3.30 | Sanskrit, and Comparative Grammar of the Indo-European Languages ... ... ... ... | Henry. |
| | 4 | History: Practical Exercises ... | Pigeonneau |
| | 4 | Greek Poetry: Lyric Element of Greek Tragedy ... ... ... | Decharme |
| | 4.45 | History of Modern Philosophy: Idea of Natural Law, &c. ... | Boutroux. |
| | 5 | Sanskrit, and Comparative Grammar of the Indo-European Languages ... ... ... ... | Henry. |
| | 5 | English Language and Literature | Baret. |

| Day | Hour | Subject | Professor |
|---|---|---|---|
| THURSDAYS. | 8.30 | History of the French Revolution: Exercises... ... ... ... | Aulard. |
| | 9 | Greek Literature and Institutions: Correction of Greek Themes, &c. | Girard. |
| | 9.30 | History of the French Revolution: Explanation of Titles ... | Aulard. |
| | 9.30 | Lectures on the History of Philosophy: Practical Exercises ... | Brochard. |
| | 10 | Latin Poetry: Passages from Lucretius... ... ... ... | Cartault. |
| | 10 | Lectures on English Language and Literature: Practical Exercises | Baret. |
| | 10.15 | Lectures on Greek Literature and History: Explanation of the Authors in the Programme ... | Girard. |
| | 10.30 | Lectures on the History of Philosophy ... ... ... ... | Brochard. |
| | 10.45 | History Lectures: Bassoinpierre's Memoirs ... ... ... ... | Zeller. |
| | 1 | English Language and Literature: Shakespeare—French Literature | Beljame. |
| | 1.30 | Lectures on German Language and Literature: Correction of Themes and Dissertations ... | Lange. |
| | 2 | French Poetry: Patriotic Poetry in France since the 16th Century | Lenient. |
| | 2 | English Language and Literature: Othello ... ... ... ... | Beljame. |
| | 2 | Roman Philology: First Chapters of Dante's Inferno ... ... | Thomas. |
| | 3 | Foreign Literature: Preparation for the Examination in German | Lichtenberger. |
| | 3 | Modern History: Relation of French Art to Institutions, &c. | Lemonnier. |
| | 3.30 | French Literature of the Middle Ages ... ... ... ... | Julleville. |
| | 4 | Foreign Literature: Preparation for the Examination in German | Lichtenberger. |
| | 4.15 | Geography: History of the Exploration of America since Columbus ... ... ... | Himly. |
| FRIDAYS. | 9 | Course of Roman Philology: Explanation of Texts with French, &c. | Thomas. |
| | 9 | Complementary Course: Auxiliary Sciences—on the History of Latin Literature ... ... | Langlois. |
| | 9.15 | Latin Eloquence: Explanation of Latin Authors ... ... ... | Martha. |
| | 9.30 | Complementary Course in Sanskrit: Explanation of Elementary Texts ... ... ... | S. Levi. |
| | 10 | Complementary Course in Philology and Metre: on Metre ... | Havet. |
| | 10 | Complementary Course of Roman Philology: History of the Literature ... ... ... | Thomas. |
| | 10.15 | Lectures on Pedagogy: Theory of History Teaching ... ... | Seignobos. |
| | 1 | Lectures on Greek Language and Literature: History of Greek Literature ... ... ... | Hauvette. |
| | 2.30 | Greek Poetry: Explanation of Texts, and Practical Exercises | Decharme. |
| | 2.30 | History of the Middle Ages: on French Ecclesiastical Institutions | Luchaire. |
| | 3.30 | Practical Exercises in History ... | Luchaire. |
| | 3 30 | Ancient History: History of Rome from Scylla to Cæsar ... ... | Bouché Leclercq |
| | 3.30 | Greek Poetry: Explanation of Texts, and Practical Exercises | Decharme. |
| | 4 | Modern and Contemporaneous History: History of the Hindus under Queen Victoria ... | Rambaud. |
| | 4.15 | French Literature (Complementary Course): History of French Literature in the 18th Century | Larroumet. |
| | 4.45 | Lectures on Geography: Text of the Programme ... ... ... | Dubois. |

| Day | Hour | Subject | Professor |
|---|---|---|---|
| SATURDAYS. | 9 | Greek Eloquence: Explanation of Greek Texts and Letters, &c. ... | Croiset. |
| | 9 | Complementary Course: Auxiliary Sciences—on the History of Palæography ... ... ... | Langlois. |
| | 10 | Complementary Course in Literature: on the Archæology of the Middle Ages ... ... ... | Langlois. |
| | 10.15 | French Eloquence: French Writers of Prose in the Nineteenth Century ... ... ... ... | Croiset. |
| | 10.15 | Lectures on Greek Literature and History: History of Greek Poetry since the Fifth Century | Girard. |
| | 1.30 | Greek Eloquence: Practical Exercises ... ... ... ... | Crouslé. |
| | 1.30 | Lectures on German Language and Literature ... ... ... | Lange. |
| | 1.30 | Lectures on Philosophy ... ... | Seailles. |
| | 2 | Lectures on Geography: Various Questions in General Geography ... ... ... ... | Dubois. |
| | 3 | Latin Poetry: Lucretius and Latin Poetry during the Ciceronian Epoch ... ... ... ... | Cartault. |
| | 3 | Archæology: Sculpture in Greece to the Fifth Century ... ... | Collignon. |
| | 3 | Lectures on Geography: Practical Exercises ... ... ... | Dubois. |
| | 4 | History: History of the Doctrine of Economics during the first part of the Nineteenth Century ... | Pigeonneau. |

## COLLÈGE DE FRANCE.

1892—*Second Term.*

| Day | Hour | Subject | Professor |
|---|---|---|---|
| MONDAYS. | 9 | Modern Philosophy: concerning the Soul ... ... ... ... | Nourrisson. |
| | 9 | Natural History of Inorganic Bodies ... ... ... ... | Fouqué. |
| | 10 | Language and Literature of the Arabs: Moallakat and Divans of Six Poets ... .. ... | B. de Meynard. |
| | 10.15 | Æsthetics and History of Art: History of Italian Art under Pius II. ... ... ... ... | Lafenestre. |
| | 10.15 | Celtic Languages and Literature: Ancient and Middle Irish Texts | H. d'Arbois de Jubainville. |
| | 10.30 | Organic Chemistry: on Organic Synthesis and Hydrocarbons ... | Berthelot. |
| | 11.15 | Comparative Grammar: Theory of the Verb in Indo-European Languages ... ... ... | Bréal. |
| | 12.30 | Egyptian Philology and Archæology: Pyramid Texts ... ... | Maspero. |
| | 1.30 | History of Latin Literature: History of the Latin Theatre ... | Boissier. |
| | 2.30 | Greek Epigraphy and Antiquities: Athenian Constitution of Aristotle ... ... ... ... | Foucart. |
| | 3 | History of Religion: History of Judaism during the last Four Centuries of the Christian Era | Réville. |
| | 3.15 | Experimental and Comparative Psychology: Will, Heredity, Perception ... ... ... | Ribot. |
| | 3.30 | Semitic Epigraphy and Antiquities, with Epigraphic Texts ... ... | Clermont-Ganneau. |
| | 4.45 | Latin Philology: on the Prosody of Vowels in the Latin Language ... ... ... ... | Havet. |

| Day | Hour | Subject | Professor |
|---|---|---|---|
| TUESDAYS. | 9 | History of Latin Literature ... | Boissier. |
| | 10 | Assyrian Philology and Archæology: Deciphering of the Assyrian Characters ... ... | Oppert. |
| | 10.30 | General and Experimental Physics: on the Optics of the Atmosphere ... ... ... ... | Mascart. |
| | 1 | Greek and Latin Philosophy: Epicurean Doctrine ... ... | Lévêque. |
| | 1 | Languages and Literatures of Slavonic Origin ... ... ... | Leger. |
| | 1 | Analytical and Celestial Mechanics: Applications, &c. ... | Kœnigs. |
| | 1.30 | General History of Science: Advent of Grecian Geometry: Abstract Science ... ... ... | P. Lafitte. |
| | 2 | History of Comparative Legislation: Political Writings of J. de Maistre ... ... ... | J. Flach. |
| | 2 | Geography: Economic Statistics and History: on French Colonization ... ... ... ... | Levasseur. |
| | 3 | Robert Browning's Poems ... | Guizot. |
| | 3.15 | Political Economy: John Stuart Mill: Principles of Political Economy... ... ... ... | Leroy-Beaulieu. |
| WEDNESDAYS. | 10 | French Language and Literature of the Middle Age: Life of St. Alexis ... ... ... ... | G. Paris. |
| | 11.15 | Language and Literature of Southern Europe ... ... | Meyer. |
| | 12.30 | Grecian Language and Literature: Sophocles ... ... ... | Rossignol. |
| | 12.30 | Egyptian Philology and Archæology: History of Egyptian Feudalism ... ... ... | Maspero. |
| | 1 | General Physics and Mathematics: Mechanical Properties of Electric Currents ... ... ... | Deprez. |
| | 1.30 | Mineralogical Chemistry: Chemical Analysis and History of the Metals ... ... ... | Schützenberger. |
| | 2 | Hebrew Language and Literature: Chaldean and Syrian Languages and Literatures ... ... ... | E. Renan. |
| | 2 | Comparative Embryology: Physiological *rôle* of the Cellular Nucleus ... ... ... ... | Balbiani. |
| | 2 | Modern French Language and Literature: French Romantic School ... ... ... ... | Deschanel. |
| | 3 | Sanscrit Language and Literature: Extracts from Mahâbhârata ... | Foucaux. |
| | 3.30 | Semitic Epigraphy and Antiquities: Hebrew Inscriptions of Jerusalem ... ... ... ... | Clermont-Ganneau. |
| | 3.30 | Natural History of Organic Bodies | F. Franck. |
| | 4.30 | Medicine: on the Muscle, and Animal Thermodynamics ... | D'Arsonval. |
| | 5 | General Anatomy: on the Vascular System ... .. ... | Ranvier. |
| THURSDAYS. | 9 | History and Morals ... ... | Longnon. |
| | 9 | Natural History of Inorganic Bodies: Work of Richthofen on the Geology of China ... ... | Fouqué. |
| | 10 | Assyrian Philology and Archæology ... ... ... ... | Oppert. |
| | 10.15 | Æsthetics and History of Art: History of Italian Art under Peter II.... ... ... ... | Lafenestre. |
| | 11.30 | Language and Literature of Southern Europe: Roman de Jaufré ... ... ... ... | Meyer. |
| | 12.45 | Mathematics: Principles of the Infinitesimal Calculus ... ... | Jordan. |
| | 1 | Roman Epigraphy and Antiquities | Cagnat. |

| Day | Hour | Subject | Professor |
|---|---|---|---|
| THURSDAYS (*cont.*) | 2.15 | Russian History from Catherine II. to Alexander I. ... ... | Leger. |
| | 3 | Chinese Language and Literature: Tartar and Manchu Language and Literature ... ... ... | [Denis. D'Hervey de St. |
| | 3 | History of Religion: History of Judaism during the last Four Centuries ... ... ... | Réville. |
| | 3.15 | Experimental and Comparative Physiology ... ... ... | Ribot. |
| FRIDAYS. | 10 | Arabic Language and Literature: | Barbier de Meynard. |
| | 10.15 | Celtic Language and Literature ... | H. d'Arbois de Jubainville. |
| | 10.30 | Organic Chemistry: Hydrocarbons in particular ... ... ... | Berthelot. |
| | 11.15 | Comparative Grammar: Theory of the Verb in Indo-European Languages ... ... ... | Bréal. |
| | 12.30 | Greek Language and Literature: Sophocles... ... ... ... | Rossignol. |
| | 12.30 | Works of Robert Browning ... | Guizot. |
| | 1 | Greek and Latin Philosophy: Doctrines of Epicurus ... ... | Lévêque. |
| | 1 | Analytical and Celestial Mechanics, Geometrical and Mechanical Applications ... ... | Kœnigs. |
| | 12.45 | Roman Epigraphy and Antiquities: French and Foreign Inscriptions ... ... ... | Cagnat. |
| | 1.45 | Greek Epigraphy and Antiquities: Mysteries of Eleusis ... ... | Foucart. |
| | 2 | History of Comparative Legislation: Landed Property in England and France since the Eighteenth Century ... ... | Flach. |
| | 2 | Persian Language and Literature: Relation between the Pehlvi and Persian ... ... ... | Darmesteter. |
| | 2 | Geography: Economic History and Statistics (Algeria, Colonies) | Levasseur. |
| | 3.15 | Political Economy: on Public Revenues and Imports ... | Leroy-Beaulieu. |
| | 3.30 | Natural History of Organic Bodies ... ... ... ... | Franck. |
| | 4.30 | Medicine: Animal Muscle and Thermodynamics ... ... | D'Arsonval. |
| | 5 | General Anatomy: on the Vascular System ... ... ... | Ranvier. |
| SATURDAYS. | 9 | Modern Philosophy: Spinoza ... | Nourrisson. |
| | 10 | French Language and Literature of the Middle Ages: Life of St. Alexis ... ... ... | G. Paris. |
| | 10.30 | Experimental and General Physics: Optics of the Atmosphere ... | Mascart. |
| | 12.45 | Mathematics: Principles of the Infinitesimal Calculus ... ... | Jordan. |
| | 1 | Mathematics and General Physics: Electric Currents ... ... | Marcel Deprez. |
| | 1 | French Language and Literature: Principal Writers ... ... | Deschanel. |
| | 1.30 | Mineralogical Chemistry: Analytical Chemistry and History of the Metals ... ... ... | Schützenberger. |
| | 2 | Persian Language and Literature: Relation between the Pehlvi and Persian ... ... ... | Darmesteter. |
| | 2 | Comparative Embryology ... | Balbiani. |
| | 2 | General History of the Sciences... | P. Lafitte. |
| | 3 | Chinese Language and Literature: Tartar and Manchu Language and Literature ... ... ... | [Denis. D'Hervey de St. |
| | 2.30 | Hebrew, Chaldean, and Syrian Languages and Literatures ... | E. Renan. |
| | 3 | Sanskrit Language and Literature: Lalila Vistara (Life of Buddha) | Foucaux. |
| | 4.45 | Latin Philology: Palæography of the Latin Classics ... ... | Havet. |

## ENGLISH BOTANY.

*English Botany*, Supplement to the Third Edition. Part I. (Orders I.-XXII.). Compiled and Illustrated by N. E. Brown, of the Royal Herbarium, Kew. Pp. 56, viii., 6 Plates. (London: Bell and Sons, 1891 [1892].)

THE third edition of "English Botany" was begun just thirty years since by Dr. Boswell (then Syme), and continued at somewhat uncertain intervals, the flowering plants being completed in 1872. The ferns followed at a later period, and the volume containing them was completed by Mr. N. E. Brown, owing to the failure of Dr. Boswell's health.

Although styled a third edition, Dr. Boswell's work was, as everyone knows, a thoroughly new book. It was the production of one who knew plants in the field as well as in the herbarium, and who had a firm hold of his subject. Mr. J. G. Baker, who speaks with authority in matters of this kind, says:—

"It is not alone the fulness and accuracy of the descriptions that make the book so valuable, but the power he shows in grasping the relationship of the types, and the acute sense of proportion shown in their arrangement. . . . I never cease, when I use the book, to admire the skill which is shown in dividing out the types into species, sub-species, and varieties—a task that was done so thoroughly well that when Sir J. D. Hooker, with all his wide experience, went over the same ground shortly after, in his 'Student's Flora,' he found extremely little to change."[1]

The book, indeed, had defects, among which may be mentioned the "popular portion" and the bad colouring of the plates, but for these Dr. Boswell was not responsible: and although the history of our British flora may seem to some to have received less attention than it merited, the author's work well deserves the high praise which Mr. Baker bestowed upon it.

The first part of the "Supplement," now before us, is the work of Mr. N. E. Brown. Mr. Brown has long been recognized as an authority upon certain difficult groups of plants. He has probably a greater knowledge of the *Stapelieæ*, for instance, than any man living; he has done much good work among the *Aroideæ*; and his many years' employment in the Kew Herbarium has been productive of other valuable contributions to systematic botany. He is careful and painstaking, and a fair draughtsman. Yet with all these qualifications he is not the man to whom the "Supplement to English Botany" should have been entrusted. Such a task could only be carried out satisfactorily by one whose knowledge of British plants was based upon an acquaintance with them in the field as well as in the herbarium, and Mr. Brown's name does not occur to us in this connection.

There was, as it seems to us, one way, and only one, in which a "Supplement to English Botany" could have been done satisfactorily. During the last thirty years our flora has received many additions of *bonâ fide* types; these should, of course, have been figured and described. Having regard to the execution of the third edition, the novelties in certain critical genera—such as *Rubus* and *Hieracium*—might have found a place; although the correlation of English with continental forms which is still proceeding in the former genus, and the (too slow) publication of Mr. F. J. Hanbury's monograph in the latter, would have justified their partial if not entire exclusion. But the attempt to put into the old bottles the new wine of recent research could only result, as it has resulted, in failure. The Batrachian Ranunculi, for instance, may not have been treated satisfactorily by Dr. Boswell; and Mr. Brown perhaps does well to reproduce a subsequent note by that author modifying his views. But the treatment as it stood was a consistent piece of work—the expression of the opinion of one man. Mr. Brown endeavours to fit Mr. Hiern's well-known paper on these plants into Dr. Boswell's original descriptions—a Procrustean undertaking, and one which, in our judgment, is entirely valueless, representing as it does neither Dr. Boswell's, Mr. Hiern's, nor any other consistent view about these troublesome plants. Mr. Brown's style is so terribly involved that it is often very difficult to ascertain what he means; and he would have been far wiser had he left the Batrachian buttercups alone.

For his rearrangement of *Thalictrum* he made "a careful examination of all the material at [his] disposal." It will hardly be believed that neither in this nor in any other instance has he taken the trouble to consult Dr. Boswell's own herbarium, although this, as Mr. Brown must know, is readily accessible to all London botanists. The craze—we can use no milder term—for burdening our lists with varietal names on the most trivial pretexts receives Mr. Brown's support: he resuscitates Pritzel's names for the bluish and reddish-flowered forms of *Anemone nemorosa* (identifying the former with the *A. Robinsoniana* of gardens), although he adds that they are "mere colour forms," with "numerous intermediate shades." Mr. Melvill's name is attached to a "var. *rosea*" of *Silene gallica*, although he did not rank it as such, but referred to it as a "form merging by every gradation into" *quinquevulnera*; and Mr. Brown enriches our nomenclature with a new name—"*Silene anglica* var. *maculata*, N.E. Br."

Speaking of Mr. Pryor's var. *oleracea* of *Silene Cucubalus*, Mr. Brown says:—

"If the plant intended is the same as *S. inflata* var. *oleracea*, Ficinus, 'Flora der Gegend um Dresden,' ed. 2, vol. i. p. 313 (1821), which is figured in Reichenbach, Icones Fl. Germ. et Helvet., vol. vi. pl. 300, f. 5120 γ, it is," &c.

Now, Mr. Pryor appends to his varietal name a reference to "Bor. Fl. Centr., ed. iii., ii., 95," and Boreau cites Reichenbach's t. 300 for his plant. How, then, can there be any question as to the plant "intended"? If Mr. Brown means to say that he is doubtful as to the accuracy of Mr. Pryor's identification, that is, of course, another matter.

Prof. L. H. Bailey lately spoke with deserved severity of certain "authors of local floras" as obtaining "a cheap notoriety by making new combinations" in nomenclature; and no one can glance through this "Supplement," or refer to the pages wasted in discussing the nomenclature of *Corydalis* and *Spergularia*, without applying his remarks, to the compiler thereof.

Much space is also taken up, and in our opinion wasted by the relegation of species to other genera than those in which they were placed by Dr. Boswell. The following

[1] *Journal of Botany*, 1888, p. 83.

note on "*Lychnis alba*, Mill.," is an illustration of this, and will serve at the same time as an example of Mr. Brown's style :—

"This is the *Silene pratensis* of vol. ii. p. 67, but, together with *S. diurna* of p. 69, should be referred to the genus *Lychnis*, where they properly belong ; *S. diurna* being *Lychnis dioica*, Linn. ; this name has been objected to on the ground that Linnæus included *L. alba* as a variety of *L. dioica*, which objection is untenable as it appears to me ; still, if Linnæus's name is rejected, then *L. diœcia*, Miller ('Gardener's Dictionary,' ed. 8, No. 3, errata, 1768), must take precedence over *L. diurna*, Sibthorp ('Flora Oxoniensis,' p. 145, 1794)."

Here is another example :—

"*Geranium striatum*, Linn. This plant was first published by Linnæus as *Geranium versicolor* in his 'Centuria I. Plantarum,' p. 21 (1755) ; but in 1759, when this same Centuria was republished in his 'Amœnitates Academicæ,' vol. iv., he altered the name to *G. striatum*, p. 282, which name was retained by Linnæus in all his later works, so that in all probability Linnæus regarded the name *G. versicolor* as a clerical error, which appears to me a consistent view to take of the case, the more so as it is also probable that the original Centurias were only printed for a restricted, or possibly private, distribution."

It is evident, in spite of all its defects, that Mr. Brown has lavished—we do not like to use a stronger expression—a great deal of time and trouble over this "Supplement." A less careful worker, indeed, might easily have produced a better book ; for the trivial corrections and emendations, the questions of synonymy, the minute criticisms, and the unnecessary additions, would not have been put forward by any save the most conscientious of writers. There is an appendix of "additions and corrections," occupying an eighth of the whole, but, at any rate so far as "corrections" are concerned, far from exhaustive. And yet, with all this elaboration, the book is not as complete as it should be. The remarkable *Sagina* described in 1887 by Dr. F. Buchanan White as *S. Boydii* is not figured, and Mr. Brown has not even seen a specimen of the plant. Mr. Boyd has had it in cultivation for several years, and would, we doubt not, have supplied examples ; and it is not easy to understand why Mr. Brown omitted to make himself acquainted with this very striking form. The plates are mostly poor : to one there is no reference in the letterpress ; another is wrongly numbered.

Since the foregoing was written, the second part of the "Supplement" has appeared. It is mainly occupied with the Rose and Brambles, concerning which Mr. Brown says, "I express no opinion, as I have never made any attempt whatever to study them." This is commendably candid, but adds materially to the difficulty of understanding why Mr. Brown was selected for the work, while it deprives the compilation of value. JAMES BRITTEN.

## *A BACTERIOLOGICAL HAND-BOOK.*

*Bacteriologisches Practicum zur Einführung in die practischwichtigen bacteriologischen Untersuchungsmethoden für Aerzte, Apotheker, Studirende.* By Dr. W. Migula. (Karlsruhe : Otto Nemnich, 1892.)

ALTHOUGH a knowledge of bacteriological methods is essential not only to those who seriously take up the study of bacteria, but also to many who, like the candidates for the diploma of public health, take but a compulsory glance at bacteriology, yet the supply of manuals describing the details of bacteriological practice is remarkably meagre.

Dr. Migula's little book should, therefore, prove very welcome to the bacteriological student, for it does not aspire to be an exhaustive work on bacteria in general, the list of which is receiving constant additions, but aims at describing simply and carefully in a handy form the principal methods of working with micro-organisms.

A number of varieties are more or less elaborately given, but the main idea has been to seek out characteristic forms which are intended to serve as types to illustrate the various points dealt with in the treatment of bacteria.

All the stages in the laboratory life-history of a micro-organism are elaborately entered into, and special chapters are devoted to the formation and staining of spores, and also to the nature of the flagella and most improved methods of exhibiting them in microscopic preparations. The latter are beautifully displayed in a photograph, showing the numerous flagella attached to the typhoid bacilli. The preparation of the various culture-media is described very minutely, and there are many useful laboratory hints and it is the more surprising, therefore, to find the method of sterilizing milk without altering its chemical composition omitted. This mode of preparing milk is naturally of importance in any inquiry as to the vitality of pathogenic micro-organisms in this medium. Again, the plan of cultivating bacteria on potatoes in tubes is not given, although it presents many decided advantages over the "dish method."

Dr. Migula repeatedly insists upon the necessity of unremitting care in carrying out all bacteriological operations to prevent the access of contamination either from the air or by contact with unsterilized or imperfectly sterilized objects. Such precautions are naturally of the utmost importance, but possibly it is unnecessary to warn students against contaminating their platinum needle through testing its temperature after heating by placing it to their lips. Such a proceeding, if ever attempted, would certainly not be quickly repeated !

But there is one piece of advice upon which the author lays great stress, and which in our opinion is not only unnecessary, but a constant menace to success. On almost every page, in one capacity or another, we find the use of corrosive sublimate most strongly recommended as a means of assisting sterilization and of affording additional protection from external contamination. It cannot be impressed strongly enough upon the student that he must depend for the success of his cultivations, not on the use of *antiseptics*, but by working on strictly *aseptic* principles, through the most conscientious devotion to every detail and precaution with which he is acquainted. The fear of contamination must ever appear to him as threatening as the "sword of Damocles," which will descend with unerring certainty as soon as the least evidence of relaxation is visible. Not only is the use of corrosive sublimate demoralizing, then, but on account of its very germicidal properties, unless handled with the utmost care, will prove a positive danger, destroying where it is least expected or wanted. This opinion is unfortunately the result of experience and not of mere imagination.

The examination of water is given *in extenso*, but there is no mention, when discussing the presence of typhoid bacilli in water, of the latest methods for their detection amongst other micro-organisms contained in natural waters.

The investigation of air for micro-organisms is entirely left out, an omission which renders the book less complete than it would otherwise appear to be.

But there is a great deal of instruction, together with many valuable hints, contained in the comparatively short space of 200 pages; and whilst, interspersed in the text, wood-cuts serve to supplement some of the descriptions of apparatus, it also boasts some very good photographs from original preparations of the *Staphylococcus pyogènes citreus*, the *Streptococcus erysipelatis*, the *Bacillus anthracis* with spores, the tuberculosis Bacillus, Koch's comma Spirillum, and others.

There is also appended a useful list of all the requisite appliances for bacteriological work.

GRACE C. FRANKLAND.

## OUR BOOK SHELF.

*Neue Rechnungsmethoden der Höheren Mathematik.* Von Dr. Julius Bergbohm. (Stuttgart: Selbstverlag des Verfassers, 1892.)

*Neue Integrationsmethoden auf Grund der Potenzial-, Logarithmal-, und Numeralrechnung.* (The same.)

THE first of these pamphlets contains an account of what the author calls the *Immensalrechnung*, the *Potenzialrechnung*, the *Radikalrechnung*, the *Logarithmalrechnung*, and the *Numeralrechnung*. In the *Immensalrechnung* an attempt is made to provide a calculus of the infinitely great (*das Immensal*), which shall form a complement to the differential calculus, or calculus of the infinitely small. The *Potenzialrechnung* contains an account of exponential functions in which the base is an infinitely small or an infinitely great quantity, and the exponent is infinitely small; and the *Radikalrechnung* an account of the inverse functions that are obtained from these by changing the exponent into its reciprocal. So, too, in the *Logarithmalrechnung*, logarithmic functions are considered in which the base and the argument are either infinitely small or infinitely great; and in the *Numeralrechnung* the inverse functions (antilogarithms or exponential functions) are discussed. The pamphlet is occupied, for the most part, with an exposition of the author's notation, a discussion of certain indeterminate forms, and a calculation of some algebraic functions containing an infinitely small argument, to a first, second, or third approximation. It is hardly possible to compliment the author on his accuracy, seeing that the statement occurs that Lt. $\log x$ is finite when $x$ is zero or infinity, the reason given being that Lt. $(x \log x)$ and Lt. $(\log x/x)$ are zero, for these values of $x$.

The second pamphlet begins with a *résumé* of some of the results of the first one; and then proceeds to discuss the application of these results to the evaluation of certain elementary integrals. The author's avowed object is to provide a method for the direct calculation of integrals, comparable with that now employed in differentiation, so that it may no longer be necessary to resort to the indirect methods of integration at present employed. It is impossible to deny that the object is a laudable one; but, to judge from the examples given in this pamphlet, it does not seem likely that the method will be of much use in the case of integrals of any degree of complexity. Dr. Bergbohm promises to supply us in the future with further examples of the application of his methods; but, until these have appeared, it is hardly possible to say that students of mathematics will find these pamphlets repay them for the trouble of reading them and of mastering the author's notation. R. E. A.

*An Elementary Course in Theory of Equations.* By C. H. Chapman, Ph.D. (New York: John Wiley and Sons, 1892.)

THIS is really an excellent little book, but is rather misnamed in being called an elementary treatise. The study of the theory of equations, although generally expanded far too considerably, is here dealt with in rather the reverse way, the treatment being somewhat too curt. For anyone beginning this subject the book would be found slightly difficult, but for a student who has already had a little experience in this direction, it should prove a very useful *vade mecum*, for the author has brought together in a few pages just those portions of the subject that are required in actual practice. The three sections treat respectively of determinants, algebraical equations, and the methods by which the real roots of numerical equations are computed, and they are each accompanied by numerous examples.

## 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.*]

### "The Grammar of Science."

IT is very idle as a rule to criticize a critic, especially when he happens, like C. G. K., to be the disciple of a school which the author of the criticized work is gently laughing at throughout his pages. But some of C. G. K.'s remarks might lead your readers to believe that the "Grammar of Science" is nonsense, even when looked at without the spectacles of the Edinburgh physical school, and his review may therefore justly call for a few words of reply.

Because C. G. K. found himself entirely unable to follow my argument as to the universality of scientific law, he was hardly justified in putting an antecedent before a consequent, and making nonsense of it. The universality of scientific law depends on the similarity of the perceptions and of the reflective faculties in normal civilized man. Why does this similarity exist? asks C. G. K.; and then turns for an answer to an antecedent in the argument—namely, that a condition of this universality is the similarity in those perceptions and reflective faculties. As a matter of fact in the "Grammar" itself, it is pointed out that a society of beings with different perceptions and reflective faculties could hardly survive in the struggle for existence with societies where there was an approach to similarity; that as soon as the divergence reaches a certain magnitude we lock up the individual as a madman or an idiot, or, in milder cases, bring great social pressure to bear upon him, and mould him to the ordinary standard.

"The laws of Nature are a mental product, yet a certain evolution theory logically based upon them quite eliminates the mental," writes C. G. K. of the "Grammar." Where he found this statement I know not, but what the "Grammar" itself states is: that the laws of evolution are themselves a mental product, a description in shorthand of the sense-impressions and stored sense-impresses of the mind at a given instant. They are a mental mode of briefly classifying sense-impressions, and not inherent in something behind sense-impressions themselves.

C. G. K. then quotes my statements as to Maxwell's descriptions of energy and matter. Now what the "Grammar" says is that Maxwell's statements are "extremely valuable as expressing concisely the nature of certain conceptual processes by aid of which we describe certain phases of our perceptual experience, but as defining matter they carry us no further than the statement that matter is that which moves," or indeed than Prof. Tait's statement that "matter is that which occupies space." The whole object of the investigation is to show that mass, but

*not* matter, is capable of definition. As Clerk Maxwell tells us that his statements contain all we *know* of matter and energy, it is clear that these are the only statements by way of *definition* which he conceives it advisable to give of them, and *they are all he does give.* I happened to be one of the unfortunate Cambridge students whose first notions of matter and force were obtained from the "Treatise on the Dynamics of a Particle," and it was therefore a relief to me when I met with Kirchhoff's "Mechanik" in 1876, and found the subjectivity of force clearly insisted on. That view of force was in the air of Berlin when I was a student there in 1879. Kirchhoff's services in this matter are referred to with special emphasis on p. 139 of the "Grammar." A perfectly consistent view of force and matter had been published by Mach in 1883. Why the fact that Prof. Tait put forward the "subjectivity of force" in a work of 1885 makes me therefore "a disciple of Prof. Tait," I fail to understand. This statement is the more astonishing, as Prof. Tait directly postulates the "objectivity of matter," but in the same work tells us that "matter is, as it were, the plaything of force." How subjective force can have an objective plaything, perhaps C. G. K. will inform us; but the statement clearly marks off the standpoint of the "Grammar" from that of Prof. Tait. Mass, according to the "Grammar," can only be defined as the ratio of mutual accelerations, and any attempt to connect it with the "quantity of matter" in a body is asserted to be unphilosophical. C. G. K. asks if a passage he quotes from Tait's "Properties of Matter" is not *essentially* the theory of "ether-squirts"? I reply *No*, the words "*constantly* swallows up an amount proportional to its mass," or "at a rate proportional to its mass," sufficing to exclude the mutually enforced flows of ether on which the "Grammarian" bases his applications of ether-squirts to chemical and cohesive actions (*American Journal of Mathematics*, vol. xiii., pp. 309-62). Had I ever read, or if read, recollected, Sir William Thomson's suggestion, it would have been referred to, and a reference to him will be introduced into later editions of the "Grammar."

C. G. K. very skilfully tries to turn off the "Grammarian's" criticism of the Edinburgh school by representing it as an attack on Newton. The words in the "Grammar" are: "Remembering these points we will now turn *to the version of the Newtonian laws given by Thomson and Tait*" (p. 381). Force, say our writers, is any cause that tends to alter a body's natural state of rest, or of uniform motion in a straight line; but force, says Prof. Tait, is *subjective*, and corresponds to nothing which exists outside ourselves. Surely it is a "veritable metaphysical somersault" to then assert that it can be "applied in a straight line"? I fail completely to see how the view that force is subjective is consonant with the definitions and laws put forward by Thomson and Tait, and asserted by them to be Newtonian. With regard to Newton's own statements, I openly declare that, with all admiration for his genius, I doubt the logical sequence and accuracy of many of his statements with regard to the philosophical basis of dynamics. Those who would bind down all time to his views on matter, force, and motion, are much like the geometricians who think it impious to cast out Euclid from school-teaching. Both Euclid and Newton have handed down to us in their pages discoveries which will always form a portion of man's intellectual heritage, but the method in which those discoveries are presented will vary from age to age with increasing clearness in man's conceptions of mental and physical processes.

Finally, C. G. K. remarks that my conclusions are "materialistic," by which term I suppose he means that he disagrees with them. As one of the chief objects of the "Grammar" is to cast the term *matter* forth from scientific language, it would have been more correct to say that my conclusions are "idealistic." I fear C. G. K. has a more supreme contempt than the majority of the countrymen of Reid and Hume for an accurate use of philosophical language. KARL PEARSON.

## Immunity of the African Negro from Yellow Fever.

THIS point, interesting to anthropologists, is raised anew by a writer on the history of epidemics (NATURE, June 16), who asks whether the alleged protection is supported by all recent authorities. Recent authorities are not so well placed for judging of this matter as the earlier; for the reason that immunity is not alleged except for the African negro of pure blood or unchanged racial characters, and that these conditions of the problem have been much less frequently satisfied in the yellow-fever harbours of the western hemisphere since the African slave trade ceased. However, there was a good opportunity in 1866, during the disastrous yellow fever among the French troops of the Mexican expedition when they lay at Vera Cruz. Among them was a regiment of Nubians, who had been enlisted for the expedition by permission of the Khedive: that regiment had not a single case of yellow fever all through the epidemic. The African negro regiment brought over from the French colonies of Martinique and Guadeloupe had two or three cases, with, I think, one death. The rest of the troops, including Frenchmen, Arabs from Algeria, native Mexicans and Creoles, had no immunity whatever, but, on the other hand, a most disastrous fatality. The medical officers of the French service have recorded the facts principally in the *Archives de Médecine Navale*, their conclusion as to racial immunity being the same that has passed current among the earlier authorities as a truth of high general value (admitting, of course, of exceptions in special circumstances), and a truth that has never, so far as I know, been formally controverted by anyone, although other points concerning yellow fever have been the subject of as obstinate controversy as those touching small-pox itself. The experiences of the French at Gorée, a town with ten times as many negroes as whites, exactly confirmed those of Vera Cruz in the same year (*Arch. de Méd. nav.*, ix. 343).

The immunity of the African negro from yellow fever has become a paragraph in some anthropological text-books. It is from the anthropologists, and not from medical authorities, that Darwin cites the fact in his "Descent of Man," adding an original theory of the immunity, which he was unable to establish after much inquiry. His theory, I need hardly say, was not that "negroes in infancy may have passed through some disease too slight to be recognized as yellow fever,"—whatever that may mean—"but which seems to confer immunity." The theory, however, is another story, or "another volume," as the writer just cited is pleased to suggest; and as for the historical fact of immunity, no one denies it, unless it be Dr. Pye Smith in his recent Lumleian lectures (*Lancet*, April 23, 1892, p. 901), who gives no reasons.

It is unfortunate that the anthropologists (Darwin among them) should have introduced one element of dubiety in placing mulattoes on the same footing, in respect of immunity, as negroes of pure descent, and another in mixing up malarial or climatic fevers with yellow fever. C. CREIGHTON.

June 20.

## The Line Spectra of the Elements.

I SEE by Prof. Stoney's letter that I have not yet succeeded in making myself understood, as he does not enter on the subject of my objection. A function of the time may well, with any assigned degree of accuracy and for any length of time, be approximately represented by a sum of circular functions, and nevertheless the periods, amplitudes, and phases may not approach definite values when the length of time for which the approximation is to hold good is increased indefinitely. I think this is quite clear from the example I have given in my last letter (p. 100), and it is not necessary to write out other examples. Now, Prof. Stoney shows how one may find by Fourier's theorem the amplitudes, periods, and phases of a sum of circular functions if one only knows the values of the sum. This deduction is not new to me. I worked out the same equations in a slightly different form, when Prof. Stoney's first letter made me further think about the subject. The deduction does also apply to functions that are approximately represented by a sum of circular functions, but *only under the restriction* that the time for which the approximation holds good is long in comparison to the longest period of the circular functions. In chapter iv. of his paper "On the Cause of Double Lines, &c." (Transactions of the Royal Dublin Society, 1891), Prof. Stoney should have added this restriction. Then the question would naturally have arisen how the restriction follows from Prof. Stoney's hypothesis on the origin of the line spectra. I do not venture to say that it does not, but the author would have to prove it.

C. RUNGE.

Technische Hochschule, Hannover.

## The Nitric Organisms.

I MUCH regret to learn from your last issue that Mr. Warington considers that I failed to do justice to his work on this

subject in my recent lecture at the Royal Institution, and which was reprinted in your columns of the 9th inst. Mr. Warington complains that I have attributed to Winogradsky, and not to himself, the separation of the nitric ferment; I think, however, that Mr. Warington does not correctly understand the sense in which I employ the word "separate," or rather "isolate" (that is the exact word which I did use), for it does not appear to me that Mr. Warington has ever claimed to have *isolated* this ferment; thus, on referring again to his most recent publication on this subject, I read, "An attempt to isolate the nitric organism by the dilution method failed, but apparently only one other organism—a stout bacillus, growing on gelatin—was present in some of the cultures" (Chem. Soc. Journ., July 1891). In an exhaustive memoir, due reference to the above attempt of Mr. Warington's would, of course, have been made; but in the impressionist sketch, which is alone possible in a Friday evening discourse at the Royal Institution, I take it that a lecturer must be allowed to use his own discretion as to what does and what does not fit into the small frame of sixty minutes without laying himself open to the imputation of having unjustly neglected or emphasized the work of individual investigators. Mr. Warington's name is so indissolubly connected with the subject of nitrification that it is the more surprising to me that he should have taken exception to the passage in question of my lecture.

PERCY F. FRANKLAND.

University College, Dundee, June 21.

### Protection against Rain in the Elder.

IT is quite possible that the mode in which the flowers of the elder protect themselves against the rain has been described before, though I do not recollect to have seen any account of it. I have been noticing the great contrast between the aspect of a large elder-tree in full blossom, visible from my study window, presented yesterday and to-day. To-day, which is warm and sunny, every inflorescence is in its normal position, with the flat surface nearly horizontal, so as to get as much sun as possible. Yesterday was cold and very wet, and in every one of the inflorescences the upper part of the stalk was so curved as to bring, as far as the foliage would permit, the surface of the inflorescence to an angle of very nearly 90° with the horizon, so that the rain ran off, and scarcely any of it reached the interior of the flowers.

June 24. ALFRED W. BENNETT.

## *THE TOTAL SOLAR ECLIPSE, APRIL* 15-16, 1893.

THE total eclipse of the sun, which will take place during the month of April next year, will most probably be very widely observed, not only because the shadow of the moon passes over such a great stretch of land, but because the phenomenon occurs at the period when a sun-spot maximum is approaching, at which time, of course, the disturbed state of the atmosphere of the sun is on the increase. The maximum time of totality is also in this case considerable, amounting to as much as 4m. 46s.

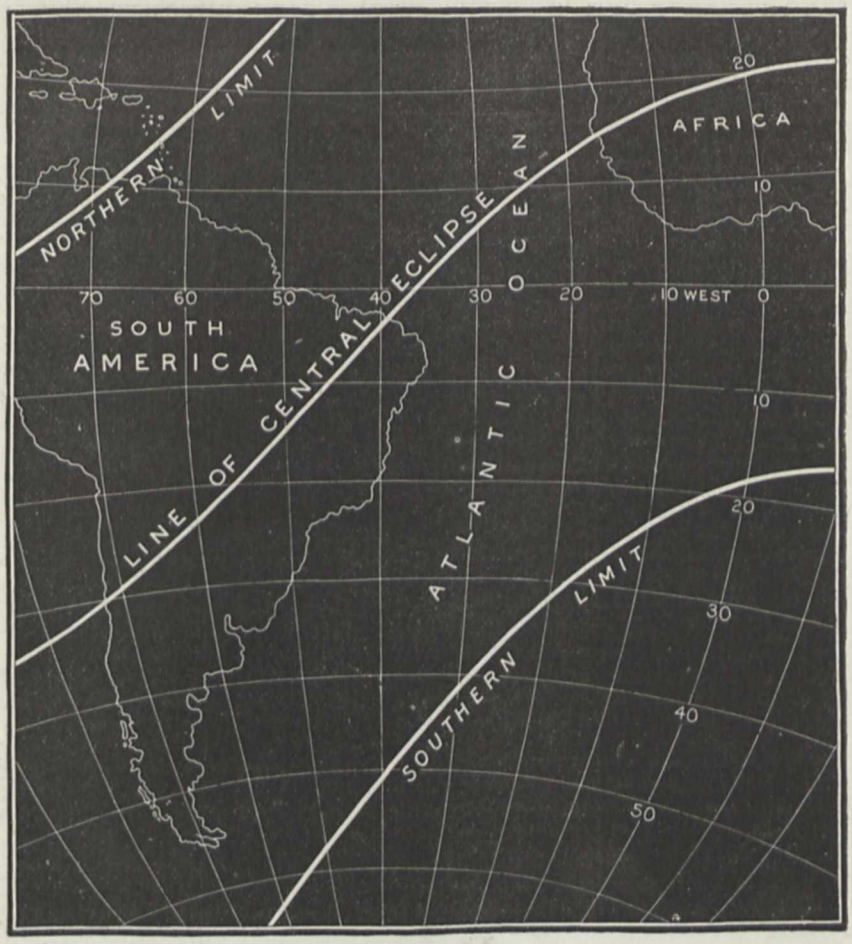



FIG. 1.—Showing the general trend of the line of totality.

*Path of Shadow.*—The general trend of the path of the shadow will be gathered from the accompanying diagram (Fig. 1). This track cuts through Chili, passes to the

north of the Argentine Republic, skirts the provinces of Bolivia and Paraguay, and runs through the heart of Brazil. The centre of the shadow leaves South America near the town of Ceara or Fortaleza, and travels across the Atlantic Ocean, striking the African coast between Cape Verde and Bathurst.

*Probable Points for Observations.*—The special points for observations may be said roughly to be three, viz. the region about Chili, the north-east corner of Brazil, *i.e.* the region of Ceara, and the Senegambian coast. These localities are so situated on the line of central and total eclipse that photographs of the corona taken at Chili will precede those taken in Africa by about 3½ hours; while those obtained in the north-east of Brazil will be intermediate between the two.

Let us deal first with the Chilian district; this, we


FIG. 2.—Showing the region on the West Coast of Africa over which the line of totality passes.

learn, will be occupied by the American astronomers. So far as we know at present, the Lick Observatory will send a party to Chili under the direction of M. Schaeberle, while Prof. Pickering will also direct other observers somewhere about the same spot. To the north of the Argentine Republic, and on the railway which runs up from Buenos Ayres, there seems to be another spot which would be available. This place, Rosario de la Frontera, lies to the north of Tucaman, and to the south of Jujuy, its approximate position being longitude 65° 7′, latitude 25° 48′ S. The duration of totality here amounts to 3m. 8s., the local time of its commencement being April 15, 20h. 40m. This place should, if possible, be made use of, for, besides being easily accessible, the probabilities from all accounts seem to be in favour of fine weather. From observations gathered from the nearest meteorological station, Salta, the mean annual temperature is found to be 63°·6 F., and the rainfall 22·8 inches; the chances for clear weather at this season being estimated at two-thirds.[1]

Following the track of the shadow across Brazil, no suitable spots are reached until the coast is approached; the most favourable place here is no doubt Fortaleza or Ceara, the capital of the province of Ceara, and a city of 20,000 inhabitants. Para Curù is also another very favourable point, lying nearly in the centre of the line of central eclipse; its position is longitude 38° 30′, latitude 3° 42′ S., and the local time of the beginning of the eclipse is April 15, 23h. 40m., the time of its duration being 4m. 44s.

With regard to the weather in this neighbourhood, the chances for clear skies seem, unfortunately, very small. The rainfall is reckoned as over 100 inches per annum, while even in April 10 inches has been usually recorded. For the last five years fifteen days on an average in this month have been rainy, the number in one year reaching twenty-one.

Taking into account the easy accessibility of the place, and its important position on the line of totality, it seems desirable that at any rate there should be some observers there.

Following the shadow over the Atlantic Ocean, we arrive at the shores of West Africa, on which probably both French and English expeditions will take up their respective positions. The accompanying map (Fig. 2) shows the coast-line of this region; AB, CD, and EF indicating the line of central eclipse and the northern and southern limits. The places which seem at present to be the most favourable are Joal and Palmerin, on the coast, if observations there are more convenient than others made inland.

The prospect of fine weather seems to be more probable here than in America. December, January, and February are the cloudy months, the weather during March and April being usually fine; the rains begin about May: sometimes tornadoes occur at intervals of five or six days, being accompanied by heavy rain, lasting generally from one to two hours, leaving the atmosphere afterwards bright and clear. The wind called the "Harmattan" during the first three months of the year is generally from the north-east and dry. It comes from the Sahara Desert, and brings with it consequently minute particles of sand, tending to give the atmosphere a yellowish tint. In April the prevailing wind is westerly to north-westerly, and not usually very strong.

The route which the English expedition will take has up the present not been definitely settled. Several lines of steamers run to Teneriffe and Grand Canary, and if one of Her Majesty's ships picked the expedition up at Teneriffe and carried them either to Bathurst or directly to the Salum River, the matter would be simplified; but failing this the only available route seems to be that by the British and African Steam Navigation Company. These steamers, touching at Madeira, Teneriffe, Grand Canary, Goree, and Dakar, naturally require much time to get to Bathurst. Of the return conditions it seems impossible to get any information at present.

Taking into account the accessibility and proximity to the line of totality, perhaps Palmerin and other places on the same river (River Salum) offer the greatest advantages. The bar at the mouth of the river would prevent a man-of-war of deep draft from proceeding up the river. As the region here is all under French protection, the necessary official letters will of course have to be obtained.

There are one or two other points relating to this region if it should by any chance be ultimately settled upon. Luxuries in the way of tea, sugar, milk (condensed), cocoa and milk, condiments, wine or spirits, flour, biscuits, soups, and preserved meats, should all be brought from England; rice, fowls, sheep, goats, and bullocks being always procurable from the native villages.

Cement and lime should also be taken out, and it seems probable that the huts for the instruments should be constructed at home and carried out there in pieces. The necessary housing of the observers (and escort, if any) would not prove very difficult, for either room could be found in the villages, or bamboo and grass huts could be quickly run up by the natives; it might be advisable to take one or two small tents, as they might prove very serviceable just after landing.

With regard to the packing of the necessary instruments, it may be said that the carriers' loads vary from 40 to 65 pounds; a case capable of being slung on a bamboo can weigh as much as 250 pounds, while to carry a weight of one hundredweight the services of two men would be required. Their wages would, of course, depend on whether they were obtained from Bathurst or the trading wharf on the river at the point of disembarkation, as in the latter case they could be discharged as soon as the selected spot had been reached.

[1] The information for the most part concerning the American stations is gathered from Mr. H. S. Pritchett's article, "The Total Solar Eclipse April 15-16, 1 93," in the June number of *Astronomy and Astro-Physics*.

## *UNIVERSITY OF DUBLIN: TERCENTENARY CELEBRATION.*

THE celebration of the tercentenary of the University of Dublin will begin on Tuesday next, and all the necessary arrangements have now been made. Neither the Great College Hall nor the Chapel have been found large enough to hold the number of guests who have accepted the invitation of the Chancellor of the University (Earl of Rosse) and the Provost of Trinity College (Rev. Dr. Salmon), and it has been deemed necessary to hold the Commemoration Service in the Collegiate and Cathedral Church of St. Patrick, and the ceremony of the presentation of addresses in the Leinster Hall, the largest covered area in Dublin. In this hall the College banquet will be given, and the students have also engaged it for a University ball, which is to bring the festivities to a close.

It is expected and hoped that most of the invited guests and delegates will arrive in Dublin in the course of Monday evening, July 4, as the reception by the Provost of Trinity College will be held at 10 o'clock on the Tuesday morning, and immediately after this ceremony the members of the three classes of University officers with the members of the Senate, the other graduates and the undergraduates, will accompany the guests and delegates from the Examination Hall of Trinity College to St. Patrick's Cathedral, a distance of about a mile. Should the weather be fine and the procession properly marshalled, the general effect promises to be as fine as it will in the streets of Dublin be novel.

In the afternoon of the same day there will be a garden party in the College Park, to which upwards of three thousand persons have been invited, and the day will close with the performance by the members of the University Choral Society of an ode written by G. F. Savage-Armstrong, and set to music by Prof. Sir Robert Stewart, and by the civic ball.

On the Wednesday morning there will be a special Commencements for the conferring of honorary degrees. The Grace has already passed the Senate for eighty-three degrees, being a number equal to one-third of the total number of the expected guests and delegates. Among those on whom the degree of Doctor of Letters is to be conferred is Prof. Max Müller. The following will receive the degree of Master of Engineering: Lord Armstrong, Sir Benjamin Baker, Sir Isaac Lowthian Bell, Sir Charles William Wilson. The degree of Doctor of Sciences will be conferred on Prof. J. Burdon-Sanderson, Prof. Michael Foster, Prof. Ludimar Hermann, Sir George Murray Humphry, Prof. Julius Kollmann, Prof. Alexander Macalister, Prof. Richet, Prof. Sir William Turner, Wilhelm Waldeyer, Rev. Prof. Thomas George Bonney, Rev. William Henry Dallinger, Sir Archibald Geikie, Othniel Caleb Marsh, Baron Adolf Eric Nordenskiöld, Abbé Alphonse François Renard, John Hall Gladstone, George Downing Liveing, Lord Rayleigh, Prof. Joseph John Thomson, Prof. Thomas Edward Thorpe, Prof. William Augustus Tilden, Francesco Brioschi, Prof. Luigi Cremona, James Whitbread Lee Glaisher, Paul A. Gordan, Edward John Routh, George H. Darwin, Simon Newcomb, Isaac Roberts, F. Tisserand. The following are those who have been selected for the degree of Doctor of Medicine: H.R.H. Duke Charles of Bavaria, John Shaw Billings, Thomas Bryant, Sir Andrew Clark, Adolf Gusserow, Jonathan Hutchinson, Prof. Thomas Grainger Stewart. On the same day there will be a garden party at the Viceregal Lodge in Phœnix Park, given by His Excellency the Lord-Lieutenant and Lady Zetland, and in the evening the College banquet will be held in the Leinster Hall. Five hundred, including all the guests and delegates, have been invited.

Thursday, July 7, there will, in the morning, be a procession, from the Examination Hall of Trinity College to the Leinster Hall, of the College authorities and the delegates and others, to witness the presentation of addresses to the University by the delegates. A delegate from each country will make a short address, and the following have been invited to take their share in this interesting ceremony:—

*Great Britain, her Colonies and Dependencies.*—Sir James Paget, Bart., F.R.S.
*America.*—Prof. O. C. Marsh, of Yale University.
*Austria-Hungary.*—Prof. A. Vámbéry, of Buda-Pesth.
*Belgium.*—Prof. V. D'Hondt, of Ghent.
*Denmark.*—Prof. M. H. Saxtorph, of Copenhagen.
*France.*—Prof. Lannelongue, of Paris.
*Germany.*—Baron Ferdinand von Richthofen, of Berlin.
*Holland.*—Prof. Tiele, of Leyden.
*Italy.*—Prof. Gaudenzi, of Bologna.
*Norway.*—Prof. Hägerup, of Christiania.
*Russia.*—Prof. Wedenski, of St. Petersburg.
*Switzerland.*—Prof. Kollmann, of Basle.
*Cambridge.*—Dr. Peile, Vice-Chancellor.
*Oxford.*—Rev. Dr. Boyd, Vice-Chancellor.

On the evening of this day there will be a dramatic performance by the students of the College, the piece selected being Brinsley Sheridan's comedy, "The Rivals." In the afternoon there will be a garden party at the Royal Hospital, Kilmainham, given by the Right Hon. the Commander of the Forces in Ireland and Lady Wolseley.

The ceremonies will be brought to a close on Friday, on which day the following have been asked to address the College students: Profs. W. Waldeyer, Berlin; F. Blass, Kiel; A. Vámbéry, Buda-Pesth; F. Max Müller, Oxford; L. Cremona, Rome; B. J. Stockvis, Amsterdam; Léon Say, Paris; and General F. A. Walker, Massachusetts. The Athletic Union will hold their annual sports in the College Park and the University ball will be given in the afternoon and evening of this day.

On Saturday, July 9, the Royal Society of Antiquaries of Ireland have organized an excursion to Kells, the many objects of great antiquarian interest of which can easily be inspected within the limits of a short day from Dublin; the excursionists will leave the Great Northern Railway Station at 9 o'clock a.m., and return by the train reaching Dublin by 5.30.

Every information can be obtained on writing to the Hon. Secretaries of the Tercentenary Committee, Trinity College, Dublin.

## *EXHIBITION AT NÜRNBERG BY THE GERMAN MATHEMATICAL ASSOCIATION.*

THE following prospectus will show the scope and object of this Exhibition:—

*Deutsche Mathematiker-Vereinigung.*

*München, Mai* 1892.

From September 12 to 18, 1892, the meetings of the "Deutsche Mathematiker-Vereinigung" and of the "Gesellschaft deutscher Naturforscher und Aerzte" will be held at Nürnberg.

At the proposition of the "Mathematiker-Vereinigung" the arrangement for an exhibition of models, drawings, apparatus, and instruments used in pure and applied mathematics is proposed. The project has secured the support of the Royal Bavarian Government.

The undertaking already enjoys the co-operation of a number of competent men of science, of several mathematical institutes of our colleges, besides that of various prominent publishers and well-known technical establishments, and thus we may hope that the exhibition will answer the expectations of its founders, viz.:

To open to wider spheres the various auxiliaries used in the instruction and investigation of both pure and applied mathematics in the shape of models, apparatus, and instruments and to forward the interests of this kind of scientific work.

At the request of the committee of the Mathematiker-Vereinigung I have the honour to invite you to participate in the exhibition, and to recommend to your special attention the following directions:—

I. Die mathematische Ausstellung gelegentlich der Versammlungen der "Deutschen Mathematiker-Vereinigung" und der "Gesellschaft deutscher Naturforscher und Aerzte" in Nürnberg will last from September 10 to 18, 1892. It comprises mathematical models, drawings, apparatus, and instruments serving both for teaching and research in pure and applied mathematics.[1]

II. The local committee of the Gesellschaft deutscher Naturforscher und Aerzte resp. the direction of the Bayerische Gewerbemuseum attends to the gratuitous granting of space required by the exhibitors.

III. The Deutsche Mathematiker-Vereinigung takes charge of all furniture, tables, screens, &c., attends to the opening and packing, also for supervision and care during the exhibition and

[1] In what belongs to the applications, we include only those having principally a mathematical interest. Concerning the experimental part of physics and those instruments, &c., which are of more practical use, it should be mentioned that all those more practical than theoretical relations will be displayed in a second exhibition, separate from ours, which comprises likewise the other branches of natural philosophy and the medicine.

That exhibition, entitled "Fachtechnische Ausstellung," under the authority of the "Gesellschaft deutscher Naturforscher und Aerzte" is arranged by the "Bayerischen Gewerbemuseum in Nürnberg," under the direction of Mr. Th. von Kramer, who has issued special programmes for that exhibition, and from whom further information may be obtained.

for the insurance against fire. But assumes no responsibility either for damage or for loss of articles.

IV. Those who desire to exhibit under closed cases must do so at their own expense.

V. The charge of transport (to Nürnberg) and, if desired, the insurance of transport is at the expense of the exhibitor. In what refers to the return transport, by the courtesy of the directors of the Bavarian and the other main lines of German railways free transport is guaranteed for all unsold objects of the exhibition. All expense of home-transport beyond this border is at the expense of the exhibitor.

VI. An explanatory detailed catalogue of the mathematical exhibition is to be issued.

The first part will consist of essays, having reference to problems, results, and methods of geometrical representation.

The second part of an enumeration of all articles exhibited in connection with detailed theoretical descriptions. Here, if desired, the prices may be added. This part of the catalogue will be fully illustrated to give a vivid impression of the exhibited articles. We respectfully request all institutes, publishers, &c., to forward woodcuts, *clichés*, &c., which may be inserted in the text.

An appendix to the catalogue will be published, including all advertisements which may hereafter serve as a directory for all those interested.[1]

VII. As far as possible all technical explanations of the articles will be undertaken by the committee.

VIII. The committee will attend to all sales and buyings (which are in view by various mathematical institutes of our Hochschulen) and give all desired information.

During the exhibition the sold articles must not be removed from the exhibition rooms, except with special permission of the committee.

IX. The intention to participate in the exhibition may be given by the use of the "Exhibition Announcement" until July 1. Address: Herrn Prof. Dr. Walther Dyck, München, Hildegardstrasse 1½.

At the same time all papers and scientific notices for the catalogue respecting woodcuts and *clichés* for illustration must be sent to the same address.[2]

The editors reserve the right of all abbreviation and change in the notes of Part 2 of the catalogue that the uniformity may require.

X. All articles proposed for exhibition must be forwarded from September 1 to 7, under the address: Mathematische Ausstelluug in Nürnberg (Bayern), zu Handen der Herren Danler and Co.

The return of all articles will be effected within two weeks after the close of the exhibition under the conditions fixed above (No. V.)

XI. For nearer information in respect to the intentions and the extent of the exhibition we annex a preliminary classification of the articles.

1. *Geometry. Theory of Functions.*

Models employed in elementary teaching of geometry (solid geometry, trigonometry, descriptive geometry).

Polyhedra. Division of surfaces and spaces in polygons respecting polyhedra.

Plane curves.

Curves in space. Developable surfaces.

Surfaces of the second order.

Higher algebraic surfaces.

Transcendental surfaces.

Models illustrating geometry of complexes.

" " curvature of surfaces.

" " theory of functions.

" " analysis situs.

2. *Arithmetic, Algebra, Integral Calculus.*

Calculating machines. Slide rules.

Instruments for solving equations and for construction of functional relations.

Curvometers, planimeters, integrating machines, instruments for solving differential equations.

3. *Mechanics. Mathematical Physics.*

Models employed in elementary teaching.

Kinematics. Machines for description and transformation of curves and surfaces. Pantographs, perspectographs.

Apparatus for demonstration of mechanical principles.

Equilibrium and motion of a point.

Poinsot motion of a rigid body; precession, nutation; dynamical tops, gyroscopes.

Models and articles showing the effect of stress flexion and torsion of solids.

Elastic properties of solids (especially of crystals).

Hydrodynamics.

Geometrical representations and mechanical apparatus illustrating physical phenomena (for ex. vibrations, wave-motion, propagation of sound and light. Thermodynamic and electrodynamic phenomena).

XII. It is understood that the exhibitors declare their willingness to submit to the present rules and further dispositions ordered by the committee for the interest of the exhibition.

For all further information please address the undersigned delegate of the committee.

Prof. Dr. WALTHER DYCK,
München, Hildegardestrasse 1½.

For the purpose of collecting and forwarding objects of interest, a Committee has been formed consisting of Lord Kelvin (Chairman), Lord Rayleigh, Profs. Sylvester, O. J. Lodge, G. F. Fitzgerald, W. G. Adams, Sir R. Ball, A. A. Common. Secretaries: A. G. Greenhill, O. Henrici.

The Secretaries will forward prospectuses and forms of application to intending exhibitors, and will take charge of objects at the Central Institution, Exhibition Road, South Kensington, S.W., and forward the objects at the proper time to Nürnberg, unless forwarded direct by the exhibitors.

[1] The fees for insertion in the appendix are 30 Reichsmark for the whole page (great 8°), 18 R.-M. for ½ page, 10 R.-M. for ¼ page, 5 R.-M. for ⅛ page.

[2] All advertisements for the Appendix and payments for same must not be deferred later than August 1, to the same address, Prof. Dyck.

## *THE KEKULÉ FESTIVAL AT BONN.*

ON June 1 a remarkable demonstration took place at the University of Bonn. The occasion was the twenty-fifth anniversary of the call of August Kekulé to the Professorship of Chemistry at that University. The details, which we have taken chiefly from the *Kölnische Zeitung*, will be of interest to the student of chemistry, and probably of value to the future historian of the science.

The ceremony began in the morning with an enthusiastic ovation on the part of the students. The chemical theatre was decorated with plants; on the blackboard figured the benzene hexagon, made up with garlands of flowers, in the midst of which appeared the letters A. K. as a monogram of roses. At the usual lecture hour Prof. Kekulé entered, and was greeted with great enthusiasm. One of the chemical students, Alfred Helle, delivered a graceful address, in which he congratulated his fellows on being privileged to sit at the feet of the greatest of living chemists, ending by calling for three cheers for the Professor, in which the audience heartily joined.

Prof. Kekulé then addressed the students, detailing with characteristic humour some passages in his life. He was, he said, a pupil at the Darmstadt Gymnasium, where he chiefly devoted himself to mathematics. He was destined by his father for the profession of architect, and some houses still existed in Darmstadt, the plans of which he had drawn when a youth at the Gymnasium. At Giessen, where he went to study architecture, he attended Liebig's lectures, whereby he was enticed to chemistry. But his relations would not at first hear of his changing his profession, and he was given half a year's grace to think over it. He spent this time at the Polytechnicum at Darm-

stadt; from which circumstance arose the myth, affirmed by Kolbe, that he was a "Realschüler," and not, as was really the case, a "Gymnasiast." His first teacher in chemistry at Darmstadt was Moldenhauer, the inventor of lucifer matches. His leisure time was spent in modelling in plaster and at the lathe. He was then permitted to return to Giessen. "I attended," he said, "the lectures, first of Will and then of Liebig. Liebig was at work on a new edition of his 'Letters on Chemistry,' for which many experiments had to be carried on. I had to make estimations of ash of albumen, to investigate gluten in plants, &c. The names of the young chemists who helped Liebig were mentioned in the book, among them mine. The proposal was then made to me, just at the time when Liebig intended to make me his assistant, that I should go for a year abroad, either to Berlin, which at that time was to Giessen a foreign land, or to Paris. 'Go,' said Liebig, 'to Paris: there your views will be widened; you will learn a new language; you will get acquainted with the life of a great city; but you will not learn chemistry there.' In that, however, Liebig was wrong. I attended lectures by Fremy, Wurtz, Pouillet, Regnault; by Marchandis on physiology, and by Payen on technology. One day, as I was sauntering along the streets, my eyes encountered a large poster with the words 'Leçons de philosophie chimique, par Charles Gerhardt, ex-Professeur de Montpellier.' Gerhardt had resigned his Professorship at Montpellier, and was teaching philosophy and chemistry as *privatdocent* in Paris. That attracted me, and I entered my name on the list. Some days later I received a card from Gerhardt; he had seen my name in Liebig's 'Letters on Chemistry.' On my calling upon him he received me with great kindness, and made me the offer, which I could not accept, that I should become his assistant. My visit took place at noon, and I did not leave his house till midnight, after a long talk on chemistry. These discussions continued between us at least twice a week, for over a year. Then I received an offer of the post of assistant to Von Plantu, at the Castle of Reichenau, near Chur, which I accepted, contrary to Liebig's wish, who recommended me as assistant to Fehling at Stuttgart. So I went to Switzerland, where I had leisure to digest what I had learnt in Paris during my intercourse with Gerhardt. Then I received an invitation from Stenhouse, in London, to become his assistant, an invitation I was loth to accept, since I regarded him, if I may be allowed the expression, as a 'Schmierchemiker." By chance, however, Bunsen came to Chur on a visit to his brother-in-law, at whose house I first met him. I consulted Bunsen as to Stenhouse's offer, and he advised me by all means to accept it. I should learn a new language, but I should not learn chemistry. So I came to London, where as Stenhouse's assistant I did not profit much. By means of a friend, however, I became acquainted with Williamson. The latter had just published his ether theory, and was at work on the polybasic acids (in particular on the action of $PCl_5$ on $H_2SO_4$). Chemistry was at one of its turning-points. The theory of polybasic radicals was being evolved: with Williamson was also associated Odling. Williamson insisted on plain simple formulæ without commas, without the buckles of Kolbe, or the brackets of Gerhardt. It was a capital school to encourage independent thought. The wish was expressed that I should stay in England and become technologist, but I was too much attached to home. I wished to teach in a German University. But where? In order to get acquainted with the circumstances at the several Universities, I became a travelling student. In this capacity I came, among other Universities, to Bonn. Here there was no chemist of eminence, and hence there were no prospects. Nowhere did there seem so much promise and so great a future as at Heidelberg. I could ask no help of Bunsen. 'I can do nothing for you,' he said, 'at least not openly. I will not stand in your way, but more I cannot promise.' I fitted up a small private laboratory in the principal street in Heidelberg at the house of a corn merchant, Gross by name—a single room with an adjoining kitchen. I took a few pupils, among whom was Baeyer. In our little kitchen I finished my work on fulminate of silver, while Baeyer carried out his researches, which subsequently became famous, on cacodyl. That the walls were coated thick with arsenious acid, and that silver fulminate is explosive, we took no thought about. After two years and a half I received a call to Ghent as ordinary professor. There I stayed nine years, and had to lecture in French. With me to Ghent came Baeyer. Through the kindness of the then Prime Minister of Belgium, Rogier, I obtained the means to establish a small laboratory. I had there with me a number chiefly of more advanced students, among whom I may name Baeyer, Hübner, Ladenburg, Wichelhaus, Linnemann, Radzizewski, and Meyer. There was not so much a systematic course of instruction as a free and pleasant academic intercourse. After nine years' work, I received the call to Bonn." With some account of his work in Bonn, and with a reference to the great attention he had always received from his pupils, Prof. Kekulé concluded his address. The enthusiasm it occasioned, says the *Kölnische Zeitung*, baffled description.

The Professor then received the congratulations of his personal staff, as well as those of the University officials, among whom were the Rector Prof. Strasburger, the Curator Dr. Gandtner, and the Dean of the Philosophical Faculty Prof. Schlüter. In the evening the Bonn students honoured him with a torchlight procession, it being the third time the Professor had received this, the most conspicuous honour which is bestowed by German students. The first occasion was in 1875, when he declined the Professorship at Munich. The second was in 1878, when he was Rector of the University, held to commemorate the restoration of unity among the students after a long period of disunion. Among the torch-bearers on that occasion was the present Emperor of Germany.

In addressing the students, Prof. Kekulé reminded them of the previous occasions on which they had honoured him in like manner, and impressed on them the necessity of guarding and fostering the unity they had attained. Thus ended an impressive and memorable incident in the history of chemical science.

J. E. MARSH.

## *THE TRUE BASIS OF ANTHROPOLOGY.*[1]

THE Nestor of American philologists, and at the same time the indefatigable Ulysses of comparative philology in that country, Mr. Horatio Hale, has just published in the Transactions of the Royal Society of Canada, an important essay on "Language as a Test of Mental Capacity," being an attempt to demonstrate the true basis of anthropology. His first important contribution to the science of language dates back as far as 1838-42, when he acted as ethnographer to the United States Exploring Expedition, and published the results of his observations in a valuable and now very scarce volume, "Ethnography and Philology." He has since left the United States and settled in Canada. All his contributions to American ethnology and philology have been distinguished by their originality, accuracy, and trustworthiness. Every one of them marks a substantial addition to our knowledge, and, in spite of the hackneyed disapproval with which reviewers receive reprints of essays published in periodicals, it is much to be regretted that his essays have never been published in a collected form.

[1] "Language as a Test of Mental Capacity." By Horatio Hale. From the Transactions of the Royal Society of Canada, 1891.

Mr. Horatio Hale's object in the essay before us is to show that language separates man from all other animals by a line as distinct as that which separates a tree from a stone, or a stone from a star.

"A treatise," he writes, "which should undertake to show how inanimate matter became a plant or an animal, would, of course, possess great interest for biologists, but it would not be accepted by them as a treatise on biology. In like manner a work displaying the anatomy of man in comparison with that of other animals cannot but be of great value, and a treatise showing how the human frame was probably developed from that of a lower animal must be of extreme interest; but these would be works, not of anthropology, but of physiology or biology. Anthropology begins where mere brute life gives way to something widely different and indefinitely higher. It begins with that endowment which characterizes man, and distinguishes him from all other creatures. The real basis of the science of anthropology is found in articulate speech, with all that it indicates and embodies." He does not hesitate to maintain that solely by their languages can the tribes of men be scientifically classified, their affiliations discovered, and their mental qualities discerned. These premises, he says, compel us to the logical conclusion that linguistic anthropology is the only "Science of Man."

These words explain at once the whole character of this important essay. Mr. Horatio Hale is a great admirer of Darwin, but not of the Darwinians. He contrasts Darwin's discernment of the value of language with the blindness of his followers, who are physiologists and nothing else. Why anthropology has of late been swamped by physiology, Mr. Horatio Hale explains by the fact that the pursuit of the latter science is so infinitely the easier. "To measure human bodies and human bones, to compute the comparative number of blue eyes and black eyes in any community, to determine whether the section of a human hair is circular, or oval, or oblong, to study and compare the habits of various tribes of man, as we would study and compare the habits of beavers and bees, these are tasks which are comparatively simple. But the patient toil and protracted mental exertion required to penetrate into the mysteries of a strange language, and to acquire a knowledge profound enough to afford the means of determining the intellectual endowments of the people who speak it, are such as very few men of science have been willing to undergo." Mr. Horatio Hale has a right to speak with authority on this point, for, besides having studied the several languages of North America, of Australia and Polynesia, no one has more carefully measured skulls, registered eyes, measured hair, and collected antiquities and curiosities of all kinds than he has done during his long and busy life. His knowledge of the customs of uncivilized races is very considerable. No one knows the Indian tribes and likewise the Australians better than he does, and he is in consequence very severe on mere theorizers who imagine they have proved how the primitive hordes of human beings, after herding together like cattle, emerged slowly through wife-capture, mother-right, father-right, endogamy, exogamy, totemism, fetichism, and clan systems, to what may be called a social status. He holds with Darwin that man was from the beginning a pairing animal, and that the peculiar usages of barbarous tribes are simply the efforts of men, pressed down by hard conditions, below the natural stage, to keep themselves from sinking lower. He gives a most graphic description of changes of civilization produced by change of surroundings in the case of the savage Athapascans, and their descendants, the quick-witted and inventive Navajos. He holds that the inhabitants of Australia were originally Dravidians, and that their social and linguistic deterioration is due to the miserable character of the island in which they had taken refuge, possibly from the Aryans, when pressing upon the aboriginal inhabitants of the Dekhan. He points out a few grammatical terminations in the Dravidian languages which show some similarity to the terminations of Australian dialects. The dative, for instance, is formed in the Dravidian Tulu by *ku*, and in the Lake Macquarie and Wiradhurei dialects of Australia by *ko*. In both families the *k* of *ku* and *ko* is liable to be changed into *g*. The plural suffix in Tamil is *gal*, in Wiradhurei *galan*. Thus in Tamil *maram*, tree, forms the nom. plur. *marangal*, the dat. plur. *marangaluk-ku*; while in Wiradhurei, *bagai*, shell, appears in the nom. plur. as *bagaigalan*, in the dat. plur. as *bagaigalan-gu*. On this point, however, Mr. Horatio Hale ought to produce fuller evidence, particularly from numerals, and the common household words of uncivilized tribes. The pronouns show many coincidences with Dravidian and Australian languages. No one is better qualified for that task than he is, for we really owe to him the first trustworthy information about the Australian dialects. He considers all the dialects spoken in Australia as varieties of one original speech, and he has proved their wonderful structure by several specimens contained in his first book, published nearly fifty years ago, and again in this last essay of his.

There is no doubt that this essay will provoke much opposition, but no one can read it without deriving most valuable information from it, and without being impressed with the singularly clear and unbiassed judgment of the author. It is to be hoped that if there is any controversy it may be carried on in the same scientific and thoroughly gentlemanlike tone in which Mr. Horatio Hale deals with those whom he has to reprove. Thus, when Prof. Whitney, a fertile writer on linguistic science in America, commits himself to the statement that the Dravidian languages have "a general agglutinative structure *with prefixes only*," Mr. Horatio Hale goodnaturedly remarks, "this is doubtless a misprint for *with suffixes only*." And when Prof. Gerland, in his continuation of Waitz's invaluable work "Die Anthropologie der Naturvölker," refers to Mr. Horatio Hale as describing the hair of the Australians as *long, fine, and woolly*, he points out that he, on the contrary, described their hair as neither woolly, like that of the Africans and Melanesians; nor frizzled, like that of the Feejeeans; nor coarse, stiff, and curling, as with the Malays; but as long, fine, and *wavy*, like that of Europeans. He naturally protests against Prof. Friedrich Müller charging him with having committed such a blunder, which, as he remarks, would be as bad as if he had described the Eskimos as having black skins. But there is not a single offensive expression in the whole of his essay, though the opportunities would have been many for adopting the style of hitting indiscriminately above and below the belt. Though he differs from Prof. Whitney, he evidently ranks him very high, and as second only to "that eminent Sanskrit scholar, Sir Monier Monier-Williams."

## *LEWIS MORRIS RUTHERFURD.*

ON May 30 last there passed away from us one whose name was familiar to many, and who was respected and beloved by all who were fortunate enough to have made his acquaintance. By the death of Lewis Morris Rutherfurd, who died at the age of seventy-six, at his estate in Tranquillity, New Jersey, astronomical science especially suffers, for he was one of the pioneers of astronomical photography and spectroscopy, and the introducer of many of the practical methods which have opened to us such a vast field of research.

Born at Morrisania, New Jersey, on November 25, 1816, he first devoted himself to the study of law, but finding his mind bent more on astronomical pursuits,

he soon thought fit to leave this profession, and being well equipped with the necessary private resources, he commenced in the year 1848 to erect an observatory in the city of New York at his own residence. On its completion, it was furnished with an 11¼-inch refractor, which he had made under his own personal direction by Fitz, and a transit instrument.

The first work he set himself to do related to the spectra of the stars. As soon as Kirchhoff's discovery was announced, Donati, at Florence, in 1860, made the first efforts in this direction; this was followed by other observers, among whom was Rutherfurd. In 1863 he published his first paper on the spectra of the celestial bodies, and indicated that the various stellar spectra which he had then observed were susceptible of being arranged in different groups. His paper, which was published in *Silliman's Journal*, vol. xxxv. p. 71, contained the following extract with reference to this classification:—"The star spectra present such varieties that it is difficult to point out any mode of classification. For the present, I divide them into three groups: First, those having many lines and bands, and mostly resembling the sun, viz. Capella, β Geminorum, α Orionis, &c. These are all reddish or golden stars. The second group, of which Sirius is the type, presents spectra wholly unlike that of the sun, and are white stars. The third group, comprising α Virginis, Rigil, &c., are also white stars, but show no lines; perhaps they contain no mineral substance, or are incandescent without flame."

Turning his attention to object-glasses for visual and photographic purposes, he described in 1865 a new form which he had specially designed for the latter. This, needless to say, brought about a great revolution in the processes employed. The history of his early attempts to produce photographically corrected object-glasses, and the wonderfully sharp and beautiful photographs of the moon which he finally obtained, will always be marked as an important era in the application of the camera to the equatorial telescope. The photographs taken at the present day, even although they are produced with larger lenses and with a more perfect knowledge of photographic processes, and with the advantages afforded by dry plates, excel only in a trifling degree those taken with the small Rutherfurd equatorial.

Another important piece of work, which occupied him some considerable time, was the mapping, by means of the photographic process, of star clusters and star groups. His ingenuity in devising and constructing accurate micrometers for measuring the impressions of the star clusters opened out a new method by which the proper motion of the stars could be photographically determined, and even their parallaxes, eliminating entirely the errors of observers.

It was absolutely essential, as he knew, in order to obtain a perfect method of measurement of the photographs, to attain the utmost perfection in the cutting of the threads of the micrometer screw, and some idea of the care which he bestowed on them may be gathered from the fact that he took three years to make a single screw. In order to test its quality, it struck him that it would be a happy thought to see if it would enable him to rule a grating. He accordingly set the apparatus up in his bedroom, and by means of an automatic arrangement kept it going all night, as at that time the local vibrations were fewest. The result was that he was able to make the most perfect gratings known, which are only now surpassed by those of Rowland, who followed in his wake.

The photographic corrector, which consisted of an additional lens to be applied to visual object-glasses, to render them fit for photographic use, was also due to his exceptional mechanical ability, and was brought out in the year 1868.

Owing to failing health he was at last obliged to give up all idea of making observations, so he resigned himself to a thorough supervision of the great number of measurements of the photographs of the star clusters that by this time had very considerably accumulated.

In the year 1884, Columbia College, New York, was the recipient of all his astronomical instruments, apparatus, and completed measures. It is only a fortnight ago when a notice of the measures of the Pleiades, which were prosecuted by Mr. Jacoby, under the direction of Prof. Rees, was made in these columns, and it will not be long before several other clusters will be published.

In this brief notice we have only referred to some of the more salient points with which he enriched the domain of astronomical science; and his was no mean spirit striving to confine to his own use the various methods of work and improvements he introduced: he scattered his gratings with a lavish hand among all who were likely to make any use of them, and his greatest delight was to help others occupied in researches kindred to his own.

## NOTES.

SIR ARCHIBALD GEIKIE has been appointed by the Council of the Royal Society to be one of the Governors of Harrow School.

IT was with deep regret that we saw the announcement in Monday's *Times* of the death of Admiral Mouchez, the Director of the Paris Observatory. In him France has lost one of her most active men of science, whose place it will be no easy task to fill.

AT St. John's College, Cambridge, on July 9, at 2.30 p.m., there will be held a meeting of the General Committee that was formed for placing a suitable memorial of the late Prof. Adams in Westminster Abbey. This meeting is specially called to consider a modification in the form of the memorial. The resolution, as passed in February, was to the effect that the memorial should "consist of a bust with tablet and inscription," but as the Dean has been unable to sanction any site in that part of the Abbey in which it was first proposed to be placed, but has offered an excellent position for a medallion, near the monument of Newton and the grave of Sir John Herschel, and close to the memorials of Darwin and Joule, the Executive Committee recommend that this offer be accepted, and that the terms of the former resolution be altered to "That the memorial consist of a medallion and inscription."

THE *Botanische Zeitung* publishes a programme of the International Botanical Congress to be held in Genoa. On Sunday evening, September 4, there will be a reception of the foreign botanists present. On Tuesday the Botanical Institute and Garden, presented to the Municipality of Genoa by Mr. Thos. Hanbury, will be formally opened. On Saturday, September 10, the Acclimatisation Garden of Mr. Hanbury at Mortola will be visited. The rest of the week will be occupied by scientific sittings, receptions, and excursions.

DR. BENECKE, the Director of the Experimental Station at Klaten, Java, has offered a prize of 1000 marks for the best essay, founded on original observations and experiments in cultivation, on the causes of the red colour in the fibrovascular bundles of *Sorghum*, which accompanies the disease known as "sereh." A very similar disease has recently become very destructive to the sugar-cane crop in Java.

IN our account last week of the Ladies' *Conversazione* of the Royal Society we stated that the Telephone Company's installation was the means by which the music from the Paris opera was rendered audible. This, as we have reason now to know, was incorrect. The Post Office undertook the whole affair, no company having anything at all to do with it.

PROF. BURT G. WILDER, M.D., of Cornell University, sends us the following correction:—In a circular, "American Reports upon Anatomical Nomenclature," issued last winter by Prof. Wilder, as Secretary of the Committee of the Association of American Anatomists, in the third paragraph of the third page, the Chairman of the Committee of the Anatomische Gesellschaft should be Prof. A. von Kölliker, and the Chairman of the American division (appointed in 1891 by the American Association for the Advancement of Science) of the International Committee on Biological Nomenclature should be Prof. G. L. Goodale. Prof. Wilder desires to express his regret for the errors, due in the one case to his own misapprehension, and in the other to a clerical mistake.

UNDER the title of "The Cambridge Natural History," Messrs. Macmillan and Co. have in active preparation an important series of volumes on the Natural History of Vertebrate and Invertebrate Animals, edited, and for the most part written, by Cambridge men. While intended in the first instance for those who have not had any special scientific training, the volumes will, as far as possible, present the most modern results of scientific research. Thus the anatomical structure of each group, its development, palæontology, and geographical distribution, will be considered in conjunction with its external character. Care will, however, be taken to avoid technical language as far as possible, and to exclude abstruse details which would lead to confusion rather than to instruction. The series will be under the general editorship of Mr. J. W. Clark, the University Registrar, and Mr. S. F. Harmer, Superintendent of the Museum of Zoology. The following writers are engaged upon the groups which precede their names:—*Mammals*, Mr. J. J. Lister; *Birds*, Mr. A. H. Evans; *Reptiles* and *Amphibia*, Dr. Gadow, F.R.S.; *Fish*, Mr. W. Bateson; *Mollusca*, Mr. A. H. Cooke; *Polyzoa*, Mr. S. F. Harmer; *Brachiopoda*, Mr. A. E. Shipley; *Insects*, Mr. David Sharp, F.R.S.; *Myriapoda*, Mr. F. G. Sinclair; *Arachnoida*, Mr. C. Warburton; *Crustacea*, Prof. W. F. R. Weldon; *Cœlenterata*, Mr. S. J. Hickson; and *Sponges*, Dr. W. J. Sollas. It is hoped that some of the volumes which are already far advanced may appear in the course of next year. The series will be fully illustrated.

THE weather during the past week has been unsettled, but considerably warmer generally. Towards the close of last week solar halos were visible in the south, and a depression moved along our west coasts in a north-north-easterly direction, accompanied by showers, while the daily temperatures reached upwards of 70° in the inland parts of England. At the beginning of the present week, a still further increase of temperature occurred, the maxima exceeding 80° in the midland and eastern parts of England, and fog became prevalent over the Channel and the southern parts of England. The atmospheric conditions, which during the greater part of the period were cyclonic, with moderate or strong south-westerly winds, amounting to a strong gale from the westward in Caithness on Monday, subsequently became anticyclonic with light north-easterly and easterly winds over England; but on Tuesday evening a depression lay over the mouth of the Channel, the conditions rapidly became more unsettled, and a very severe thunderstorm occurred on that night in London and the greater part of England, accompanied by heavy rain. The *Weekly Weather Report* for the period ending the 25th instant shows that the rainfall exceeded the mean in nearly all districts; in the eastern and southern parts of England the excess was rather large. But reckoning from the beginning of the year there was still a deficit in all districts, although the amount was trifling in the north-east and north-west of England.

A NEW meteorological journal, entitled *L'Atmosphère*, has recently appeared in Paris. It contains several short original articles and miscellaneous notes collected by the director of a private observatory, named Tour Saint-Jacques. At present there is no such journal published in France, excepting the *Annuaire* of the Meteorological Society, containing the papers read by its members. The current number (No. 5) contains an article on the optical phenomena of the atmosphere, by A. Cornu, member of the Institute, and one on solar phenomena and terrestrial magnetism, by E. Marchand, of the Lyons Observatory. It also gives a list of the principal meteorological papers published in recent serials.

A SERIES of severe earthquake shocks is reported from Guodolajara, Mexico. The first shock was felt last Friday night, and lasted eighteen seconds. Windows were broken and plastering cracked in numerous houses, and hundreds of panic-stricken people took refuge in the streets until daylight. On Saturday a second shock occurred, wrecking a number of buildings. Several persons were seriously hurt, but in no case are their injuries expected to prove fatal. Several other shocks have been felt since. The volcano Colima is said to be in a state of much activity. Great volumes of sulphur, smoke, and lava are issuing from the crater.

A PAPER setting forth a proposal for a national photographic record and survey, by Mr. W. J. Harrison, was lately read before the Photographic Society of Great Britain, and has now been issued separately. Mr. Harrison's idea is that a pictorial record of the present condition of the country should be secured by photography, the work being accomplished by professionals, individuals (amateurs), photographic societies, and agencies under the control of the Government. In the course of the paper he gives an interesting account of the way in which the local photo-survey of Warwickshire is being carried out.

ANTHROPOLOGISTS will read with interest some folk-songs and myths from Samoa, printed in the new number of the Journal and Proceedings of the Royal Society of New South Wales (vol. xxv.). They are translated by the Rev. G. Pratt, and introductions and notes are provided by Dr. John Fraser.

PROF. F. STARR will contribute to the July number of the *Popular Science Monthly* an article on "Anthropological Work in America." It will be accompanied by portraits of seventeen American anthropologists. According to *Science*, the article shows that "both in quality and amount, the work of Americans in this field compares favourably with that of Europeans."

A SOCIETY which may have opportunities of doing much valuable work has been formed in Wellington, New Zealand. It is called the Polynesian Society, "Polynesia" being intended to include Australia, New Zealand, Melanesia, Micronesia, and Malaysia, as well as Polynesia proper. The President is Mr. H. G. Seth-Smith, chief judge of the native land court, while the Queen of Hawaii is patron. We have just received the first number of the Society's Journal, in which there are papers on the races of the Philippines, by Elsdon Best; Maori deities, by W. L. Gudgeon; the Tahitian "Hymn of Creation," by S. P. Smith; Futuna, or Horne Island, and its people, by S. P. Smith; Polynesian causatives, by E. T.; and the Polynesian bow, by E. Tregear. There is also a paper giving the genealogy of one of the chieftainesses of Rarotonga, by a native of Rarotonga. The original was written in 1857, and is printed in the Journal, with a translation by Mr. Henry Nicholas, and notes by the editors. The editors are of opinion that the paper "apparently supports by direct traditional testimony the theory propounded by Hale, and subsequently advocated by Fornander, of the occupation of the Fiji Group by the Polynesian race, and of their later migration eastward to Samoa and the Society Group."

THE facility with which enlargements can now be produced, and the introduction of good commercial bromide paper, to say nothing of the artistic effects of the results, have all tended to increase the popularity of the practice of enlarging. When an amateur was formerly in need of moderate-sized pictures, he was compelled more or less to use a large camera, but now the inclination is to employ small cameras and therefore small plates, and to subsequently adopt the enlarging process to give him the required size picture. A very useful and handy little book treating of this process, written by Mr. John A. Hodges, has lately been issued by Messrs. Iliffe and Son, and contains much practical information for working either by artificial light or daylight. Methods of constructing cameras suitable for this work, lanterns, and various accessories, are all very well described and illustrated, and if carefully followed out will render many an amateur independent of the instrument-maker. In the section relating to the chemical manipulations there are also some useful hints which will save a beginner much annoyance and help him to produce satisfactory results.

OBERLIN COLLEGE, Ohio, is issuing a series of Bulletins giving the results of special work done in its museum and laboratories. Two have now been published, the first being a preliminary list of the flowering and fern plants of Lorain County. The second, which we have just received, contains a descriptive list of the fishes of Lorain County, and has been prepared by Mr. L. M. McCormick.

ACCORDING to the *Pioneer Mail* of June 8, the residents of Howrah have been finding lately that jackals are animals of anything but an attractive temper. In some cases they have come right up to the bungalows in search of prey. A little girl, aged about five years, was playing in a verandah, when a jackal suddenly rushed on her, and was dragging her away, when she was rescued. She was severely bitten. Three natives, while walking along Kooroot Road, were attacked by a jackal, which was only driven off after a stubborn fight; and a tale is told of two women, while standing near a tank, being attacked and bitten. So serious has the state of matters become, that the public propose to submit a memorial to the district magistrate praying for the adoption of measures for the destruction of these pests.

REFERRING to Malta's spring visitors, the *Mediterranean Naturalist* for June says that during the preceding month the valleys and gorges were alive with orioles, warblers, rollers, and bee-eaters. In the rich crimson clover enormous numbers of quails found shelter during their sojourn *en route* for the Continent, while the branches and foliage of the carob, the prickly pear, and the orange trees were thronged with harriers and larks.

MR. F. TURNER contributes to the April number of the *Agricultural Gazette of New South Wales* a paper on the carob bean tree as one of the commercial plants suitable for cultivation in New South Wales. The Agricultural Department distributed a quantity of seed last year, and some healthy young plants raised from this seed are now growing in several parts of the colony. Mr. Turner expects that when the tree becomes better known to cultivators it will be extensively grown to provide food for stock, more especially during adverse seasons. The carob can not only be trained into a very ornamental shade tree, but may be planted as a wind-break to more tender vegetation. He advises all who cultivate it to keep bees, if only a single hive. It is astonishing, he says, how many flowers these industrious insects will visit in the course of a day, and be the agency whereby they are fertilized.

SOME time ago a sugar school was established in connection with the State University, Lincoln, Nebraska, and if we may judge from the first formal report, lately submitted by Prof. Lloyd, it is likely to do much excellent work. The school opened on January 5 with twenty-five students. These students were mostly members of other classes in the chemical department of the University; the only preparation required for entrance being a clear conception of the principles of elementary chemistry, such as may be obtained in some of the high schools of Nebraska. The course consisted of two lectures a week, given by Mr. Lyon, with five hours of laboratory work. The lectures embraced the following subjects: (1) chemistry of the sugars; (2) technology of beet-sugar manufacture; (3) culture of the sugar beet. During the latter part of the winter term, Prof. DeWitt B. Brace gave the class four lectures on the theory of light, dealing with (1) the wave theory of light; (2) polarization of light; (3) rotation of the plane of polarization; (4) application of these principles to the polariscope and to the different forms of saccharimeters. It is hoped that in the coming year the work may be greatly extended.

A "Dictionnaire de Chimie industrielle" is being issued in parts, under the direction of A. M. Villon, by the "Librairie Tignol." It gives an account of the applications of chemistry to metallurgy, agriculture, pharmacy, pyrotechnics, and the various arts and handicrafts.

MESSRS. LONGMANS, GREEN, AND CO. have issued a third edition, revised and enlarged, of Prof. E. A. Schäfer's "Essentials of Histology." The intention of the author is to supply students with directions for the microscopical examination of the tissues.

A WORK on the "Migration of Birds," by Charles Dixon, will shortly be published by Messrs. Chapman and Hall.

A PAPER upon the oxidation of nitrogen by means of electric sparks is contributed, by Dr. V. Lepel, to the current number of the *Annalen der Physik und Chemie*. It is well known that small quantities of nitric and nitrous acids and their ammonium salts are produced during the passage of high tension electrical discharges through moist air. Dr. V. Lepel's experiments have been conducted with the view of obtaining more precise information concerning the nature of the chemical reactions which occur, and the experimental conditions most favourable for increasing the amount of combination. The first action of the spark discharge appears to be the production of nitric oxide, which is immediately converted by the oxygen present into nitrogen peroxide. The latter then reacts with the aqueous vapour present, forming nitric acid and liberating nitric oxide in accordance with the well-known equation $3NO_2 + H_2O = 2HNO_3 + NO$. It has been found, however, that the continued passage of sparks through the same quantity of moist air does not result, as might at first sight be expected, in the conversion of more and more of the atmospheric gases into oxidized products. For the passage of sparks through the gaseous oxides of nitrogen first formed results in their decomposition again into their elementary constituents. If, for instance, spark discharges are passing at the rate of one per second, the whole of the nitrogen peroxide molecules have not time to react with the water molecules to form nitric acid, before the passage of the next spark, and hence some of them suffer decomposition; indeed, it is probable that a number of the nitric oxide molecules first formed have not even time to combine with oxygen to form the peroxide before the passage of the next discharge, which brings about their dissociation. Hence it is that, in a closed space, a limit is soon reached beyond which there is no further increase in the amount of nitric acid. For this reason the yield of nitric acid has hitherto been very small. Dr. V. Lepel has made experiments, therefore, with a slowly moving atmosphere, and under different conditions of pressure, and with various types of spark

discharge, with the result that he has already increased the amount of combination to 10 per cent. of the total amount of air employed. The air is exposed under increased pressure to a series of parallel spark discharges in the same tube. The change of atmosphere is not made continuously, but intermittently, and the gases are expelled from the discharge tube into a large absorption vessel in which the products are absorbed in a solution of water, or of a caustic alkali. Detailed accounts are given in the memoir of the efficacy of the various forms of high tension discharge, and Dr. V. Lepel is now experimenting with the discharge from a Töpler influence machine with sixty-six rotating plates. Of particular interest are his remarks concerning the probable effect of the high voltage discharges of which we have lately heard so much. He considers it not improbable that by their aid a new mode of producing nitric acid from the atmospheric gases on the large scale may be introduced, rendering us altogether independent of the natural nitrates as a source of nitric acid.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from North Borneo, presented by the Rev. Augustus D. Beaufort; two Small Hill Mynahs (*Gracula religiosa*) from India, presented by Lieut.-Col. W. S. Hore; a Chough (*Pyrrhocorax graculus*) from the Aran Islands, Galway, presented by Miss Balfour; four Sœmmerring's Pheasants (*Phasianus sœmmerringi* ♂ ♂ ♀ ♀) from Japan, presented by Mr. Frank Walkinshaw; an Æsculapian Snake (*Coluber æsculapii*), a Vivacious Snake (*Tachymenis vivax*) from Central Europe, presented by Mr. Alfred Scrivener; a Cayenne Lapwing (*Vanellus cayennensis*) from South America, two Axolotls (*Siredon mexicanus*) from Mexico, purchased; a Ruddy-headed Goose (*Bernicla rubidiceps* ♀) from the Falkland Islands, received in exchange; a Burchell's Zebra (*Equus burchellii* ♂); a Thar (*Capra jemlaica*), a Japanese Deer (*Cervus sika*), born in the Gardens.

## OUR ASTRONOMICAL COLUMN.

VARIABLE NEBULÆ.—Mr. Barnard, in *Astronomische Nachrichten*, No. 3097, mentions the cases of two nebulæ which he supposes must be of a variable type. The first has a diameter of about 1′, and appears rather like a comet, the brightness gradually increasing towards the centre, there being no nucleus. Its position for 1889·0 was R.A. 3h. 56m. 17s., Declination + 69° 30′ 38″. The other nebula was discovered by him in 1888, and was estimated to lie between magnitudes 9 and 10, the stellar nucleus being of the thirteenth magnitude. Subsequent observations made in 1891 showed that this nebula had become considerably fainter (13½ mag.), there being still a faint nucleus visible; its diameter was estimated as ½′, while its position for 1888·0 was R.A. oh. 37m. 55·7s., Decl. − 8° 48′ 6″·5.

VARIATION OF LATITUDE.—Mr. Chandler, toward the latter end of last year, contributed to the *Astronomical Journal* several articles on the variation of terrestrial latitudes, in which the following points were brought out :—(1) This variation is truly terrestrial. (2) The period of revolution, from 1863 to 1885, of the pole of the earth's figure round that of rotation amounted to 427 days in a west to east direction. (3) About the year 1730, the length of this period was a little over a year. (4) The velocity of rotation is slowly diminishing. In the present number (267) of the same journal he brings together evidence to establish some further conclusions at which he has arrived, basing them on a very considerable number of series of observations. The results may be briefly summarized as follows :—(*a*) About 1774 the rate of angular motion of the pole was a maximum with a daily rate of 1″·034, and since that period the decrease has taken place at an accelerating rate. (*b*) If $\theta$ be the daily angular motion and T the interval in days from September 18, 1875, the angular velocity of the polar motion may be put in the form

$$\theta = 0''{\cdot}852 - 0''{\cdot}000\,009\,8\,T - 0''{\cdot}000\,000\,000\,132\,T^2,$$

(*c*) The law of the periodic variation may be expressed as follows:—

$$\phi = \phi_0 - 0''{\cdot}22 \cos [\lambda + (t - T)\theta],$$

where T is the time when the north pole of the earth's figure passes the Greenwich meridian,
E the number of completed revolutions between a given date, $t$, and the adopted epoch,
$\theta$ the daily angular motion,
$\phi$ the instantaneous value of the latitude of a place,
$\phi_0$ the mean latitude,
and $\lambda$ the longitude of the same place,
the values of T and $\theta$ being obtained from the equations—

$$T = 1875 \text{ Sept. } 18{\cdot}5 + 422^d{\cdot}56\,E + 1^d{\cdot}034\,E^2 + 0^d{\cdot}009\,E^3 + 0^d\,000067\,E^4,$$

$$\theta = \frac{360^\circ}{P},$$

when $P = 423^d{\cdot}62 + 2^d{\cdot}0953\,E + 0^d{\cdot}0274\,E^2 + 0^d{\cdot}000268\,E^3$.

(*d*) A sensibly constant angular distance between the poles of figure and rotation during the last fifty years has been maintained.

(*e*) By a comparison of absolute and differential determinations the variation is entirely due to zenithal alterations, and not to a simultaneous variation of the zenith and the astronomical pole.

COMPARATIVE SPECTRA OF HIGH AND LOW SUN.—Mr. Edward Stanford has just published five plates, 16¾ × 19⅝ inches, in portfolio form, of Mr. McClean's beautiful comparative photographic spectra of the high and low sun from H to A. The collotype prints have been reproduced from the mounted photographs by the Direct Photo-Engraving Company, and are enlarged about 8½ times from the original negatives. Published simultaneously also are his comparative spectral photographs of the sun and metals, extending from above H to near D. The two series include the platinum and iron-copper groups.

THE CORONOIDAL DISCHARGES.—The discovery of the presence and power of electricity is, comparatively speaking, very modern, and it is only now we are finding out the diversity of results it is capable of producing. The sun being our great source of heat and light, it is only natural that we should suspect him of having a greater quantity of this form of energy in some way or the other, on a scale, of course, very much greater than ours. In a paper read before the National Academy of Sciences, Washington, and published in the June number of the *American Journal of Science*, Mr. M. I. Pupin describes a series of experiments that he has been carrying out with regard to electrical discharges through poor media. The apparatus which he used is fully described, so we will only refer to the plates which illustrate the points he wished to emphasize. The illustrations are from photographs of discharges taken under conditions under which the solar corona is observed, and suggest in a very striking manner the phenomena that are usually observed at these times. In one case, when the vacuum was very poor, the discharge started in the form of four large streamers, together with large jets, their distribution over the whole surface of the sphere being more or less uniform. The appearance of the sphere "reminded me very much of the granular structure of the sun's disk, . . . and the very luminous points which appeared from time to time . . . reminded me . . . of the sun's faculæ." Further experiments regarding the rotational motion of the streamers lead him to conclude that two discharge streamers tended to blow each other out, "owing to the motion of the cooler gas between them, this motion being produced by the enormous heating effect of the discharge." The figures shown are very striking indeed, and represent the general appearances of the corona during eclipses with a remarkable degree of accuracy.

## GEOGRAPHICAL NOTES.

M. JOSEPH MARTIN, well-known on account of his explorations in North-eastern Siberia, has died at Marghilan while on a journey in Central Asia.

THE Kalahari Desert has been crossed successfully by a "trek" of 150 waggons from the Rustenburg district of the Transvaal, bound for Mossamedes, where an active Boer colony has been established, a large party having embarked at Cape Town to join the overland division. Later reports affirm that

a Boer republic has been declared in the plateau region of Angola, one of the healthiest parts of tropical Africa.

THE survey of the district surrounding Aden has been completed by the officers of the Survey of India Department after a very arduous campaign. Work was on several occasions almost stopped by sickness, and by the open hostility of the natives.

STIMULATED by the recent discovery of two complete mammoth carcases in the Government of Irkutsk, the St. Petersburg Academy of Sciences has commissioned Prof. Tcherski, of Irkutsk, to proceed to Yakutsk, on the Lena, and thence, accompanied by Cossacks and pack-horses, eastward to the Kolyma Valley, pushing on if possible this summer to Nizhne Kolymsk in 69° N., returning before winter to Sachiversk on the Indigirka, a town situated on the Arctic Circle. The main object of the expedition is to study the drift geology, but collections will be made in all departments of science, including barometric observations, in order to determine the orography of this rarely visited part of Siberia.

*Globus* announces the formation of a new islet in the Caspian, near Baku, by upheaval. It lies three and a half miles from shore, and measures 175 feet by 100 feet, rising about 20 feet above the water. Its surface is irregular, and composed of blackish-grey and yellow hardened mud.

WITH reference to the note on p. 65 as to the discovery of a new range of mountains in Benin, it is only fair to former travellers in that region to say that the map by the Intelligence Department, although bearing no mountain shading, has marked upon it "Mt. Ara," very near the position where the range seen by Governor Carter is situated.

THE mountaineering expedition, led by Mr. Conway, to attempt the ascent of the loftiest Himalayan summits, has been making excursions from Gilgit and mapping the Bagrot Valley, but bad weather has prevented any very important climbing from being done. A *Times* telegram from Calcutta conveys news of June 8 from Gilgit, from which it appears that the greatest height yet reached is 17,000 feet, one night having been passed at an elevation of 15,600 feet. The party was about to set out for Nagar, *en route* for Askoley, by the Hissar Pass.

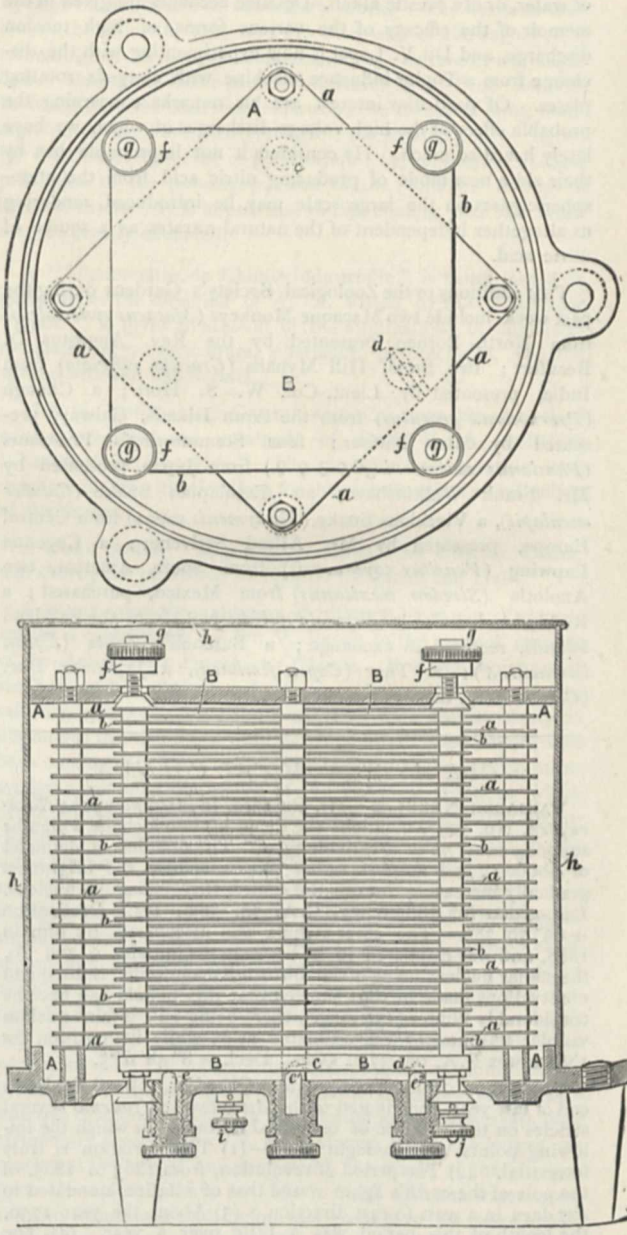
## *A NEW FORM OF AIR LEYDEN.*[1]

IN the title of this paper as originally offered for communication "*Air Condenser*" stood in place of "*Air Leyden*," but it was accompanied by a request to the Secretaries to help me to a better designation than "Air Condenser" (with its ambiguous suggestion of an apparatus for condensing air), and I was happily answered by Lord Rayleigh with a proposal to use the word "leyden" to denote a generalized Leyden jar, which I have gladly adopted.

The apparatus to be described affords, in conjunction with a suitable electrometer, a convenient means of quickly measuring small electrostatic capacities, such as those of short lengths of cable.

The instrument is formed by two mutually insulated metallic pieces, which we shall call A and B, constituting the two systems of an air condenser, or, as we shall now call it, an air leyden. The systems are composed of parallel plates, each set bound together by four long metal bolts. The two extreme plates of set A are circles of much thicker metal than the rest, which are all squares of thin sheet brass. The set B are all squares, the bottom of which is of much thicker metal than the others, and the plates of this system are one less in number than the plates of system A. The four bolts binding together the plates of each system pass through well-fitted holes in the corners of the squares; and the distance from plate to plate of the same set is regulated by annular distance pieces which are carefully made to fit the bolt, and are made exactly the same in all respects. Each system is bound firmly together by screwing home nuts on the ends of the bolts, and thus the parallelism and rigidity of the entire set is secured.

The two systems are made up together, so that every plate of B is between two plates of A, and every plate of A, except the two end ones, which only present one face to those of the opposite set, is between two plates of B. When the instrument is set up for use, the system B rests by means of the well-known "hole slot and plane arrangement,"[1] engraved on the under side of its bottom plate, on three glass columns which are attached to three metal screws working through the sole plate of system A. These screws can be raised or lowered at pleasure, and by means of a gauge the plates of system B can be adjusted to exactly midway between and parallel to the plates of system



A. The complete leyden stands upon three vulcanite feet attached to the lower side of the sole plate of system A.

In order that the instrument may not be injured in carriage, an arrangement, described as follows, is provided, by which system B can be lifted from off the three glass columns and firmly clamped to the top and bottom plates of system A.

The bolts fixing the corners of the plates of system B are made long enough to pass through wide conical holes cut in the top and bottom plates of system A, and the nuts at the top end of the bolts are also conical in form, while conical nuts are also

[1] "On a New Form of Air Leyden, with Application to the Measurement of Small Electrostatic Capacities." By Lord Kelvin, P.R.S. Read at the Royal Society on June 2.

[1] Thomson and Tait's "Natural Philosophy," § 198 example 3.

fixed to their lower ends below the base plate of system A. Thumbscrew nuts, *f*, are placed upon the upper ends of the bolts after they pass through the holes in the top plate of system A.

When the instrument is set up ready for use, these thumbscrews are turned up against fixed stops, *g*, so as to be well clear of the top plate of system A ; but when the instrument is packed for carriage they are screwed down against the plate until the conical nuts mentioned above are drawn up into the conical holes in the top and bottom plates of system A ; system B is thus raised off the glass pillars, and the two systems are securely locked together so as to prevent damage to the instrument.

A dust-tight cylindrical metal case, *h*, which can be easily taken off for inspection, covers the two systems, and fits on to a flange on system A. The whole instrument rests on three vulcanite legs attached to the brass plate on system A ; and two terminals are provided, one, *i*, on the base of system A, and the other, *j*, on the end of one of the corner bolts of system B.

The air leyden which has been thus described is used as a standard of electrostatic capacity. In the instrument actually exhibited to the Society there are twenty-two plates of the system B, twenty-three of the system A, and therefore forty-four octagonal air spaces between the two sets of plates. The thickness of each of these air spaces is approximately 0·301 of a centimetre. The side of each square is 10·13 cm., and therefore the area of each octagonal air space is 85·1 sq. cm. The capacity of the whole leyden is therefore approximately $44 \times 85 \cdot 1/(4\pi \times \cdot 287)$, or 1038 cm. in electrostatic measure. This is only an approximate estimate, founded on a not minutely accurate measurement of dimensions, and not corrected for the addition of capacity, due to the edges and projecting angles of the squares and the metal cover. I hope to have the capacity determined with great accuracy by comparison with Mr. Glazebrook's standards in Cambridge.

To explain its use in connection with an idiostatic electrometer for the direct measurement of the capacity of any insulated conductor, I shall suppose, for example, this insulated conductor to be the insulated wire of a short length of submarine cable core, or of telephone, or telegraph, or electric light cable, sunk under water, except a projecting portion to allow external connection to be made with the insulated wire.

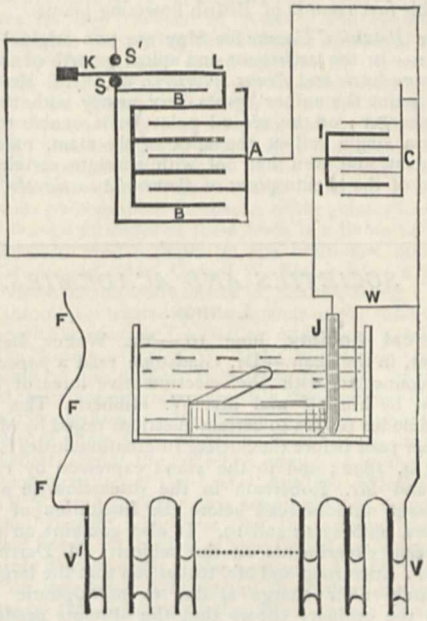
The electrometer which I find most convenient is my "multicellular voltmeter," rendered practically dead-beat by a vane under oil hung on the lower end of the long stem carrying the electric "needles" (or movable plates). In the multicellular voltmeter used in the experimental illustration before the Royal Society, the index shows its readings on a vertical cylindric surface, which for electric light stations is more convenient than the horizontal scale of the multicellular voltmeters hitherto in use ; but for the measurement of electrostatic capacity the older horizontal scale instrument is as convenient as the new form.

To give a convenient primary electrification for the measurement, a voltaic battery, *vv'*, of about 150 or 200 elements, of each of which the liquid is a drop of water held up by the capillary attraction between a zinc and copper plate about 1 mm. asunder. An ordinary electric machine, or even a stick of rubbed sealing-wax, may, however, be used, but not with the same facility for giving the amount of electrification desired as the voltaic battery.

One end of the voltaic battery is kept joined metallically to a wire, W, dipping in the water in which the cable is submerged, and with the case C of the multicellular, and with the case and plates A of the Leyden, and with a fixed stud, S, forming part of the operating key to be described later. The other end of the voltaic battery is connected to a flexible insulated wire, FFF, used for giving the primary electrification to the insulated wire J of the cable, and the insulated cells, II, of the multicellular kept metallically connected with it. The insulated plates B of the leyden are connected to a spring, KL, of the operating key referred to above, which, when left to itself, presses down on the metal stud S, and which is very perfectly insulated when lifted from contact with S by a finger applied to the insulating handle H. A second well insulated stud, S', is kept in metallic connection with J and I (the insulated wire of the cable and the insulated cells of the multicellular).

To make a measurement, the flexible wire F is brought by hand to touch momentarily on a wire connected with the stud S', and immediately after that a reading of the electrometer is taken and watched for a minute or two to test either that there is no sensible loss by imperfect insulation of the cable and the insulated cells of the multicellular, or that the loss is not sufficiently rapid to vitiate the measurement. When the operator is satisfied with this, he records his reading of the electrometer, presses up the handle H of the key, and so disconnects the plates B of the leyden from S and A, and connects them with S', J, I. Fifteen or twenty seconds of time suffices to take the thus diminished reading of the multicellular, and the measurement is complete.

The capacity of the cable is then found by the analogy :—As the second reading of the electrometer is to the excess of the




first above the second, so is the capacity of the leyden to the capacity of the cable.

A small correction is readily made with sufficient accuracy for the varying capacity of the electrometer, according to the different positions of the movable plates, corresponding to the different readings, by aid of a table of corrections determined by special measurements for capacity for the purpose on the multicellular.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—Prof. Liveing announces a course of lectures in general chemistry, to be given during the Long Vacation by Mr. Fenton, beginning on July 7. Mr. Fenton will also give a series of demonstrations on the chemistry of photography.

At the Congregation on June 16, seven graduates in arts were admitted to the degree of Doctor in Medicine, and thirty-one to the degrees of Bachelor of Medicine and Bachelor of Surgery. These are the largest numbers hitherto admitted at one time.

Sir R. S. Ball, Lowndean Professor of Geometry and Astronomy, has been elected to a Professorial Fellowship at King's College.

At Christ's College the following awards have been made to students of natural science :—Scholarships : E. K. Jones (£50), G. A. Anden (£30), J. M. Woolley (£30), C. F. G. Masterman (£50), H. Pentecost (£50), A. M. Hale (£30). Exhibition : A. M. Barraclough (£30). At Emmanuel College :—Scholarship : A. Eichholz (£80). Exhibition : J. C. Muir (£30).

At the annual election of scholars in St. John's College, the following awards in Natural Science have been made :—Foundation Scholarships : W. L. Brown, T. L. Jackson, W. McDougall, S. S. F. Blackman. Exhibitions in Augmentation of Scholarships : Villy, Whipple (First Class Nat. Sci. Tripos, Part II.). Hughes Prize (highest in third year) : Villy. Herschel Prize in Astronomy : Pocklington. Hutchinson Studentship for Research in Zoology : E. W. MacBride.

## SCIENTIFIC SERIALS.

THE numbers of the *Journal of Botany* for May and June appeal almost entirely to students of systematic and descriptive botany:—Mr. F. J. Hanbury continues his notes on *Hieracia* new to Britain, in the course of which he describes three species altogether new.—Mr. Geo. Massee contributes diagnoses of a number of new species of Fungi from St. Vincent, illustrated by three coloured plates.—Mr. E. G. Baker continues his Synopsis of genera and species of *Malveæ*; Rev. Moyle Rogers his essay at a key to British *Rubi*; and Mr. W. A. Clarke his first records of British flowering plants.

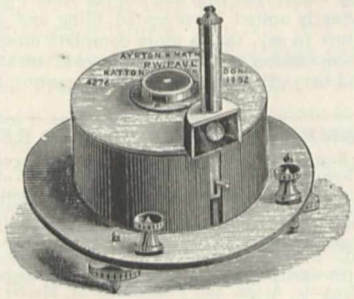
IN the *Botanical Gazette* for May are two original papers of interest:—On the archegone and apical growth of the stem in *Tsuga canadensis* and *Pinus sylvestris*, by D. M. Mottier. On the first point the author agrees very nearly with the account by Strasburger; on the second point he is unable to say that there is a single cell at the apex of the stem, unless in the young plant, and even then not with absolute certainty.—Germination of the teleutospores of *Ravenalia cassiæcola*, by B. M. Duggar.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Physical Society**, June 10.—Mr. Walter Baily, Vice-President, in the chair.—Dr. Gladstone read a paper on some points connected with the electromotive force of secondary batteries, by himself and Mr. W. Hibbert. The communication includes replies to certain questions raised by M. Darrieus in a paper read before the Société Internationale des Électriciens on May 4, 1892; and to the views expressed by Prof. Armstrong and Mr. Robertson in the discussion on a paper by the present authors read before the Institution of Electrical Engineers, on May 12 and 19. It also contains an account of their recent experiments on the subject. M. Darrieus agrees with Prof. Armstrong and Mr. Robertson that the large E.M.F. immediately after charge is due to persulphuric acid, and opposes the ordinary theory that the ultimate product of discharge is lead sulphate at both plates, so far as the positive plate is concerned. The authors attribute the finding of large quantities of lead oxide by M. Darrieus to difficulties in analysis, for it is not easy to imagine that oxide of lead could remain as such in presence of sulphuric acid. They have also shown that the changes of E.M.F. during charge and discharge coincide fairly well with those obtained by putting Pb and $PbO_2$ plates in different strengths of acid, and conclude "that the changes of E.M.F. . . . depend on the strength of the acid that is against the working surfaces of the plates." Prof. Armstrong and Mr. Robertson disagree with the authors' views, and suppose that the sulphuric acid used was contaminated with soluble peroxides; and they also believe that $H_2SO_4$ itself takes part in the reactions. As regards the first objection, the authors see no reason why the traces of soluble peroxide (if any) on the plates should always vary in amount with the strength of the fresh acid in which the plates were dipped. The second point they leave an open question. In reply to the criticism on the summation of the two curves obtained respectively with two lead plates and two lead peroxide plates in acids of different strengths, they point out that the resulting curve coincides both in shape and magnitude with that determined when a Pb and a $PbO_2$ plate were placed in different strengths of acid. Whilst admitting the possibility of the lead supports having some influence on the result, they cannot conceive that such large and uniform differences as those given in their paper can be due to accidental operations of local action. To show that the increase of E.M.F. does not depend on the presence or absence of persulphuric acid, the authors have tested the E.M.F. of a Pb and a $PbO_2$ plate, free from soluble oxides, in sulphuric acid of 15 per cent. strength, a porous diaphragm being between the plates. The E.M.F. was 1·945 volts. After adding 1 per cent. of persulphate of potassium to the liquid surrounding the $PbO_2$ plate, the E.M.F. was unaltered; whilst putting the Pb plate in the same liquid only reduced the E.M.F. to 1·934. Experiments had also been made on cells with phosphoric acid of different strengths, instead of sulphuric acid. Changing the density from 1·05 to 1·5, raised the E.M.F. 0·176 volt, whilst calculations from Lord Kelvin's law gave 0·171 volt. In this case they consider that no acid analogous to persulphuric acid could be present. They also find that the effects of charging and repose on the E.M.F. of phosphoric acid cells are quite analogous to those obtained with sulphuric acid. The researches are being extended chiefly on the thermochemical side. Prof. Ayrton thought there was no question that the strength of acid had much to do with the changes of E.M.F. The point at issue, he considered, was whether the changes were direct effects of the strength of acid, or due to secondary actions brought about by alterations in strength. Mr. E. W. Smith said Mr. Robertson and himself were repeating the author's experiments with two $PbO_2$ plates without any grid. They had obtained results analogous to those mentioned in the paper, but the true explanation of the effects was still to seek. Mr. W. Hibbert contended that the soluble oxides referred to by Prof. Armstrong and Mr. Robertson were not present in their experiments. They had also proved that changes in acid strength altered the E.M.F., whilst presence of persulphuric acid did not. Dr. Gladstone, in reply, said they also were making experiments without grids, but had not made sufficient progress to discuss them at present. Mr. Hibbert and himself believed the effects of local action inconsiderable, whilst Messrs. Armstrong and Robertson thought them very important. He hoped that ere long the points would be settled conclusively.—A paper on workshop ballistic and other shielded galvanometers, by Prof. W. E. Ayrton, F.R.S., and Mr. T. Mather, was read by Prof. Ayrton. The galvanometers described were of the type having movable coils and fixed magnets, the advantages of which are well known. In designing the ballistic instruments, their aim had been to obtain sensibility and portability, combined with being screened from external influences, for it was often desirable to measure the magnetic fluxes and fields in dynamos by apparatus near the machines. One of the improvements adopted was the narrow coil described in a paper "On the Shape of Movable Coils, &c.," read before the Society in 1890. Such coils are particularly advantageous for ballistic instruments, for not only can greater swings be obtained by the discharge of a given quantity of electricity through such a coil than with ordinary shaped coils when the periodic times are the same, but even when the same control is used, the same length of wire in the coil, and suspended in the same field, the narrow coil is more sensitive to discharges than coils of any other shape. Another improvement was the use of phosphor bronze strip for the suspensions instead of round wire. For a given tensile strength, both the control and the subpermanent set could be diminished by using strip. In February 1888 the authors made a d'Arsonval of the ordinary type as a ballistic instrument, and found that although it was suitable for comparing condensers, yet for induction measurements the damping was excessive unless the resistance in the circuit was very large. This greatly reduced the sensitiveness. In 1890 they tried one of Carpentier's milliamperemeters as a ballistic instrument, but found it insensitive. A narrow coil instrument made in the same year was found to be sensitive for currents; but as the coil was wound on copper to get damping, it was not suitable for ballistic work. In January 1892 a somewhat similar instrument was constructed for ballistic purposes, and was found very sensitive and convenient. Although the coil had only a resistance of 13 ohms, one microcoulomb gave a swing of 170 divisions on a scale 2000 divisions distant, the periodic time being 2·7 seconds. The instrument could be used near electromagnets or dynamos, and was so sensitive that for ordinary induction measurements very large resistances can be put in series with it, thus reducing the damping to a very small amount. On the other hand, the coil could be brought to rest immediately by a short circuit key. It had the further advantage that it was not necessary to redetermine its constant every time it was used. The chief disadvantage of such instruments was the variable damping on closed circuits of different resistances. This could, however, be overcome by arranging shunts and resistances so that the external resistance between the galvanometer terminals was the same for all sensibilities. A portable ballistic instrument, intended for workshop use, was next described. This had a narrow coil and a pointer moving over a dial whose whole circumference was divided into 200 parts. The instrument had been designed to give a complete revolution for a reversal of a flux of two million C.G.S. lines, but the pointer could turn through two or more revolutions. To test strong fields a test coil with a total area of 10,000 square centimetres is used, and has a trigger arrangement for suddenly twisting it through two right angles. The instrument then reads off directly the strength of

field in C.G.S. lines. To vary the sensitiveness in known proportions, resistances are employed. Referring to the improvements made in movable coil instruments since January 1890, when a paper on "Galvanometers" was read before the Society by Dr. Sumpner and the present authors, Prof. Ayrton said Mr. Crompton had greatly increased the sensitiveness of Carpentier's instruments by suspending the coils with phosphor-bronze strip. Mr. Paul had brought out a narrow-coil instrument which combined the advantages of portability, dead-beatness, quickness,



and sensibility. Specimens of these instruments were exhibited. The narrow coils are inclosed in silver tubes, which serve to damp the oscillations. Such a coil is suspended within a brass tube which also forms the mirror chamber, and slides down between the poles of a circular magnet fixed to the base. To clamp the coil, a plug mounted on a slotted spring passes through a hole in the brass tube. A tube can be taken out and replaced by another containing a coil of different resistance in a few seconds. An instrument of this kind, with a coil of 300 ohms, gave 95 divisions per microampere, and the damping on open circuit was such that any swing was $\frac{1}{12}$ of the previous one. On comparing recent instruments with those mentioned in the paper on galvanometers above referred to, a distinct improvement is apparent, for their sensitiveness is, for the same resistance and periodic time, as great as that of Thomson instruments. Prof. Perry remarked that the forces dealt with were extremely small. Mr. Swinburne thought that ballistic galvanometers might be regarded as instruments indicating the time integral of E.M.F. rather than quantity. Illustrating his meaning by reference to dynamos, he said that if two machines arranged as dynamo and motor were joined by wires, then, if the armature of the dynamo were turned through any angle, that of the motor would move through the same angle, supposing friction, &c., eliminated. Speaking of figures of merit, he pointed out that the power consumed was the important factor. Prof. S. P. Thompson inquired what was the longest period yet obtained with narrow-coil instruments. The decay of magnetism in large dynamos was so slow that very long periods were required. He himself had used a weighted coil for such measurements. He also wished to know why the figures of merit were expressed in terms of scale divisions on a scale at 2000 divisions distance, instead of in angular measure or in tangents. Mr. E. W. Smith asked what was the length of strip required to prevent permanent set when the deflection exceeded a revolution. Mr. A. P. Trotter thought that, in testing magnetic fluxes by the workshop ballistic instrument, the test coil might be left in circuit instead of putting in another coil. He wished to know what error was introduced by the change of damping caused by the resistance of the circuit not being quite constant. In his reply, Prof. Ayrton said Mr. Boys had pointed out that the scientific way to lengthen period was not by weighting the coils or needles, but to weaken the control. Periods of 5 seconds had been obtained. At present it was not easy to obtain longer periods owing to difficulties in obtaining sufficiently thin strip, and to the magnetism of materials.

**Zoological Society**, June 14.—Prof. W. H. Flower, C.B., F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of May 1892, calling special attention to a pair of the rare and beautiful Passerine bird the Grey Coly-Shrike (*Hypocolius ampelinus*) from Fao, Persian Gulf, presented by Mr. W. D. Cumming. He also made some remarks on the most interesting objects observed during a recent visit to the Zoological Gardens of Rotterdam, the Hague, Amsterdam, and Antwerp.—A communication from Mr. T. D. A. Cockerell contained particulars of the occurrence of a species of Jacana (*Jacana spinosa*) in Jamaica.—Dr. John Anderson, F.R.S., exhibited and made remarks on some specimens of the Mole-Rat (*Spalax typhlus*) from Egypt.—Prof. Romanes gave an account of some results recently obtained from the cross-breeding of Rats and of Rabbits, and showed that it did not follow that a blending of the characters of the parents was the result of crossing two different varieties.—Prof. Howes exhibited and made remarks on some photographs received from Prof. Parker, of Otago, New Zealand, illustrative of Sea-Lions, Penguins, and Albatrosses in their native haunts.—Dr. Dawson made remarks on the Fur-Seal of Alaska, and exhibited a series of photographs illustrating the attitudes and mode of life of these animals.—Mr. Sclater called attention to the habits of a South African Snake (*Dasypeltis scabra*) as exhibited by an example now in the Society's Gardens.—Mr. Sclater also read some extracts from a letter addressed to him by Mr. H. H. Johnston, C.B., announcing the despatch of a consignment of natural history specimens illustrative of the fauna and flora of the Shiré Highlands.—Mr. W. Saville Kent exhibited and made remarks on some photographs of a species of the genus *Podargus*, showing the strange attitudes of these birds in a living state.—Mr. F. E. Beddard read a paper on the brain and muscular anatomy of *Aulacodus*.—Mr. Gerard W. Butler read a paper on the subdivision of the body-cavity in Snakes, being a continuation of the subject treated of in a memoir on the subdivision of the body-cavity in Lizards, Crocodiles, and Birds, previously read before the Society.—Mr. J. W. Gregory gave an account of his researches on the British Palæogene Bryozoa, of which he recognized thirty species, represented in the National Collection by about 750 specimens.—Mr. Sclater gave an account of a small collection of Birds from Anguilla, West Indies, made by Mr. W. R. Elliott, one of the collectors employed by the Committee for the exploration of the Lesser Antilles.—Prof. G. J. Romanes, F.R.S., read a paper on a seemingly new diagnostic character of the Primates, which was that the terminal joints of both hands and feet in all species of this Order are destitute of hairs. This rule did not apply to the Lemurs.—Mr. O. Thomas read a paper on the genus *Echinops*, of the order Insectivora, and gave notes on the dentition of the allied genera *Ericulus* and *Centetes*.—Mr. G. A. Boulenger gave an account of the Reptiles and Batrachians collected by Mr. C. Hose on Mount Dulit, North Borneo. Amongst these was a fine new Lizard of the genus *Varanus*, proposed to be called *V. heteropholis*. Two new Batrachians were also described as *Rhacophorus dulitensis* and *Nectophryne hosii*.—A paper was read by Lieut.-Colonel H. H. Godwin-Austen, F.R.S., on new species and varieties of the Land-Molluscan genus *Diplommatina*, collected by himself, and more recently by Mr. W. Doherty, in the Naga and Munipur Hill ranges. The author described twenty-seven supposed new species, the most remarkable being *D. unicrenata*, with a peculiarly formed peristome.—A communication was read from Mr. B. B. Woodward on the mode of growth and the structure of the shell in *Velates conoideus*, Lamk., and in other *Neritidæ*. The mode of growth and the structure of this shell were described as follows: Up to a certain point the growth is normal; a change in the direction of growth afterwards takes place, and the test is enlarged by the addition of fresh shelly matter on the exterior of the under side, and by the removal of previously-formed layers on the inner surface. The internal septum that serves the purpose of a myophore was shown to have originated in the paries, which, in the course of growth, had been replaced by the septum. In this respect *Velates conoideus* epitomized in its life-history conditions which are found in distinct recent species of the closely-allied genus *Neritina*. The relations of the paries and septum in this last genus were also described in this paper.—This meeting closes the present session. The next session (1892–93) will commence in November 1892.

PARIS.

**Academy of Sciences**, June 20.—M. d'Abbadie in the chair.—Phenomena of the residual life of muscle taken from the living being: physiological action of the muscular bases, by MM. Arm. Gautier and L. Landi.—On the influence of mineral filters on liquids containing substances produced by microbes, by M. Arloing.—On the sanitary system adopted by the Venice Conference to prevent cholera from penetrating into Europe through the Isthmus of Suez, by M. P. Brouardel. Four previous conferences for the reform of the quarantine system having failed, that convened at Venice in January 1892 has at last adopted a system chiefly advocated by the French dele-

gates, and practically tested on the Pyrenees frontier during the cholera in Spain two years ago. On that occasion the passengers' linen was disinfected in heating ovens by steam under pressure, and the cholera patients, real or suspected, were isolated. It having been shown that it is practically impossible for a vessel to pass the Suez Canal in quarantine, without contact with the shores, it was resolved that no vessel should be allowed to pass into the Mediterranean unless it was free from infection or had been completely disinfected. Vessels from the Orient which have had no case of cholera since their departure will be allowed a perfectly free passage. Those which have had cases of cholera during the voyage, but none for seven days before arrival, will be allowed to pass the Canal in quarantine if they have a medical officer and a disinfecting stove on board. If not, they will be retained at the entrance of the Canal, where a sanitary station will be erected, and where the disinfection will take place. Infected vessels will be detained at the entrance, the patients will be disembarked and isolated, and the vessels will be disinfected. It is calculated that, out of 16,000 vessels that have passed through the Canal in five years, under the regulations now adopted 28 would have had to undergo a delay of a few hours for disinfection, and 2 would have been detained for a few days.—On the law of correspondence of tangent planes in the transformation of surfaces by curved symmetry, by M. S. Mangeot.—On the distribution of pressures in a rectangular solid charged transversally, by M. Flamant.—On the law of resistance of the cylinders utilized in the crusher manometers, by M. P. Vieille.—On the Doppler-Fizeau method, by M. Moessard. If the relative motions of the source and the observer be alone considered, without reference to the distortion of the wave-front due to motion through the connecting medium, the ratio of the real to the apparent wave-length will be $\frac{V}{V - v + v'}$, where V is the velocity of wave propagation, $v$ that of the source, $v'$ that of the observer. The true formula for this ratio is $\frac{V - v'}{V - v}$, which, in the case of $V = v$, will differ from the former by infinity.—An examination of the possibility of a reciprocal action between an electrified body and a magnet, by M. Vaschy. Showing that such an action cannot exist unless it be due to a physical quality of the ether different from that implied by the coefficients $k$ and $k'$ in the electric and magnetic laws of attraction, viz. $f = k\frac{qq'}{r^2}$, and $f = k'\frac{mm'}{r^2}$.—Action of nitric oxide on the metallic oxides, by MM. Paul Sabatier and J. B. Senderens.—On a bromo-nitride of phosphorus, by M. A. Besson.—On permolybdic acid, by M. E. Péchard.—On the alteration of preserved ferruginous mineral waters, by M. J. Riban.—On the transformation of gallic acid into pyrogallol: fusion point of pyrogallol, by M. P. Cazeneuve.—On the intestinal calculi of the cachalot (*ambre gris*), by M. Georges Pouchet.—The heliotropism of the *Nauplius*, by M. C. Viguier.—Researches on the proximate composition of vegetable tissues, by M. G. Bertrand.—On the action of some mineral salts on lactic fermentation, by M. Ch. Richet.—On the respiratory exchange, by MM. Chr. Bohr and V. Henriquez. An account of experiments showing that the lungs are not only the seat of the process of gaseous exchange, but also of the oxidation of tissue elements.—Origins and trophic centres of the vaso-dilatatory nerves, by M. J. P. Morat.—Researches on the requirements of the vine, by M. A. Muntz.—On the topography of some lakes of the Jura, the Bugey, and the Isère, by M. A. Delebecque.

AMSTERDAM.

**Royal Academy of Sciences**, May 28.—Prof. van de Sande Bakhuyzen in the chair.—Mr. Behrens dealt with specimens of brass made by compression of the constituents at ordinary temperature by Prof. W. Spring, Liége, Belgium. One of the specimens, kindly forwarded by Prof. Spring, was of a reddish colour, and had been produced by compressing a mixture of 9 parts of copper and 1 part of zinc; another, pale yellow, by compressing a mixture of 7 parts Cu and 3 parts Zn. Both specimens had been filed up twice, and again consolidated by pressure. The reddish metal was a little softer than common cast brass; it could be somewhat flattened under the hammer. The yellow metal was harder than common brass, and brittle. Both varieties contain a great quantity of yellow alloy, which seems to be in an amorphous state, showing a uniform, finely granular appearance, without any vestige of the beautiful crystallites, so characteristic for copper-zinc alloys, obtained by fusion. Further, a good deal of angular fragments of red copper, some of them cracked and doubled up, with yellow threads between the red lumps and strands, and finally some zinc, angular fragments and threads, trending outwards and uniting near the curved surface of the cylindrical specimens. The metal is nearly, but not wholly compact. There is much that gives evidence of a flow in the yellow alloy and in the zinc, but nothing pointing to a truly liquid state of the alloy or one of its components. Regelation seems to be put aside, while there does not remain any doubt that zinc and copper have been intimately mixed and actually united by repeated filing and compression. One may venture to say, that a more complete union of metallic powders by compression will lead to alloys of most remarkable properties, and may give some alloys that cannot be produced by fusion.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Our Earth—Night to Twilight, vol. i.: G. Ferguson (Unwin).—The Alternate Current Transformer, vol. ii. The Utilization of Induced Currents: Prof. J. A. Fleming (*Electrician* Company).—Essai sur la Vie et la Mort: A. Sabatier (Paris, Babé).—Chambers's Encyclopædia, vol. ix. (Chambers).—Iconographia Floræ Japonicæ, vol. i. Part 2: Dr. K. Yatabe (Tōkyō).—Thermodynamique à l'Usage des Ingénieurs: A. Witz (Paris, Gauthier-Villars).—U.S. Relief Map (Washington).—Bees for Pleasure and Profit: G. G Samson (Lockwood).—Waterdale Researches; or, Fresh Light on the Dynamic Action and Ponderosity of Matter: 'Waterdale' (Chapman and Hall).—Helen Keller: Souvenir of the First Summer Meeting of the American Association to Promote the Teaching of Speech to the Deaf; second edition (Washington, Volta Bureau).

PAMPHLETS.—Descriptive List of the Fishes of Lorain County, Ohio: L. M. McCormick (Oberlin).—Land Improvement in India: Colonel A. T. Fraser (Bombay, Thacker).—Proposal for a National Photographic Record and Survey: W. J. Harrison (Harrison).

SERIALS.—Journal of the College of Science, Imperial University, Japan, vol. v., Part 1 (Tōkyō).—Journal of the Institution of Electrical Engineers, June (Spon).—Journal of the Polynesian Society, vol. i. No. 1 (Wellington, N.Z.).—Proceedings of the Society for Psychical Research, June (Kegan Paul).—Deutsche Ueberseeische Meteorologische Beobachtungen, Heft 4 (Hamburg).—Journal and Proceedings of the Royal Society of New South Wales, vol. xxv., 1891 (Kegan Paul).—Beiträge zur Biologie der Pflanzen, v. Band. 3 Heft (Williams and Norgate).—Bulletin from the Laboratories of Natural History of the State University of Iowa, vol. ii. No. 2 (Iowa).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Sechzehnter Band, 1 Heft, Fünfzehnter Band, 3 Heft (Williams and Norgate).—Encyklopædia der Naturwissenschaften, Erste Abthg., 67 Liefg., Zweite Abthg, 69–70 Lief. (Williams and Norgate).

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