SCIENCE

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FRIDAY, SEPTEMBER 15, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES.

THE figures in the accompanying table, which have been obtained from official sources, show that in the course of the past eight years the degree of doctor of philosophy or doctor of science has been conferred on 2,037 students by thirty-five American universities. This record is tolerably complete, for although the degree

TABLE I.

DOCTORATES CONFERRED.

	1898	1899	1900	1901	1902	1903	1904	1905	Total
Chicago	36	24	37	36	27	32	36	44	272
Yale	34	30	26	39	29	36	39	34	267
Harvard	26	24	36	29	31	28	46	38	258
Johns Hopkins	33	38	33	30	17	23	31	35	240
Columbia	22	33	21	25	32	39	29	38	239
Pennsylvania	24	20	15	25	14	29	18	26	171
Cornell	19	7	19	21	23	20	13	21	143
Clark	12	5	9	7	1	4	10	18	66
Michigan	7	4	5	3	10	10	8	7	54
New York	5	9	7	6	4	4	9	7	51
Wisconsin	5	7	5	5	6	2	10	9	49
Boston	0	0	0	0	0	4	7	14	25
Virginia	0	2	2	8	6	3	1	1	23
George Washington	1	0	5	3	2	4	3	3	21
Minnesota	1	2	3	2	3	3	3	3	20
California	1	3	2	2	1	3	3	4	19
Brown	1	3	3	2	2	5	0	2	18
Bryn Mawr	3	3	1	2	2	0	5	2	18
Princeton	0	3	3	3	1	1	2	5	18
Stanford	2	0	2	2	2	1	1	1	11
Nebraska	2	1	1	1	0	0	2	3	10
Georgetown	0	0	0	0	0	3	1	2	6
Washington	0	2	0	1	0	1	1	0	5
Iowa	0	0	0	0	0	2	0	2	4
North Carolina	0	0	0	0	2	1	0	1	4
Vanderbilt	0	0	3	1	0	0	0	0	4
Cincinnati	0	0	0	0	0	1	1	1	3
Colorado	0	1	0	0	0	0	2	0	3
Kansas	0	1	0	0	0	2	0	0	3
Lafayette	0	0	0	0	0	3	0	0	3
Missouri	0	1	0	0	0	0	0	2	3
Lehigh	0	0	0	0	0	2	0	0	2
Syracuse	0	1	0	0	1	0	0	0	2
Illinois	0	0	0	0	0	0	0	1	1
Tulane	0	0	1	0	0	0	0	0	1
	234	224	239	253	216	266	281	324	2037

has been conferred by other institutions, but few of them have proper facilities for research. The table shows that 324 degrees were conferred this year, a considerable increase over 1904 and over any preceding year. During the first five years covered by these records there was no increase in the number of degrees, the average being 233. In 1903 there was a gain of 33 above this average, in 1904 of 48, and this year of 91. The increase in the present year is satisfactory, and if maintained may supply the demand for those competent to carry on research work. An average increase of about twelve degrees a year for the past seven years is, however, small, not in proportion to the increase in the number of graduate students or of academic and other positions where competence in research is a qualification. It is further probable that the number of degrees given to American students by German universities has decreased during this period.

Attention has been called on previous occasions to the large percentage of degrees conferred by a few institutions. There is, however, a slight tendency, that will probably become more marked, for the gap between the seven institutions at the head of the list and those below to be filled in. The fact that Boston University this year conferred 14 degrees is probably exceptional, but the nine degrees conferred by the University of Wisconsin are more likely to be increased than diminished in subsequent years. Several institutions of the central and western states, of which California and Wisconsin may be especially mentioned, have greatly improved their facilities for graduate work during the period covered by these statistics. Up to the present time the universities fall into rather well-marked groups. Chicago, Yale, Harvard, Johns Hopkins and Columbia have, in the course of the past eight years, each conferred about 250 degrees; Pennsylvania and Cornell about 150; Clark, Michigan, New York and Wisconsin about 50; Boston, Virginia, George Washington, Minnesota, California, Brown, Bryn Mawr and Princeton about 20; Stanford and Nebraska about 10.

The University of Chicago gave this year 44 doctor's degrees, of which 21 were in the sciences, and these figures place Chicago at the head of both lists, it surpassing Yale as the university which up to last year had conferred the greatest number of degrees, and the Johns Hopkins University, which up to last year had conferred the greatest number of degrees in science. Clark University this year conferred as many as 18 degrees, all in the sciences, and Boston University conferred 14 degrees, none of which were in the sciences.

TABLE II.

DOCTORATES CONFERRED IN THE SCIENCES.

	1898	1899	1900	1901	1902	1903	1904	1905	Total	Per Cent.
Chicago	12	13	19	16	15	21	14	21	131	48
Johns Hopkins	19	17	20	19	9	10	17	18	129	53
Columbia	10	23	12	13	14	18	11	20	121	51
Harvard	11	7	15	15	14	15	23	12	112	43
Yale	11	15	10	18	10	13	15	13	105	39
Cornell	11	2	11	13	16	13	8	13	87	61
Pennsylvania	8	8	6	12	5	14	9	12	74	43
Clark	12	5	9	7	1	4	10	18	66	100
Wisconsin	2	4	1	3	4	0	4	3	21	43
Michigan	0	3	1	0	5	4	6	?	19	35
California	1	3	1	2	1	3	2	3	16	84
George Washington	1	0	3	1	1	4	1	3	14	67
Brown	1	0	0	1	2	4	0	2	10	56
Bryn Mawr	1	2	1	2	1	0	2	0	9	50
Princeton	0	3	1	0	0	1	1	3	9	50
Virginia	0	2	0	4	1	2	0	0	9	39
Nebraska	2	1	1	1	0	0	1	2	8	80
Stanford	2	0	0	1	2	1	1	1	8	73
Minnesota	0	1	1	0	2	1	0	1	6	30
New York	1	1	0	1	0	0	1	1	5	10
Washington	0	2	0	1	0	1	1	0	5	100
Iowa	0	0	0	0	0	1	0	2	3	75
Kansas	0	1	0	0	0	2	0	0	3	100
North Carolina	0	0	0	0	2	1	0	0	3	75
Lehigh	0	0	0	0	0	2	0	0	2	100
Missouri	0	1	0	0	0	0	0	1	2	67
Vanderbilt	0	0	1	1	0	0	0	0	2	50
Cincinnati	0	0	0	0	0	0	0	1	1	33
Colorado	0	1	0	0	0	0	0	0	1	33
Georgetown	0	0	0	0	0	0	1	0	1	17
Lafayette	0	0	0	0	0	1	0	0	1	33
Syracuse	0	0	0	0	1	0	0	0	1	50
	105	115	113	131	106	136	128	150	984	48

Table II. shows the number of degrees that have been conferred in the natural and exact sciences by the several institutions. The last column gives the per cent. of doctor's degrees in the sciences that each institution has conferred. It is thus seen that the study of the natural sciences is relatively emphasized in certain institutions, some universities conferring more than half the degrees in the sciences and others less than half.

The third table gives the degrees conferred in each of the sciences. Chemistry maintains the position of having more than twice as many doctorates as physics, which stands next on the list. Psychology this year passes zoology, and mathematics makes a considerable gain.

TABLE III.

DOCTORATES CONFERRED IN THE SCIENCES.

	1898	1899	1900	1901	1902	1903	1904	1905	Total
Chemistry	27	32	26	28	26	33	33	36	241
Physics	11	7	15	23	12	14	17	14	113
Psychology	18	15	9	13	8	16	10	21	110
Zoology	12	11	11	15	16	12	15	15	107
Mathematics	11	13	11	18	8	7	13	20	101
Botany	11	11	12	8	11	9	17	15	94
Geology	6	5	5	10	6	10	7	4	53
Physiology	4	1	4	1	8	8	1	3	30
Astronomy	3	2	4	5	2	4	4	3	27
Education	0	5	8	2	1	2	0	6	24
Sociology	0	5	3	3	4	2	1	1	19
Paleontology	0	4	2	1	0	2	2	3	14
Bacteriology	0	1	1	1	1	3	3	0	10
Anthropology	2	0	2	1	0	1	2	1	9
Agriculture	0	0	0	0	2	2	2	2	8
Engineering	0	0	0	1	0	3	1	3	8
Anatomy	0	0	0	1	0	4	0	0	5
Mineralogy	0	2	0	0	1	1	0	1	5
Pathology	0	0	0	0	0	3	0	0	3
Geography	0	0	0	0	0	0	0	1	1
Metallurgy	0	0	0	0	0	0	0	1	1
Meteorology	0	1	0	0	0	0	0	0	1
	105	115	113	131	106	136	128	150	984

The institutions that conferred three degrees or more in special subjects are as follows: *Chicago*—botany, 7; chemistry, 4; mathematics, 4. *Johns Hopkins*—chemistry, 7; physics, 3; zoology, 3. *Columbia*—education, 6; psychology, 5. *Harvard*—chemistry, 4; psychology, 4. *Yale*—chemistry, 6. *Clark*—psychology, 9; physics, 4; mathematics, 4. *Pennsylvania*—chemistry, 5; mathematics, 3.

The names of those on whom the degree was conferred in the natural and exact sciences, with the subjects of their theses, are as follows:

UNIVERSITY OF CHICAGO.

Maxwell Adams: 'On Some Derivations of Hydroxylamine.'

Frederick Lendall Bishop: 'The Thermal Conductivity of Lead.'

Edwin Bayer Branson: 'The Structure and Relationships of the American Labyrinthodontidæ.'

Orville Harry Brown: 'The Effects of Certain Salts on Kidney Excretion with Special Reference to Glycosuria.'

William McAfee Bruce: 'The Oxygen Ethers of Urea.'

Mintin Asbury Chrysler: 'The Development of the Central Cylinder in Araceæ and Liliaceæ.'

Nellie Esther Goldthwaite: 'On Cyanocetic Ether.'

Heinrich Hasselbring: 'Certain Problems of Assimilation.'

Clifton Durant Howe: 'Reforestation on the Colchester-Essex Sand Plains.'

Lynds Jones: 'The Development of the First Down and its Relation to the Definitive Feather.'

Herbert Edwin Jordan: 'Group Characters of Various Types of Linear Groups.'

William Jesse Goad Land: 'A Morphological Study of *Thuja*.'

William Burnet McCallum: 'Regeneration and Polarity in Plants.'

Thomas Emery McKinney: 'Concerning a Certain Type of Continued Fractions depending upon a Variable Parameter.'

Robert Lee Moore: 'Sets of Metrical Hypotheses of Geometry.'

Horatio Hackett Newman: 'The Morphogeny of the Chelonian Carapace.'

Alfred Reginald Schultz: 'The Underground Water Supply of Wisconsin, Northern Illinois and the Northern Peninsula of Michigan.'

Etoile Bessie Simons: 'A Morphological Study of *Sargassum Filipendula*.'

Arthur Whipple Smith: 'The Symbolic Treatment of Differential Geometry.'

Oswin William Wilcox: 'A Study of Ethylchlorsulphorate.'

Robert Bradford Wylie: 'The Morphology of *Elodea Canadensis*.'

YALE UNIVERSITY.

Harold Cornelius Bradley: 'The Physiology of the Gastropod *Sycotypus Canaliculatus*.'

Howard Stanley Bristol: 'Researches in Organic and Inorganic Chemistry.'

James Brown: 'The Interaction of Hydrochloric Acid and Potassium Permanganate in the Presence of Various Inorganic Salts.'

Charles Paxson Flora: 'The Estimation of Cadmium.'

Beverly Waugh Kunkel: 'Studies on the Anatomy of the California Limbless Lizard, *Auniella Pulchra*, with a General Consideration of the Pineal Apparatus of the Vertebrates.'

Bertram Augustus Lenfest: 'The Accuracy of Linear Movements.'

Raymond Benedict McClenon: 'On Simple Integrals with Variable Limits.'

George Grant MacCurdy: 'The Eolithic Problem: Evidences of a Rude Industry antedating the Paleolithic.'

Ralph Nelson Maxson: 'The Estimation of Small Amounts of Gold.'

James Caddall Morehead: 'Numbers of the Forms 2. $q = 1$ and Fermat's Numbers.'

Percy Edward Raymond: 'A Tropidoletus Faunule at Canandaigua Lake, N. Y. The Chazy Formation and its Fauna.'

Frederick Clark Stanley: 'A Critical Study of the Composition of Hornblende.'

Joannes Gabriel Statiropoulos: 'Researches in Organic Chemistry.'

HARVARD UNIVERSITY.

Bird Thomas Baldwin: 'The Mutual Influence of Different Starting Points on the Series of Associations.'

Gustavus Edward Behr, Jr.: 'Changes in the Free Energy of Iron under Varying Conditions.'

Maulsby Willett Blackman: 'The Spermatogenesis of *Scolopendra heros*.'

Howard Lane Blackwell: 'Dispersion in Electric Double Refraction.'

Latham Clarke: 'Addition Compounds of Dimethylaniline.'

George Shannon Forbes: 'Energy Changes involved in the Dilution of Zinc and Cadmium Amalgams.'

Walter Burton Ford: 'On the Problem of Analytic Extension as applied to Functions defined by Power Series.'

Charles Hughes Johnston: 'A Psychological Study of the Mutual Influence of Feelings.'

Herbert Adolphus Miller: 'The Race Problem and Psychophysics.'

Amon Benton Plowman: 'The Comparative Anatomy and Phylogeny of the Cyperaceæ.'

Frederick William Russe: 'On Tetrabromorthobenzoquinone.'

Clement Leslie Vaughan: 'The Motor Power of Optical Stimulations of Different Degrees of Complexity.'

JOHNS HOPKINS UNIVERSITY.

Eugene Cook Bingham: 'The Conductivity and Viscosity of Solutions of Certain Salts in Mixtures of Acetone with Methyl Alcohol and Ethyl Alcohol and Water.'

Hamilton Bradshaw: I., 'Relative Rates of Oxidation of Ortho, Meta and Para Compounds.' II., 'Orthosulphaminebenzoic Acid and Related Compounds.' III., 'Some Derivatives of Phenylglycocollorthosulphonic Acid.'

Philip Howard Cobb: 'A Further Investigation of the Chlorides of Orthosulphobenzoic Acid.'

Eugene Willis Gudger: 'The Breeding Habits and the Segmentation of the Egg in the Pipefish, *Siphostoma Floridæ*.'

August Ernest Guenther: 'A Study of the Comparative Effects of Solutions of Potassium, Sodium and Calcium Chlorides on Skeletal and Heart Muscle.'

William Edwin Hoffman, Jr.: 'Camphoroxalic Acid Derivatives.'

Robert Edward Loving: 'The Arc in High Vacua.'

William John Miller: 'The Crystalline Limestones of Baltimore County, Maryland.'

Henry Bayard Phillips: 'Some Invariants and Covariants of Ternary Collineations.'

James Temple Porter: 'Selective Reflection in the Infra-red Spectrum.'

Samuel Ritterhouse: 'The Embryology of *Stomotoca Apicata* and the Embryology of *Turritopsis Nutricula*.'

Forrest Shreve: 'The Development and Anatomy of *Sarracenia Purpurea* L.'

Roswell Powell Stephens: I., 'On a Curve of the Fifth Class.' II., 'On a System of Parastroids.'

Henry Philip Straus: 'An Electrolytic Method for the Preparation of Pure Caustic Alkalies for the Laboratory.'

Levi Shoemaker Taylor: 'An Electrical Method for the Combustion of Organic Compounds.'

Mayville William Twitchell: 'The Cenozoic Cassiduloidea of the United States.'

Horace Scudder Uhler: 'Absorption Spectra of the Aniline Dyes.'

Augustus Price West: 'A Study of the Effect of Temperature on Dissociation and on the Tempera-

ture Coefficients of Conductivity in Aqueous Solutions.'

COLUMBIA UNIVERSITY.

Felix Arnold: 'The Psychology of Association.'

Charles Josephus C. Bennett: 'Formal Discipline.'

Jesse Dismukes Burks: 'Exact Methods in City School Administration.'

Emily Matilda Coddington: 'The Historical Development of Pseudo-spherical Surfaces.'

Ellwood Patterson Cubberley: 'Equalization of the Advantages of Education by Means of State Aid.'

Frederick Morgan Davenport: 'A Sociological Study of Revivals.'

Walter Fenno Dearborn: 'The Psychology of Reading.'

Edward Charles Elliott: 'A Fiscal Study of Municipal School Administration.'

Roland McMillan Harper: 'A Phytogeographical Sketch of the Altamaha Gut Region of the Coastal Plain of Georgia.'

Linville Laurentine Hendren: 'The Rate of Recombination of the Ions in Gases at Low Pressures.'

Vivian Allen Charles Henmon: 'The Time of Perception as a Measure of Differences in Sensations.'

Howard Daniel Marsh: 'The Diurnal Course of Human Efficiency.'

Junius Lathrop Meriam: 'Studies in Normal Schools and Elementary Teachers.'

Henry Raymond Mussey: 'The Production of Iron Ore in the United States.'

Bruce Ryburn Payne: 'A Comparative Study of the Content and Time Allotments of the Curricula of Public Elementary Schools in Cities of the United States, England, Germany and France.'

George Drayton Strayer: 'City School Expenditures; the Variability and Interrelation of the Principal Items.'

Satoru Tetsu Tamura: 'A Mathematical Theory of the Nocturnal Cooling of the Atmosphere near the Earth's Surface.'

Ida Carleton Thallon: '*Lycosura* and *Damophon*.'

Lorande Loss Woodruff: 'An Experimental Study on the Life-History of Hypotrichous Infusoria.'

Naohidé Yatsu: 'Studies on the Embryology and Cytology of *Cerebratulus lacteus*.'

UNIVERSITY OF PENNSYLVANIA.

Clarence William Balke: 'Double Fluorides of Tantalum.'

Matthew Hume Bedford: 'Columbates.'

Alice Lenore Davison: 'The Electrolytic Determination of Cadmium with the Use of a Rotating Anode.'

Henry Fox: 'The Pharyngeal Pouches and Their Derivatives in the Mammalia.'

Robert Harvey Gault: 'On Conditions Affecting the Maximal Rate of Voluntary Extensor and Flexor Movements of the Right Arm.'

Oliver Edmunds Glenn: 'The Determination of the Abstract Groups of Order p^2qr, p, q and r being Distinct Primes.'

Ulysses Sherman Hanna: 'The Bitangentials of the Plane Quintic and Plane Sextic.'

Robert Harbison Hough: 'On the Mechanical Equivalent of the Heat of Evaporation of Water.'

Alice Madeleine McKelden: 'Groups of Order 2^m that Contain Cyclic Subgroups of Orders 2^{m-1}, 2^{m-2}, and 2^{m-3}.'

Burnett Smith: 'Senility Among Gastropods.'

Ralph Ogden Smith: 'The Rapid Determination of Lead and Mercury in the Electrolytic Way.'

James Renwick Withrow: 'The Electrolytic Precipitation of Gold with the Use of a Rotating Anode and the Rapid Analysis of Halides.'

CORNELL UNIVERSITY.

Oscar Perry Akers: 'On the Congruence of Axes in a Bundle of Linear Complexes.'

James Munsie Bell: 'Dineric Equilibria.'

Ralph Vary Chamberlin: 'North American Spiders of the Family Lycosidæ.'

Samuel Richard Cook: 'On the Velocity of Sound in Gases, and the Ratio of the Specific Heats, at the Temperature of Liquid Air.'

William Chauncey Geer: 'Contributions to the Chemistry of Indium.'

George David Hubbard: 'The Geographic Influence of the Precious Metals in the Development of the United States.'

Frederick Edward Kester: 'The Joule-Thomson Effect in Certain Gases.'

Charles Edward Lewis: 'The Embryology and Development of *Riccia lutescens* and *Riccia chystallina*.'

Richard Roswell Lyman: 'The Flow of Water over Weirs.'

Donald Alexander MacRae: 'Life of Sophocles, from the Sources.'

Addams Stratton McAllister: 'Alternating Current Commutator Motors.'

Herman Campbell Stevens: 'A Plethysmographic Study of Attention.'

George Frederick Warren, Jr.: 'The Apple Industry of Wayne and Orleans Counties, N. Y.'

Gershom Franklin White: 'The Bacterial Flora of the Apiary with Special Reference to Bee Diseases.'

CLARK UNIVERSITY.

Reginald Bryant Allen: 'On Hypercomplex Number Systems Belonging to an Arbitrary Domain of Rationality.'

Charles E. Browne: 'A Study of the Simpler Arithmetical Processes.'

W. Fowler Bucke: 'Examinations and Grading.'

Arthur L. Clark: 'Surface Tension at the Interface between Certain Liquids and Vapors.'

Joseph George Coffin: 'Construction and Calculation of an Absolute Standard of Self-Inductance.'

John Shaw French: 'On the Theory of the Pertingents to a Plane Curve.'

Jesse Nevin Gates: 'Cubic and Quartic Surfaces in Four-fold Space.'

Benjamin Spencer Gowen: 'Group Psychoses.'

John Charles Hubbard: 'On the Conditions for Sparking at the Break of an Inductive Circuit.'

Herbert G. Keppel: 'The Cubic Three-spread Ruled with Planes in Four-fold Space.'

Walter Libby: 'Poetic Imagination.'

Thomas Scott Lowden: 'A Study in Personal Hygiene.'

Josiah Moses: 'Pathological Aspects of Religion.'

Fred Mutchler: 'A Study of the Structure and Biology of the Yeast Plant.'

Maurice Herman Small: 'On Some Psychical Relations of Society and Solitude.'

Lewis Madison Terman: 'Genius and Stupidity.'

Charles W. Waddle: 'Miracles of Healing.'

Roy Titus Wells: 'Experiments on the Self-Induction of Currents in Cylindrical Cores.'

NEW YORK UNIVERSITY.

Frederick Malling Pedersen: 'The Influence of Molecular Constitution upon the Internal Friction of Gases.'

UNIVERSITY OF WISCONSIN.

Edgar Burton Hutchins: 'A Contribution to the Chemistry of the Tellurates.'

Oliver Patterson Watts: 'An Investigation of the Borides and the Silicides.'

Stephen Marshall Hadley: 'Relative Masses of Binary Stars.'

GEORGE WASHINGTON UNIVERSITY.

Ray Smith Bassler: 'A Study of the James Types of Ordovician and Silurian Bryozoa.'

Hiram Colver McNeil: 'On the Constitution of Certain Natural Silicates.'

Henry Albert Pressey: 'Flow of Water in Channels.'

UNIVERSITY OF MINNESOTA.

Edward M. Freeman: 'The Seed-Fungus of *Lolium Temulentum* L., the Darnel.'

UNIVERSITY OF CALIFORNIA.

Ralph Hamilton Curtiss: I., 'A Method of Measurement and Reduction of Spectrograms for the Determination of Radial Velocities.' II., 'Application to a Study of the Variable Star W Sagittarii.'

Charles Gardner Rogers: 'The Effect of Various Salts upon the Survival of the Invertebrate Heart.'

Mooshegh Vaygouny: 'On Two New Electrochemical Processes for the Extraction of Silver and Gold from their Ores.'

BROWN UNIVERSITY.

Norman Armin Dubois: 'Some Condensation Products of 1-Phenyl-Naphthalene 2, 3, Dicarboxylic-Anhydride.'

Arthur Eugene Watson: 'An Investigation into the Source of the Condensation-Nuclei produced by the Action of X-Rays in Dust-Free Air.'

PRINCETON UNIVERSITY.

Adam Miller Hiltebeitel: 'The Problem of Two Fixed Centers and Certain of its Generalizations.'

Walter Mann Mitchell: 'Researches in the Sun-Spot Spectrum, Region F–A.'

Frank Albert Stromsten: 'Contributions to the Anatomy and Development of the Venous System of Turtles.'

LELAND STANFORD JUNIOR UNIVERSITY.

William Albert Manning: 'Studies on the Class of Primitive Substitution Groups.'

UNIVERSITY OF NEBRASKA.

Esther Pearl Hensel: 'An Investigation of the Movements of Petals.'

Homer Leroy Shantz: 'A Study of the Vegetation of the Mesa Region East of Pike's Peak.'

STATE UNIVERSITY OF IOWA.

Paul Bartsch: 'A Study in Distribution Based upon the Family Pyramidellidæ of the West Coast of America.'

William Bonar Bell: 'Modifications in Size, Form and Function of Homologous Crustacean Appendages.'

UNIVERSITY OF CINCINNATI.

Harry Shipley Fry: 'The Reducing of Magnesium Amalgam on Aromatic Nitro Compounds.'

UNIVERSITY OF MISSOURI.

Francis Potter Daniels: 'The Flora of Columbia, Missouri and Vicinity. An Ecological and Systematic Study of a Local Flora.'

THE ADVANCE OF OUR KNOWLEDGE OF THE CAUSATION AND METHODS OF PREVENTION OF STOCK DISEASES IN SOUTH AFRICA DURING THE LAST TEN YEARS.

II.

B. PARASITE UNKNOWN.

I. *Rinderpest.*

We now turn our attention to the important diseases of the second group. In these the parasites causing them are unknown—that is to say, no parasites can be detected by the microscope or by culture—but it is equally true that they must be present in the blood and fluids of the sick animals in some form or other. In all probability they are ultra-microscopic—too small to be seen with our present instruments. This is borne out by the fact that they are able to pass through the pores of porcelain filters, which keep back the smallest micro-organisms we are able to recognize.

The first of the second group of diseases is rinderpest, which has overrun and devastated South Africa within the last ten years.

Rinderpest has been known from time immemorial in Europe and Central Asia, and is an exceedingly fatal disease, killing 90 to 100 per cent. of the cattle attacked.

The recent epidemic, according to some, originated in the Nile provinces, and slowly crept southwards, reaching the Transvaal in 1896, after a journey lasting some fifteen years. Great efforts were made to oppose its passage, but nothing seemed to avail. In parts of the country where there were few or no cattle the epidemic spread by means of the wild animals—particularly the buffalo—which have been exterminated in many places.

Ten years ago the symptoms and contagious nature of this disease were well known, but nothing was known as to methods of prevention, and it is to the investigation of this epidemic in South Africa that the discovery of practical methods of immunizing cattle, and in this way of stamping out the disease, is due.

As soon as it was apparent that the epidemic was spreading into South Africa, all the colonies made strenuous efforts to combat it. The Transvaal government invoked the aid of the Pasteur Institute, and Messrs. Bordet and Danysz were sent out to discover some method of prevention. They worked near Pretoria, and were assisted by Dr. Theiler, then the principal veterinary surgeon. Before they arrived on the scene the Natal government had despatched Mr. Watkins-Pitchford, their principal veterinary surgeon, to the Transvaal, where he also at first had Dr. Theiler as his colleague, and where he did some good pioneer work in the serum therapeutics of the disease. In the Cape Colony Dr. Hutcheon, the principal veterinary surgeon, and Dr. Edington, the government bacteriologist, were no less active. It is, however, to Professor Robert Koch, of Berlin, that the honor is undoubtedly due of first publishing a practical method of immunizing cattle against rinderpest. He arrived at Kimberley on December 5, 1896, and in the incredibly short space of time of two months was able to report two methods of immunizing, viz., by the injection of rinderpest bile, and, secondly, by the injection of serum from immune animals. I have always thought that the discovery that the injection of bile taken from an animal dead of rinderpest rendered cattle immune was particularly brilliant. Up to that time no one had dreamt that bile could possess such a quality. It is true that both Transvaal and Orange Free State Boers are said to have