

SCIENCE

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DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES

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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.

IN the first five of the fifteen years during which records of the doctorates of philosophy conferred by our universities have been annually printed in SCIENCE, there was no increase in the number, the average being 233. In the course of the past ten years the number has about doubled, amounting this year to 492. The twenty-one German universities gave two years ago 1,703 doctorates of philosophy (of which 32 were to Americans), so we still fall far behind that country in the number of men adequately prepared for advanced teaching and research. As the population of the United States is half again as large as that of Germany, we must increase six-fold the number of doctorates conferred before we can reach the present level of that country.

The seven universities given at the beginning of the table conferred three fifths of all the degrees, but the other universities have gained somewhat, as for the first ten years covered by these statistics they conferred only one quarter of the degrees. The universities which have hitherto done less research work, and especially the state universities, are gaining somewhat on the older universities, with the exception of Columbia. This university has made a remarkable advance in the past two years, conferring this year 81 and last year 75 doctorates, thus drawing ahead of Chicago in the total number of degrees conferred in the past fifteen years. Yale and the Johns Hopkins remain about stationary in the number of degrees they confer, while Cornell, Pennsylvania and Harvard have

TABLE I
Doctorates Conferred

	Average of 10 Years, 1898-1907	1908	1909	1910	1911	1912	Total for 15 Years, 1898-1912
Columbia.....	32.2	55	59	44	75	81	636
Chicago.....	35.6	54	38	42	55	57	602
Harvard.....	33.8	42	38	35	42	41	536
Yale.....	31.8	32	44	27	31	31	483
Johns Hopkins.....	30.5	28	27	23	28	32	443
Pennsylvania.....	22.5	32	29	26	29	34	375
Cornell.....	18.1	22	34	35	34	33	339
Wisconsin.....	8.6	17	16	18	15	27	179
Clark.....	8.7	11	9	14	16	6	143
New York.....	6.7	15	13	11	17	10	133
Michigan.....	6.9	4	13	7	6	11	110
Boston.....	4.4	11	13	6	13	8	95
California.....	3.3	4	10	6	6	15	74
Princeton.....	2.6	6	4	8	9	12	65
Illinois.....	.5	5	4	12	11	20	57
Minnesota.....	2.4	3	5	1	2	12	47
Bryn Mawr.....	2.1	4	2	5	5	9	46
George Washington Virginia.....	2.8	3	4	4	5	2	46
.....	2.8	4	1	4	2	4	43
Brown.....	2.3	2	5	1	4	6	41
Catholic.....	2.0	1	3	3	5	5	37
Stanford.....	1.4	2	3	5	4	4	32
Nebraska.....	2.0	2	2	1	0	3	28
Iowa.....	1.1	2	0	4	3	7	27
Massachusetts Inst. Cincinnati.....	.3	3	0	3	2	6	17
.....	.3	0	2	2	5	3	15
Ohio.....	.4	0	2	0	2	5	13
Indiana.....	.0	3	3	0	2	4	12
Missouri.....	.4	3	0	2	2	1	12
Vanderbilt.....	.6	1	1	2	0	1	11
Washington.....	.7	1	0	0	2	1	11
Georgetown.....	1.0	0	0	0	0	0	10
Pittsburgh.....	.1	4	0	2	1	1	9
Kansas.....	.3	0	0	3	1	0	7
Syracuse.....	.2	0	2	1	2	0	7
Colorado.....	.5	0	1	0	0	0	6
North Carolina.....	.5	0	1	0	0	0	6
Northwestern.....	.4	0	1	0	1	0	6
Tufts.....	.5	0	0	1	0	0	6
Washington and Lee.....	.4	1	0	0	0	0	5
Lafayette.....	.3	0	0	0	0	0	3
Dartmouth.....	.1	1	0	0	0	0	2
Lehigh.....	.2	0	0	0	0	0	2
Tulane.....	.1	0	0	0	0	0	1
Total.....	272.4	378	389	358	437	492	4,778

increased their numbers and in this order. Wisconsin conferred this year 27 degrees, Illinois 20, California 15, Minnesota 12 and Iowa 7, this being in each case a large advance over the numbers conferred in any previous year. Princeton with 12 degrees and Bryn Mawr with 9 also demonstrate a decided growth in graduate work.

TABLE II
Doctorates Conferred in the Sciences

	Average of 10 Years, 1898-1907	1908	1909	1910	1911	1912	Total for 15 Years, 1898-1912	Per Cent.
Chicago.....	16.4	37	20	24	35	37	317	53
Johns Hopkins.....	16.8	17	20	15	19	23	262	59
Columbia.....	13.4	21	23	11	29	36	254	40
Cornell.....	10.4	15	24	27	27	28	225	66
Yale.....	12.4	16	27	12	15	21	215	45
Harvard.....	14.1	13	14	10	20	15	213	40
Pennsylvania.....	9.0	18	13	12	10	9	152	41
Clark.....	7.7	11	8	14	16	6	132	92
Wisconsin.....	2.8	6	4	13	13	14	78	44
California.....	2.4	2	6	4	5	12	53	72
Michigan.....	2.8	1	5	1	3	8	46	42
Illinois.....	.3	0	2	9	6	15	35	61
Princeton.....	1.1	3	3	2	5	7	31	48
George Washing- ton.....	1.7	2	2	3	4	2	30	65
Brown.....	1.2	2	2	1	3	4	24	59
Stanford.....	1.1	2	2	1	4	3	23	72
Bryn Mawr.....	1.0	1	0	2	1	3	17	37
Massachusetts Inst.....	.3	3	0	3	2	6	17	100
Nebraska.....	1.3	1	2	1	0	0	17	61
Virginia.....	1.1	2	0	1	1	2	17	40
Minnesota.....	.7	1	2	1	2	2	15	32
New York.....	.6	1	3	2	1	2	15	11
Iowa.....	.7	0	0	2	1	3	13	48
Ohio.....	.4	0	2	0	2	5	13	100
Indiana.....	.0	3	3	0	2	4	12	100
Washington.....	.7	1	0	0	2	1	11	100
Catholic.....	.5	—	2	0	1	1	9	24
Missouri.....	.3	2	0	2	2	0	9	75
Cincinnati.....	.1	0	1	1	4	1	8	53
Kansas.....	.3	0	0	3	1	0	7	100
Vanderbilt.....	.3	1	1	0	0	1	6	55
Tufts.....	.5	0	0	0	0	0	5	83
North Carolina.....	.3	0	1	0	0	0	4	67
Northwestern.....	.2	0	1	0	1	0	4	67
Washington and Lee.....	.3	1	0	0	0	0	4	80
Boston.....	.1	0	1	0	0	1	3	3
Pittsburgh.....	.0	0	0	1	1	1	3	33
Syracuse.....	.1	0	0	1	1	0	3	43
Colorado.....	.2	0	0	0	0	0	2	33
Dartmouth.....	.1	1	0	0	0	0	2	100
Lehigh.....	.2	0	0	0	0	0	2	100
Georgetown.....	.1	0	0	0	0	0	1	10
Lafayette.....	.1	0	0	0	0	0	1	33
Total.....	124.1	184	194	179	239	273	2,310	48

It is a fact of interest to readers of this journal that the number of degrees conferred in the natural and exact sciences increases more rapidly than in other subjects. During the ten years from 1898 to 1907 there were conferred an average of 124

degrees in the sciences as compared with 148 in other departments. In the following three years the numbers were almost exactly the same, whereas in the past two years the sciences have drawn ahead, being responsible this year for 273 degrees, as compared with 219 in other subjects. This advance is too large and too long continued to be attributable to a chance variation; it appears that the sciences are gaining ground in our universities. In Germany more degrees are conferred in the humanities than in the sciences, and the large number of degrees conferred there in the languages is striking. In this country there were this year only 17 degrees in Latin and 5 in Greek. Among the sciences, as always, chemistry leads and by a larger margin than ever before. This degree is in many cases awarded to men who propose to undertake industrial work; while this is doubtless quite as important as teaching, the degree has a somewhat different significance, so that it might indeed be advisable to award a doctorate of engineering rather than the doctorate of philosophy. Physics follows chemistry in the total number of degrees conferred, and is in turn followed by zoology, though there were this year more degrees awarded in botany, mathematics, geology and psychology than in zoology. Agriculture and bacteriology, as well as botany, show decided gains; there are also gains in physiology and anatomy.

The institutions which this year conferred two or more degrees in a science are: in *chemistry*, Columbia, 11; Johns Hopkins and Yale, 9 each; Chicago and Wisconsin, 8 each; Illinois, 6; Cornell, 5; Harvard and Ohio, 4 each; Massachusetts Institute, 3; Michigan and Princeton, 2 each; in *physics*, Cornell and Princeton, 4 each; Chicago, Illinois, Michigan, Pennsylvania and Yale, 3 each; Columbia, Johns Hopkins and Wisconsin, 2 each; in *zoology*,

TABLE III
Doctorates Distributed According to Subjects

	Average of 10 Years, 1898-1907	1908	1909	1910	1911	1912	Total for 15 Years, 1898-1912
Chemistry.....	32.3	54	43	48	68	78	614
Physics.....	15.5	22	25	25	33	30	290
Zoology.....	15.2	25	18	24	25	20	264
Psychology.....	13.5	23	21	20	23	29	251
Mathematics.....	12.1	23	14	23	25	22	228
Botany.....	12.6	11	16	10	20	30	213
Geology.....	7.1	5	13	10	15	22	136
Physiology.....	4.1	7	13	4	2	12	79
Astronomy.....	3.4	1	7	3	4	2	51
Agriculture.....	1.0	2	7	4	11	11	45
Bacteriology.....	1.4	1	5	1	4	6	31
Anthropology.....	1.0	4	4	2	2	0	22
Paleontology.....	1.6	1	0	2	0	1	20
Anatomy.....	.9	2	0	1	1	6	19
Pathology.....	.5	2	3	1	1	2	14
Engineering.....	.8	0	0	1	2	2	13
Mineralogy.....	.6	0	3	0	1	0	10
Metallurgy.....	.3	0	1	0	1	0	5
Geography.....	.1	1	1	0	1	0	4
Meteorology.....	.1	0	0	0	0	0	1
Total.....	124.1	184	194	179	239	273	2,310

	1908	1909	1910	1911	1912	Total for 5 Years
English.....	30	27	31	33	34	155
History.....	32	22	25	26	23	128
Economics.....	17	42	7	16	26	108
Philosophy.....	25	14	19	26	15	99
Education.....	6	9	13	23	22	73
Latin.....	12	12	15	11	17	67
German.....	14	14	16	7	15	66
Romance.....	12	16	6	12	15	61
Sociology.....	6	6	14	18	13	57
Oriental.....	9	15	11	1	10	46
Greek.....	13	11	5	7	5	41
Political Science.....	9	4	9	6	10	38
Theology.....	7	2	1	7	7	24
Philology and Comparative Literature.....	0	1	5	1	2	9
Law.....	1	0	1	2	1	5
Classical Archeology.....	0	0	0	1	3	4
Music.....	1	0	1	1	0	3
Fine Arts.....	0	0	0	0	1	1
Total.....	194	195	179	198	219	985

Harvard, 5; Cornell, 3; California and Chicago, 2 each; in *psychology*, Columbia, 8; Clark, 6; Pennsylvania, 4; Cornell, 3; Chicago and Johns Hopkins, 2 each; in *mathematics*, Chicago 7; Columbia, 4; Cali-

fornia, Johns Hopkins and Yale, 2 each; in *botany*, Chicago, 8; Cornell, 4; Columbia, 3; California, Indiana, Iowa and Michigan, 2 each; in *geology*, Johns Hopkins, 5; Yale, 4; Massachusetts Institute, 3; Bryn Mawr and Columbia, 2 each; in *physiology*, California, 4; Columbia, 3; Chicago, 2; in *agriculture*, Cornell, 6; Illinois, 3; in *bacteriology*, Brown, 2; in *pathology*, Chicago, 2.

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

Warder Clyde Allee: "The Effect of Dissolved Gases on the Behavior of Isopods."

Harriett May Allyn: "A Contribution to the Analysis of Fertilization in *Chaetopterus*."

Harold DeForest Arnold: "Limitations Imposed by Slip and Inertia Terms upon Stokes's Law for the Motion of Spheres through Liquids."

Melvin Amos Brannon: "The Action of Salton Sea Water on Plant Tissues."

Clyde Brooks: "The Effect of Lesions of the Dorsal Nerve on the Reflex Excitability of the Spinal Cord."

Edward Wilson Chittenden: "Infinite Developments and the Composition Property ($K_{12}B_1$)_s in General Analysis."

Grace Lucretia Clapp: "The Life History of *Aneura pinguis*."

Harry John Corper: "Correlation of Chemical and Histological Changes in Necrosis and Autolysis."

Edmund Vincent Cowdry: "The Relations of Mitochondria and other Cytoplasmic Constituents in Spinal Ganglion Cells of the Pigeon."

Lloyd Lyne Dynes: "The Highest Common Factor of a System of Polynomials with an Application to Implicit Functions."

Sophia Hennion Eckerson: "A Physiological and Chemical Study of After-ripening."

Charles Albert Fischer: "Some Contributions to the Theory of Functions of Lines."

Laura Campbell Gano: "The Physiographic Ecology of Northern Florida."

Stella Mary Hague: "A Morphological Study of *Diospyros virginiana*."

Ansel Francis Hemenway: "The Phloem of Dicotyledons."

Ernest Edward Irons: "Studies on Immunity."

Fred Conrad Koch: "The Nature of the Iodine Complex in Thyreo-globulin."

Oliver Justin Lee: "On the Conditions for Reversal of the Calcium Lines."

Harvey Brace Lemon: "The Influence of Temperature upon the Intensities of the Lines of the Hydrogen Spectrum."

Theodore Lindquist: "Mathematics for Freshmen Students of Engineering."

Arno Benedict Luckhardt: "The Relation of the Spleen to the Fixation of Antigens and the Production of Immune Bodies."

Eugene Franklin McCampbell: "The Toxic and Antigenic Properties of *Bacterium welchii*."

Howard Wilson Moody: "A Determination of the Ratio of the Specific Heats and the Specific Heat at Constant Pressure of Air and Carbon Dioxide."

John Foote Norton: "Simultaneous Reactions in Amide Formation."

Paul David Potter: "The Hydrates of Arsenic Pentoxide."

Carl Leo Stahr Rahn: "A Critical and Constructive Study of the Psychology of Thinking."

Ralph Eugene Root: "Iterated Limits in General Analysis."

Lester Whyland Sharp: "Spermatogenesis in Equisetum."

Anna Morse Starr: "Comparative Anatomy of Dune Plants."

Charles Thompson Sullivan: "Properties of Surfaces whose Asymptotic Lines belong to Linear Complexes."

Arthur Carleton Trowbridge: "The Geology of the Owens Valley California Region with special Reference to the Terrestrial Deposits."

Harlan Leo Trumbull: "The Molecular Rearrangement of Acid Chloramides and the Ionization of their Salts."

Charles Herman Viol: "Studies in Radioactivity."

Leroy Samuel Weatherby: "The 'Salt Effects' of the Nitrates and Sulphonates in the Catalysis of Imido Esters."

Franklin Lorenzo West: "The Physical and Chemical Properties of Organic Amalgams."

Russell Morse Wilder: "The Etiology of Typhus Fever."

Albert Harris Wilson: "The Canonical Types of Nets of Quadratic Forms in the Galvis Field of Order p^n ."

COLUMBIA UNIVERSITY

David Alperin: "Contribution to the Knowledge of Nucleoprotein Metabolism with special reference to Uricolysis and to the Properties of Uricase."

Tsuru Arai: "Mental Fatigue."

Charles Homer Bean: "The Curve of Forgetting."

Louis Edward Bisch: "Biochemical Studies of Protagon and Mucoid."

Jacob J. Bronfenbrenner: "A Biochemical Study of the Phenomenon known as Complement-splitting."

Arthur Jerome Culler: "Interference and Adaptability."

Bernard Ogilvie Dodge: "Methods of Culture and the Morphology of the Archicarp in certain Species of the Ascobolaceæ."

Harry Linn Fisher: "The Preparation and Properties of 5-Amino-6-Quinoline-Carboxylic Acid, and some Compounds derived therefrom."

Alexander Oscar Gettler: "The Balance of Acid-forming and Base-forming Elements in Foods, and its Relation to Ammonia Metabolism."

Alfred Norton Goldsmith: "On the Spectroscopic Examination of Positive Rays isolated by Transmission through thin Partitions."

Marston Lovell Hamlin: "I. The Preparation of two Derivatives of Glucosamine. II. Spigeline, an Alkaloid of *Spigelia marilandica*. III. Derivatives of 4-Hydroxy-5-Nitro-Quinazoline."

Raleigh Frederick Hare: "A Study of the Chemistry of the Carbohydrates of the Prickly Pear and its Fruits."

John Diederich Haseman: "Some Factors of Geographical Distribution in South America."

Milo Burdette Hillegas: "A Scale for the Measurement of Quality in English Composition by Young People."

Jesse Earl Hyde: "The Waverly Formations of Central and Southern Ohio."

Max Kahn: "Biochemical Studies of Sulfocyanates."

John Leonard Kantor: "A Biochemical Test for Free Acid."

Joseph Lipke: "Natural Families of Curves in a General Curved Space of n Dimensions."

Henry Howard Marvin: "The Selective Transmission and the Dispersion of the Liquid Chlorides."

Chester Arthur Mathewson: "A Study of some of the more Important Biochemical Tests."

Julia Eleanor Moody: "Observations on the

Life-history of two Rare Ciliates—*Spathidium spathula* and *Actinobolus radians*."

Fayette T. Owen: "Part I. Molten Hydrated Salts as Solvents for Freezing Point Method. Part II. The Weight of the Falling Drop and the Laws of Tate."

Albert Theodore Poffenberger, Jr.: "Reaction Time to Retinal Stimulation; with reference to the Speed of Conduction through Nerve Centers."

David Edgar Rice: "Visual Acuity with Lights of Different Colors and Intensities."

Winifred Josephine Robinson: "A Taxonomic Study of the Pteridophyta of the Hawaiian Islands."

Emily Cromwell Seaman: "Biochemical Studies of the Effects of Beryllium Sulfate."

Lewis Parker Sicheloff: "Simple Groups from Order 2001 to order 3640."

Benjamin Roy Simpson: "Correlation of Mental Abilities."

Bertram Garner Smith: "The Embryology of *Cryptobranchus allegheniensis*."

William Mackey Smith: "Simply Infinite Systems of Plane Curves. A Study of Isogonals, Equitangentials and other Families of Trajectories."

Charles Arthur Stewart: "The Geology and Ore-deposits of the Silverbell Mining District, Arizona."

Frederick Tilney: "Contribution to the Study of the Hypophysis Cerebri, with special reference to its Comparative Histology."

John Welhoff Todd: "Reaction to Multiple Stimuli."

Edward Everett Whitford: "The Pell Equation."

Harold Edward Woodward: "A Study of Surface Tension of Blood Serum by the Drop Weight Method."

Frederick William Zons: "A new Method, Volumetric, for the Determination of Thorium in the Presence of other Rare Earths and its Application to the Analysis of Monazite Sand."

CORNELL UNIVERSITY

Herman Camp Allen: "The Reduction of Nitrobenzene by Means of Ferrous Hydroxide."

Ross Peter Anderson: "Researches on Tellurium."

Mortier Franklin Barrus: "The Bean Anthracnose."

Henry Louis Brakel: "The Effect of Vibration on the Resistance of Metals."

Stanley Eugene Brasefield: "A Study of certain Force Fields."

Harry Oliver Buckman: "Optimum and Excessive Soil Moisture in its Effect upon the Soil and the Crop."

Lewis Josephus Cross: "A Study of the Relation of the Chemical Composition of Hens' Eggs to the Vitality of the Young Chick."

Lucy May Day: "The Effect of Illumination on Peripheral Vision."

Austin Southwick Edwards: "An Experimental Study of Suggestion."

Robert James Evans: "Studies in the Variation of *Stellaria media* as induced by Temperature Exposures."

Earl Frederick Farnau: "Luminescence."

Alexander Hardie Forman: "The Effect of Magnetization on the Opacity of Iron to Röntgen Rays."

Sidney Longman Galpin: "Studies of Flint Clays and their Associates."

Charles Cleveland Hedges: "Some Chemical Relations of Lime-sulphur Solutions, Lead Arsenate and Nicotine."

Emmet Francis Hitch: "Tetrachlorfluorescein and some of its Derivatives."

James Franklin Illingworth: "A Study of the Biology of the Apple Maggot (*Rhagoletis pomonella*) together with an Investigation of the Methods of Control."

Christian Nephi Jensen: "Fungous Flora of the Soil."

Clyde Everett Leighty: "Studies of Variation and Correlation of Oats (*Avena sativa*)."

Merris Mickey McCool: "The Antitoxic Action of certain Nutrient and Non-nutrient Mineral Bases with respect to Plants."

Anna Haven Morgan: "The Biology of Mayflies."

Frank Millett Morgan: "Involutorial Transformations."

Clyde Hadley Myers: "Variation, Correlation and Inheritance of Characters of Wheat and Peas grown on Soils of different Degrees of Fertility."

Irving Perrine: "The Claiborne Pelecypod Fauna of the Gulf Province."

Harry Westfall Redfield: "A Study of Hydrogen Sulphide Production by Bacteria and its Significance in the Sanitary Examination of Water."

George Jackman Sargent: "Electrolytic Chromium."

Alma de Vries Schaub: "On the Intensity of Images."

John Edwin Turlington: "The Effect on Plant Growth of Nutrients applied at different Periods."

Rhett Youmans Winters: "The Inheritance of Size of Capsules in Pepper Hybrids."

JOHNS HOPKINS UNIVERSITY

Raymond Binford: "The Germ-cells and the Process of Fertilization in the Crab *Menippe mercenaria*."

Thomas Ross Brown: "A Consideration of the Continued Fevers in the Tropics."

Joseph Chandler: "On the Reactions of Thiourazoles and Thiourazole Salts: I. A Study of the Reaction between Sodium 1-Phenyl-3-Thiourazole and Ethyl Iodide. II. A Study of 1, 4-Diphenyl-5-Thiourazole."

Burton William Clark: "The Trenton Limestone at Rathbone Brook, Herkimer County, New York—Its Stratigraphy, Fauna and Age."

Charles Wythe Cooke: "The Greenbrier Formation in Maryland. A Contribution to Mississippian Paleontology."

Paul Bell Davis: "Conductivity and Negative Viscosity Coefficients of certain Rubidium and Ammonium Salts in Glycerol, and in Mixtures of Glycerol with Water from 25° to 75°."

Felton Samuel Dengler: "I. The Detection and Determination of Minute Quantities of Glycerol. II. The Volumes of Weight-normal Cane Sugar Solutions at Different Temperatures."

Henry Otto Eyssell: "I. The Detection of Mannite in Alkaline Solutions of Copper Sulphate. Combustion of Mannite by Alkaline Solutions of Potassium Permanganate in the Presence of Copper Sulphate. II. A Determination of the Volume of Weight-normal Solutions of Cane Sugar at 15°, 20°, 25° and 30°."

Julia Peachy Harrison: "On the Reversible Addition of Alcohols to Nitriles catalyzed by Sodium Ethylate."

Clarence Wilson Hewlett: "Analysis of Complex Sound Waves."

Oliver Baker Hopkins: "The Carboniferous Sphenophyllales, Equisetales and Lycopodiales of Maryland, including certain Forms from Pennsylvania and Ohio."

Samuel Francis Howard: "The Conductivity, Temperature Coefficients of Conductivity and Dissociation of certain Electrolytes in Aqueous Solution at 35°, 50° and 65°."

John Frederick Hunter: "A Study of the Precambrian Rocks of the Gunnison River."

Harry Miles Johnson: "Some Tests on the Reac-

tions of Dogs to Stimuli, under Conditions of Sensory Control."

Willis Edgar Maneval: "The Development of *Magnolia* and *Liriodendron*, including a Discussion of the Primitiveness of the Magnoliaceæ."

Charles Ferdinand Meyer: "On the Vibration of Telephone Diaphragms."

John William Nowell: "A Study of the Steric Hindrance Effect of various Substituent Groups in the Ortho Position to the Carboxyl; on the Reaction which takes Place when Parasulphaminobenzoic Acids are heated to 220°."

Alfred Springer, Jr.: "A Study of the Conductivity and Dissociation of certain Organic Acids in Aqueous Solution at different Temperatures."

Joshua Irving Tracey: "Researches on the Rational Quintic."

Lloyd Van Doren: "A Comparative Study of the Semi-permeable Membranes of Copper Ferrocyanide and Nickel Ferrocyanide."

George Ross Maurice Wells: "The Influence of Stimulus-duration on Reaction Time."

Richard Claggett Williams: "The Shenandoah Limestones of the Hagerstown Quadrangle."

Roy Martin Winger: "On Self-projective Rational Curves of the Fourth and Fifth Order."

YALE UNIVERSITY

William Raymond Barss: "Ionization by Collision in Gases and Vapors."

Philip Lee Blumenthal: "The Separation and Estimation of Chlorine and Bromine in Halogen Salts by the Differential Action of Oxidizers."

Charles Andrew Brautlecht: "Synthesis of Thio-tyrosine."

Gerald Burnham: "Sulphur Combinations in Proteins-thiopolypeptides."

Amy Louise Daniels: "Fat-transport and Metabolism, Studied with the Aid of Fat-soluble Dyes."

Archibald Lamont Daniels, Jr.: "On the Librations of Bodies whose Periods are One Third that of the Disturbing Body."

Charles Raymond Downs: "Water-gas Tar: its Composition and Commercial Possibilities."

Charles Wales Drysdale: "The Geology of the Franklin Mining District, British Columbia."

Marion Graham Elkins: "The Maturation Phases in *Smilax herbacea*."

Herbert Hartley Guest: "Thiohydantoins and their Biochemical Interest."

Frank Loyal Haigh: "On certain Physical Properties of the Alkali Nitrates, Chlorides and Sulphates."

Charles Hoffman: "A New Method for Synthesizing Alpha-amino Acids; Halogen Derivatives of Tyrosine."

Davenport Hooker: "The Development and Function of Voluntary and Cardiac Muscles in Embryos without Nerves."

Robert Curtis Lewis: "The Rate of Elimination of Nitrogen as influenced by Diet Factors."

Alexander Graham McGougan: "The Emission of Electrons by Metals under the Influence of Alpha Rays."

John Johnston O'Neill: "Geology and Petrography of the Beloeil and Rougemont Mountains, Quebec."

Samuel James Plimpton: "On the Recombination of Ions produced by Röntgen Rays."

William Henry Twenhofel: "Geology, Stratigraphy and Physiography of Anticosti Island."

Harley Richard Willard: "On a Family of Oscillating Orbits of Short Period (with a chart)."

Merton Yarwood Williams: "Geology of the Arisaig-Antigonish District, Nova Scotia."

Morley Evans Wilson: "Preliminary Memoir on the Abitibi District, Pontiac County, Quebec."

HARVARD UNIVERSITY

Roger Adams: "I. A Study of the Solubilities in Aqueous Alkalis of various Hydrazones of certain Aromatic Ortho-hydroxyaldehydes and Ketones. II. Nonanes. III. A New Bottling Apparatus."

John Detlefsen: "A Genetic Study of Color and Coat Characters, and Growth and Size in a Cavy Species Cross."

Arthur Johnson Eames: "The Morphology of *Agathis australis* (Lamb.) Steud."

Gustavus John Esselen, Jr.: "Studies on Benzhydrols. I. The Resolution of p-Aminobenzhydrol into its Optical Isomers. II. The Splitting of Benzhydrols by the Action of Bromine."

Augustus Henry Fiske: "I. On certain Nitro Derivatives of Vicinal Tribrombenzol. II. Decomposition of Tetrabromorthoquinone. III. Hydrates of Sodium Carbonate and their Temperatures of Transition."

Fred Ford Flanders: "The Determination and Metabolism of Benzoic Acid and Hippuric Acid."

Tomlinson Fort: "Problems connected with Linear Difference Equations of the Second Order with special Reference to Equations with Periodic Coefficients."

Alfred Otto Gross: "The Reactions of Arthropods to Monochromatic Lights of Equal Intensities."

Franklin Paradise Johnson: "The Development of the Mucosa of the Digestive Tube in the Human Embryo, with notes on the Effects of Distention of the Intestine upon the Shape of Villi and Glands."

Sidney Isaac Kornhauser: "A Comparative Study of the Chromosomes in the Spermatogenesis of *Enchenopa binotata* (Say) and *Enchenopa (Campylenchia) Stål curvata* (Fabr.)."

Edwin Carleton MacDowell: "Size Inheritance in Rabbits."

Samuel Copeland Palmer: "The Numerical Relations of the Histological Elements in the Vertebrate Retina."

Eugene Lyman Porter: "Conditions affecting the Liminal Electrical Stimulus of a Spinal Reflex."

John Edward Rouse: "The Mental Life of Domestic Pigeons: An Experimental Study of certain Emotional and Associative Processes."

George Defrees Shepardson: "The Equivalent Frequency of Telephone Circuits."

UNIVERSITY OF ILLINOIS

Samuel Herbert Anderson: "Ionization of Photo-electric Properties of Vapors of Alkali Metals."

Stuart Jeffery Bates: "The Iodine Coulometer and the Value of the Faraday."

Charley Francis Briscoe: "Tubercle Bacilli in Nature."

David William Cornelius: "The Study of the Velocity of Electrons in the Photo-electric Effect as a Function of the Wave-lengths of the Light."

William Wells Denton: "Projective Differential Geometry of Developable Surfaces."

James Everett Egan: "Observations on the Rare Earths. Yttrium Chloride and the Atomic Weight of Yttrium."

Hugh Byron Gordon: "A Differential Dynamic Method for the Accurate Determination of Relative Vapor-pressure Lowering."

Walter Edward Joseph: "A Study of Protein as a Factor in the Nutrition of Swine with special reference to the Distribution of the various Forms of Nitrogen in the Animal Body."

Jacob Garrett Kemp: "Conditions of Sensibility of Photo-electric Cells with Alkali Metals and Hydrogen."

Leonidas Rosser Littleton: "Molecular Rearrangements in the Camphor Series. Derivatives of Isocamphoric Acid; Isoaminolauronic Acid and its Decomposition Products."

Ellison Lloyd Ross: "Phosphorus Metabolism of Lambs."

Earle Kenneth Strachan: "The Equilibrium between Arsenious Acid and Iodine in Aqueous Solution."

Maurice Cole Tanquary: "Biological and Embryological Studies on Formicidæ."

Albert Lemuel Whiting: "A Biochemical Study of Nitrogen in certain Legumes."

Richard Hermon Williams: "A Study of Protein as a Factor in the Nutrition of Swine, with special reference to the Distribution of the Forms of Ash and Phosphorus in the Animal Body."

UNIVERSITY OF WISCONSIN

Martin Fuller Angell: "Thermal Conductivity of Metals at High Temperatures."

Freda Marie Bachman: "A Cytological Study of *Collema*."

Oscar Leonard Barneby: "Reactions of the Rare Earths in Non-aqueous Solvents."

Frederick William Cunningham: "A Study of Fume Settling."

Horace Grove Deming: "Some Compounds of Cellulose."

Melvin Edison Diemer: "A Study of Aurous Compounds."

Emil Oscar Ellingson: "On Abietic Acid and some of its Salts."

Robert Harvie: "Ontario Gabbros and Associated Ores."

Winfield Scott Hubbard: "Studies of the Tryptic Digestion of Silk."

Alfred Edward Koenig: "A Study of some of the Salts of Fatty Acids."

James Nelson Lawrence: "Efficiency of Gas Calorimeters."

George Vest McCauley: "The Distribution of Energy in the Spectra of Metals."

Warner Jackson Morse: "Comparative Studies of the Bacteria associated with the Blackleg Disease of Potatoes."

Carl Ferdinand Nelson: "Studies on Osmosis."

UNIVERSITY OF CALIFORNIA

Charles Barrows Bennett: "The Purines of Muscle."

Victor Birekner: "The Oxidations and Cleavages of Glucose: Yeast Glucase, a new Glucolytic Ferment."

Lyman Luther Daines: "The Comparative Development of the Cystocarps of *Antithamnion* and *Prionitis*."

Jay Clinton Elder: "The Relation of the Zona Pellucida to the Formation of the Fertilization Membrane in the Egg of the Sea Urchin (*Strongylocentrotus purpuratus*)."

Thomas Harper Goodspeed: "Quantitative Studies of Inheritance in *Nicotiana* Hybrids."

Myrtle Elizabeth Johnson: "The Control of Pigment Formation in Amphibian Larvæ."

Walter Pearson Kelley: "The Functions and Distribution of Manganese in Plants and Soils."

Charles Gustave Paul Kuschke: "The Abelian Equations of the 10th Degree, irreducible in a given Rational Domain."

Loye Holmes Miller: "Contributions to Avian Paleontology from the Pacific Coast Region of North America."

Edward Haslam Walters: "The Hydrolysis of Casein by Trypsin."

Baldwin Munger Woods: "A Discussion by Synthetic Methods of two Projective Pencils of Conics."

Reynold Young: "The Polarization of the Light in the Solar Corona."

UNIVERSITY OF PENNSYLVANIA

Newcomb Kinney Chaney: "The Electrolytic Preparation of Antimony."

Ralph Winfred Duncan: "The Optical Constants of Sodium and Potassium."

Robert Carithers Duncan: "The Optical Constants of Sodium and Potassium."

Engelhardt August Eckhardt: "The Optical Constants of Solid Solutions."

Samuel Weiller Fernberger: "On the Methods of Just Perceptible Differences and Constant Stimuli."

Joseph Madison McCallie: "Standardization of some of the Common Tests used in testing the Acuteness of the Vision of School Children."

Francis Norton Maxfield: "An Experiment in Linear Space Perception: A Psychophysical Study of Sensitivity in the Discrimination of Small Differences in Lines about Two Inches Long."

Reuel Hull Sylvester: "The Form Board Test."

Edward Embree Wildman: "The Spermatogenesis of *Ascaris megalocephala*, with special reference to the Two Cytoplasmic Inclusions, the Refractive Body and the 'Mitochondria'; Their Origin, Nature and Role in Fertilization."

UNIVERSITY OF MICHIGAN

Harvey Clayton Brill: "A Study of the Formation of Pyrimidines by use of Nitromalonie Aldehyde."

Henry Newell Goddard: "Can Soil Fungi Assimilate Atmospheric Nitrogen?"

Clarence W. Greene: "Polarization in the Aluminium Rectifier, with special reference to the Development of a Potentiometer Method of determining the Decay of the Counter Electromotive Force of Polarization."

James Elmer Harris: "The Elastic Properties of Bismuth Wires."

Irving Day Scott: "The Spacing of Fracture Systems and its Influence on the Relief of the Land."

Clarence Jay West: "The Salts of the Oxy Xanthenols (A Contribution to the Chemistry of Quino Carbonium Salts)."

Neil Hooker Williams: "Stability of Remanent Magnetism."

Elizabeth Dorothy Wuist: "The Morpho-physiological Life History of the Gametophyte of *Onoclea struthiopteris*."

PRINCETON UNIVERSITY

Garrett Davis Buckner: "Studies on the Silver Coulometer."

Karl Taylor Compton: "Studies in the Photoelectric Effect."

Claude William Heaps: "The Effect of Magnetic Fields on the Resistance of Metals and Conducting Crystals."

Otto Frederic Kampmeier: "The Development of the Thoracic Duct in the Pig."

Joseph Stanley Laird: "A Study of the Inclusions in Electrolytic Silver, and their Effect on the Electrochemical Equivalent of Silver and the Electrochemical Equivalent of Cadmium."

Charles Sheard: "The Ionization Produced by Hot Salts and by Freshly Heated Metal Wires."

Phillips Thomas: "A Study of the Action of Dielectrics under Applied Alternating Electric Stresses, with regard to the Loss of Energy which occurs."

CLARK UNIVERSITY

Eugene William Bohannon: "Exceptional Children and the Only Child in the Family."

John Madison Fletcher: "An Experimental Study of some of the Incoordinations of Functional Speech Disturbances."

Frank Eugene Howard: "The Pedagogy of the Emotions."

Karl Johan Karlson: "Psychoanalysis and Mythology."

John Milton McIndoo: "Instinct as related to Education."

Tadaichi Ueda: "The Psychology of Justice."

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

John Andrew Allan: "Geology of the Ice River District, British Columbia."

Norman Levi Bowen: "The Binary System: $\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8$ (Nephelite, Carnegieite) $\text{CaAl}_2\text{Si}_2\text{O}_8$ (Anorthite)."

Arthur Edgar: "The Equilibrium between Nitric Acid, Nitric Oxide and Nitrous Acid."

Merle Randall: "Studies in Free Energy."

Frank Finch Rupert: "The Free Energy of Concentrated Solutions."

Stuart James Schofield: "Geology of East Kootenay, British Columbia, with special reference to the Origin of Granite in Sills."

OHIO STATE UNIVERSITY

Cecil Ernest Boord: "The Action of Substituted Hydrazones upon Orthoquinones—a Contribution to a Study of the Constitution of Orthohydroxyazo Compounds."

Freda Detmers: "An Ecological Study of Buckeye Lake—a Contribution to the Phytogeography of Ohio."

David Raymond Kellogg: "The Hydrolysis of Ethyl Acetate by Neutral Salt Solutions."

George Weatherworth Stratton: "The Action of Substituted Tollyl Hydrazines upon Quinones."

Edgar John Witzemann: "Oxidation of Propylene Glycol."

BROWN UNIVERSITY

William Ward Browne: "Acid Production by the *Bacillus coli* Group."

John Wymond Miller Bunker: "Colon Bacilli in Polluted Oysters."

Robert Foster Chambers: "A Study of Symmetrical Tribrom Phenyl Propionic Acid."

Walter Edward Sullivan: "*Pseudopleuronectes americanus*."

INDIANA UNIVERSITY

Caroline Anna Black: "The Morphology of *Riccia frostii* Aust."

Mary Theresa Harman: "Method of Cell Division in the Sex Cells of *Tenia teniaeformis*."

Cora Barbara Hennel: "Certain Transformations and Invariants connected with Difference Equations and other Functional Equations."

William Logan Woodburn: "Spermatogenesis in certain Hepaticæ."

BRYN MAWR COLLEGE

Eleanora Frances Bliss: "Crystalline Rocks of the Doe Run Region, Pennsylvania."

Minnie Almira Graham: "A Study of the Change from Violet to Green in solutions of Chromium Sulphate."

Anna Isabel Jonas: "The Geology of the Avondale District, a Key to the Relations of the Wissahickon Mica-gneiss and the Shenandoah Limestone of the Piedmont of Pennsylvania."

UNIVERSITY OF IOWA

James Ellis Gow: "Embryology of the Aroids."

Fred Jay Seaver: "The Hypocreales of North America."

Franklin Orion Smith: "The Effect of Training in Tonal Hearing."

STANFORD UNIVERSITY

Charles Victor Burke: "A Biological and Taxonomic Study of the Cyclogasteridæ."

John Edgar Coover: "Formal Discipline from the Standpoint of Experimental Psychology."

Hally Delilia Mary Jolivet: "Studies on the Reaction of *Pilobolus* to Light Stimuli."

GEORGE WASHINGTON UNIVERSITY

A. L. Kibler: "Mercury Fulminate."

W. J. McCaughey: "Mineralogical Methods in Soil Investigation."

UNIVERSITY OF MINNESOTA

Francis Cowles Frary: "Equilibria in Systems containing Alcohols, Salts and Water, including a New Method of Alcohol Analysis."

Charles Eugene Johnson: "The Development of the Prootic Head Somites and Eye Muscles of *Chelydra serpentina*."

NEW YORK UNIVERSITY

Ephraim M. Ewing: "The Venous Pulse."

Albert B. Pacini: "Metamorphism in Portland Cement."

UNIVERSITY OF VIRGINIA

George Frederic Paddock: "Some Adaptations and Criticisms of Spectroscopic Orbit Formulæ with an Application to V 4 Eridani, A. G. C. 4821x."

Stephen Taber: "Geology of the Gold Belt in the James River Basin, Virginia."

BOSTON UNIVERSITY

Robert E. Bruce: "Latitude Determination."

CATHOLIC UNIVERSITY OF AMERICA

Ignatius Albert Wagner: "The Condensation of Acetone by Means of Calcium Carbide."

UNIVERSITY OF CINCINNATI

Frances Kohnky: "The Subjective Element in Mysticism."

UNIVERSITY OF PITTSBURGH

Harry Nelson Eaton: "Geology of South Mountain and the Reading Hills, Pennsylvania."

VANDERBILT UNIVERSITY

Ernest Victor Jones: "A Spectrographic Study of Tellurium."

WASHINGTON UNIVERSITY

Charles Haskell Danforth: "The Anatomy of *Polyodon*."

THE CELEBRATION OF THE TWO HUNDREDTH ANNIVERSARY OF THE ROYAL SOCIETY

THE celebration of the two hundred and fiftieth anniversary of the founding of the Royal Society of London began on Monday, July 15, when the president and the fellows received their guests informally in the rooms of the society at Burlington House. The first formal recognition of the anniversary, apart from the visit of the president and the treasurer to the king to present to him the memorial volumes on Saturday, was at noon on Tuesday at Westminster Abbey, when a special service was held. The dean of Westminster preached the sermon, taking his text from Esdras, "Truth abounds and is strong for ever." The formal reception of the delegates took place in the afternoon at Burlington House. After formally giving the delegates welcome, Sir Archibald Geikie, the president, made an address in which he traced the origin and early days of the society.

The ceremony of presenting addresses of congratulation followed. Besides the formal addresses, there were speeches by a representative of each country or dominion. The selected speakers were:

Austria-Hungary—Professor Izidor Fröhlich, rector of the Royal Hungarian University, Budapest.

Belgium—Professor Louis Dallo, Académie Royale des Sciences, Brussels.

Denmark—Professor Hector F. E. Jurgensen, University of Copenhagen.

France—M. Gabriel Lippmann, president of the Académie des Sciences de l'Institut, Paris.

Germany—Professor Dr. Woldemar Voigt, rector of the University of Göttingen.

Greece—Professor Andrew Andreades, University of Athens.

Italy—Professor Vito Volterra, University of Rome.

Monaco—Mr. J. Y. Buchanan, F.R.S., Oceanographical Institute.

Netherlands—Professor P. Zeeman, secretary of the Academy of Sciences, Amsterdam.

Norway—Professor H. Mohn, president of the Academy of Sciences of Christiania.

Russia—Dr. O. Backlund, Acad. Impériale des Sciences, St. Petersburg.

Spain—Professor Rodriguez Carracido, Real Acad. de Ciencias, Madrid.

Sweden—Count K. A. H. Mörner, vice-president, Kongliga Svenska Vetenskaps Akademien, Stockholm.

Switzerland—Professor E. Naville, University of Geneva.

Egypt—Dr. James Currie, principal of the Gordon College, Khartum.

Japan—Professor R. Fujisawa, Imperial University, Tokyo.

United States—Professor W. B. Scott, vice-president American Philosophical Society, Philadelphia.

Australia—Professor H. Laurie, University of Melbourne.

Canada—Dr. W. Peterson, principal, McGill University, Toronto.

India—Dr. F. G. Selby, late vice-chancellor, University of Bombay.

South Africa—Sir David Gill, F.R.S., Royal Society of South Africa.

England and Wales—Dr. C. B. Heberden, vice-chancellor of Oxford (universities), and Sir C. H. Read, president, London Society of Antiquaries (learned societies).

Scotland—The Very Rev. Dr. G. Adam Smith, principal of the University of Aberdeen.

Ireland—Professor J. Joly, F.R.S., University of Dublin (Trinity College).

On Tuesday evening a banquet took place at the Guild-hall. Sir Archibald Geikie was in the chair and the principal addresses were