

# SCIENCE

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FRIDAY, SEPTEMBER 5, 1902.

DOCTORATES CONFERRED BY AMERICAN  
UNIVERSITIES.

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FOR the fifth year we publish statistics in regard to the conferring of the degree of doctor of philosophy by American universities. The figures have been obtained from official sources; they are correct and reasonably complete. Twenty-seven institutions are given on the table, and replies have been received from as many more. Several of our best colleges do not give the degree. This appears to be wise, at least so long as universities such as Kansas, Missouri and Tulane have found occasion to grant it but once in five years, and Stanford and Princeton have on the average granted it but twice a year. The figures published, not very promptly, by the Bureau of Education indicate a larger number of doctorates of philosophy, but these must include institutions that have no right to confer this degree, giving it for work done *in absentia* or perhaps for the payment of a fee. Our record during the past five years shows that the degree has been granted by good institutions to 1,158 candidates, or an average of about 230 each year. This is a considerable number of well-educated men, but after all rather insignificant when compared with the population of the country, or even with the number of teachers employed in our schools. No statistics are available to show

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the number of doctorates conferred on Americans by German or other foreign universities, but as our own universities become better equipped the number of students going abroad tends to decrease.

## DOCTORATES CONFERRED.

	1902	1901	1900	1899	1898	Total
Chicago .....	27	36	37	24	36	160
Yale .....	29	39	26	30	34	158
Johns Hopkins...	17	30	33	38	33	151
Harvard .....	31	29	36	24	26	146
Columbia .....	32	25	21	33	22	133
Pennsylvania ....	14	25	9	20	24	92
Cornell .....	23	21	19	7	19	89
Clark .....	1	7	9	5	12	34
New York.....	4	6	7	9	5	31
Michigan .....	10	3	5	4	7	29
Wisconsin .....	6	5	5	7	5	28
Virginia .....	6	8	2	2	0	18
Columbian .....	2	3	5	0	1	11
Brown .....	2	2	3	3	1	11
Bryn Mawr.....	2	2	1	3	3	11
Minnesota .....	3	2	3	2	1	11
Princeton .....	1	3	3	3	0	10
California .....	1	2	2	3	1	9
Stanford .....	2	2	2	0	2	8
Nebraska .....	0	1	1	1	2	5
Vanderbilt .....	0	1	3	0	0	4
Washington .....	0	1	0	2	0	3
Syracuse .....	1	0	0	1	0	2
Colorado .....	0	0	0	1	0	1
Kansas .....	0	0	0	1	0	1
Missouri .....	0	0	0	1	0	1
Tulane .....	0	0	1	0	0	1
	214	253	233	224	234	1158

It may be seen from the table that the twenty-seven institutions are pretty definitely grouped. There are five institutions, Chicago, Yale, Johns Hopkins, Harvard and Columbia, whose number of doctorates during the past five years range from 160 to 133. Then come Pennsylvania and Cornell whose numbers are 92 and 87 respectively. These seven universities have conferred just four fifths of all the degrees that have been conferred by reputable institutions. Clark, New York, Michigan and Wisconsin form a group conferring about six degrees annually. With Virginia intervening, we next come to a group con-

sisting of Columbian, Brown, Bryn Mawr, Minnesota, Princeton, California and Stanford, each of which confers about two degrees a year. There is then a drop to institutions conferring on the average one degree or less.

During the five years over which the statistics extend there has been no marked increase in the number of degrees conferred or alteration in the relative positions of the universities. The remarkable growth of the state universities is not witnessed by an increase in the number of degrees, but we may expect to see this in the course of the next five years. The 253 degrees last year were probably the largest number in the history of American education; but this year there is a drop to 214, the smallest number during the years covered by the records.

## DOCTORATES CONFERRED IN THE SCIENCES.

	1902	1901	1900	1899	1898	Total
Johns Hopkins...	9	19	20	17	19	84
Chicago .....	15	16	19	13	12	75
Columbia .....	14	13	12	23	10	72
Yale .....	10	18	10	15	11	64
Harvard .....	14	15	15	7	11	62
Cornell .....	16	13	11	2	11	53
Pennsylvania ....	5	12	6	8	8	39
Clark .....	1	7	9	5	12	34
Wisconsin .....	4	3	1	4	2	14
Michigan .....	5	0	1	3	0	9
California .....	1	2	1	3	1	8
Bryn Mawr.....	1	2	1	2	1	7
Virginia .....	1	4	0	2	0	7
Columbian .....	1	1	3	0	1	6
Stanford .....	2	1	0	0	2	5
Nebraska .....	0	1	1	1	2	5
Brown .....	2	1	0	0	1	4
Minnesota .....	2	0	1	1	0	4
Princeton .....	0	0	1	3	0	4
New York.....	0	1	0	1	1	3
Washington .....	0	1	0	2	0	3
Vanderbilt .....	0	1	1	0	0	2
Colorado .....	0	0	0	1	0	1
Kansas .....	0	0	0	1	0	1
Missouri .....	0	0	0	1	0	1
Syracuse .....	1	0	0	0	0	1
	104	131	113	115	105	568

In the second table similar statistics are given for the sciences. As has been stated in previous years, the distinction between the sciences and the humanities is somewhat arbitrary. In psychology, education, sociology and anthropology the attempt has been made to include the degrees under the sciences only when the thesis indicated that the subject had been treated as a natural science. It will be seen that the degrees are almost equally divided between the natural and exact sciences on the one hand, and languages, history, economics, philosophy, etc., on the other. Some universities appear, however, to favor one of the groups. Thus, Johns Hopkins, Cornell and Columbia have conferred more than half their degrees in the sciences, and Harvard, Yale, Chicago and Pennsylvania more than half in the humanities.

## DOCTORATES CONFERRED IN THE SCIENCES.

	1902	1901	1900	1899	1898	Total
Chemistry .....	24	28	26	32	27	137
Physics .....	12	23	15	7	11	68
Zoology .....	16	15	11	11	12	65
Psychology .....	8	13	9	15	18	63
Mathematics ....	8	18	11	13	11	61
Botany .....	11	8	12	11	11	53
Geology .....	6	10	5	5	6	32
Physiology .....	8	1	4	1	4	18
Education .....	1	2	8	5	0	16
Astronomy .....	2	5	4	2	3	16
Sociology .....	4	3	3	5	0	15
Paleontology ....	0	1	2	4	0	7
Anthropology ...	0	1	2	0	2	5
Bacteriology ....	1	1	1	1	0	4
Mineralogy .....	1	0	0	2	0	3
Agriculture .....	2	0	0	0	0	2
Anatomy .....	0	1	0	0	0	1
Engineering .....	0	1	0	0	0	1
Meteorology .....	0	0	0	1	0	1
	104	131	113	115	105	568

It is evident from the third table that about again as many degrees are awarded in chemistry as in any other science. There is then a group of sciences of nearly equal rank—physics, zoology, psychology, mathematics and botany—in which the numbers

range from 68 to 53. There is then a drop to geology with 32 and to physiology with 18 degrees. Agriculture appears on the list this year for the first time with two degrees, and last year one degree was awarded in engineering. It is to be hoped and expected that research work in these applied sciences and in experimental medicine will increase. In regard to the cultivation of the sciences at different centers it appears that this year chemistry was relatively favored at Columbia, Johns Hopkins, Harvard, Yale and Pennsylvania; physiological chemistry at Yale; physics, zoology and psychology at Cornell; geology at Chicago, Harvard and Michigan, and botany at Chicago.

The names of those on whom the degrees were conferred in the sciences and the titles of their theses are as follows:

## CORNELL UNIVERSITY.

Frank Allen: 'The Relation of Color-Blindness to the Fundamental Color Sensation.'

Leroy Anderson: 'Some of the Influences affecting Milk Production with especial reference to the Relation of Food to Milk Fat.'

John Wallace Baird: 'The Relation of Accommodation and Conveyance to the Perception of Depth.'

Peter Field: 'The Forms of Unicursal Quintic Curves.'

Charles Stuart Gager: 'The Development of the Pollinium and Sperm Cells in *Asclepias Cornuti* Decaisne.'

Elmer Edgar Hall: 'The Penetration of Totally Reflected Light into the Rarer Medium.'

William Atwood Hilton: 'The Morphology and Development of Intestinal Folds and Villi in Vertebrates.'

George L. Hoxie: 'The Induction Motor and its Engineering Capabilities.'

Carlotta Joaquina Maury: 'The Marine Oligocens of the United States.'

Kiichi Miyaké: 'The Development of the Archegonium and Fertilization in *Picea* and *Abies*.'

Henry Lewis Rietz: 'On Primitive Groups of Odd Order.'

Mary Jane Ross: 'The Origin and Development of the Gastric Glands of *Desmognathus*, *Amblystoma* and Pig.'

Augustus Valentine Saph: 'An Experimental Study of the Resistances to the Flow of Water in Pipes.'

Margaret Everitt Schallenberger: 'The Growth of the Child's Mind: A Study of the Development of Mental Structure.'

Lee Barker Walton: 'Evidence concerning the Double Nature of the Segment in Hexapoda, Chilopoda and Diplopoda.'

Floyd Rowe Watson: 'Surface Tension at the Interface of Two Liquids determined Experimentally by the Method of Ripple Waves.'

#### UNIVERSITY OF CHICAGO.

Wallace Appleton Beatty: 'Action of Sodium Alcoholates on Salts of Fatty Acids.'

Fred Harvey Hall Calhoun: 'The Relations of the Kewatin Ice Sheet to the Mountain Glaciers of Montana.'

Katherine Elizabeth Dopp: 'The Place of Industry in Elementary Education.'

Nevin Melancthon Fenneman: 'The Development of the Profile of Equilibrium of the Subaqueous Shore Terrace.'

Arthur White Greely: 'Studies on the Effects of Low Temperatures upon Morphogenetic Processes.'

Eugene Howard Harper: 'History of the Fertilization and Early Development of the Pigeon's Egg.'

Shinkishi Hatai: 'Studies on the Central Nervous System of the Rat and Cat.'

Edward Cary Hayes: 'The Sociologist's Object of Attention.'

Frank Baldwin Jewett: 'A New Method of Measuring the Vapor Density of Metals at Low Temperatures.'

Anstruther Abercrombie Lawson: 'Studies on the Morphology of the Nucleus.'

Burton Edward Livingstone: 'The Rôle of Diffusion and Osmotic Pressure in Plant Physiology.'

Florence May Lyon: 'Development of the Sporangium and Gametophyte of *Selaginella rupestris*.'

Thomas Milton Putnam: 'Concerning the Linear Fractional Group on three Variables with Coefficients in the Galois Field of order  $p^n$ .'

William George Tight: 'Origin and Development of the Ohio River.'

Frank Alonzo Wilder: 'The Age and Origin of the Gypsum of Webster County, Iowa.'

#### COLUMBIA UNIVERSITY.

Benjamin Arthur Bensley: 'The Evolution of the Australian Marsupialia, with Remarks on the Relationship of the Marsupials in General.'

Leopold Boroschek: 'Some New Derivatives of the Mono-nitro-ortho-phthalic Acids.'

Robert Henry Bradford: 'Reactions of the Ziervogel Process, and their Temperature Limits.'

William Austin Cannon: 'Studies in Plant Hybrids.'

Robert Heywood Fernald: 'Working Details of a Gas-engine Test, Including a Method of Determining the Temperatures of Exhaust Gases.'

Carl Gundersen: 'On the Measure or Content of Assemblages of Points.'

Cassius Jackson Keyser: 'The Plane Geometry of the Point in Space of Four Dimensions.'

George Alfred Lawrence: 'Studies upon the Cerebral Cortex in the Normal Human Brain and in Dementia Paralytica.'

Charles Edward Lucke: 'The Heat-engine Problem.'

Floyd Jay Metzger: 'A New Separation of Thorium from Cerium, Lanthanum and Didymium and its Application to the Analysis of Monazite.'

Charles Joseph Pretzfeld: 'A New Separation of Mercury from Arsenic, Antimony and Copper.'

Austin Flint Rogers: 'Crystallographic Studies.'

John Cutler Torrey: 'The Early Development of Thalassima.'

Lewis Addison Youtz: 'A Study of the Quantitative Determination of Antimony.'

#### HARVARD UNIVERSITY.

Ebenezer Henry Archibald: 'The Atomic Weight of Cæsium.'

Robert Stanley Breed: 'The Metamorphosis of the Muscles of a Beetle (*Thymalus marginicollis*, Chev.).'

Frederick Alexander Bushée: 'Ethnic Factors in the Population of Boston.'

George Perkins Clinton: 'North American Ustilagineæ.'

Otto Dunkel: 'Regular Singular Points of a System of Homogeneous Linear Differential Equations of the First Order.'

Richard Blair Earle: I., 'On the Constitution of the Colored Compounds obtained from Sodie Alcoholates and certain Aromatic Compounds.' II., 'On the Action of Sodie Sulphite in Alcoholic Solution on Tribromdinitrobenzol and Tribromtrinitrobenzol.'

William Jay Hale: I., 'On the Oximes of Nitromalonic Aldehyde.' II., 'On the Condensation of Nitromalonic Aldehyde with Benzylmethyl Ketone.'

Cyrus Ambrose King: 'Observations on the Cytology of *Araiospora pulchra* Thaxter.'

Frederick Meakin: 'Inhibition of Ideas.'

Edgar William Olive: 'A Monograph of the Acrasieæ.'

Carleton Estey Preston: 'Structural and Ecological Studies on Desert Vegetation.'

William Martin Smallwood: 'The Maturation, Fertilization and Early Cleavage of *Bulla solitaria*.'

Joseph Edmund Woodman: 'Geology of the Moose River Gold District, Halifax County, Nova Scotia; together with the Pre-Carboniferous History of the Meguma Series.'

Robert Mearns Yerkes: 'The Psychic Processes of the Frog.'

#### YALE UNIVERSITY.

Alling Pruden Beardsley: I, 'On the Action of Phenylhydrazine on Acylthiocarbamic and Acylimidothiocarbamic Esters: Pyro- $\alpha$ ,  $\beta$ '—Diazole Derivatives.' II, 'On the Action of Phenylhydrazine on Benzoylpseudothioureas: 1, 5-Diphenyl—3—Amino—Pyro- $\alpha$ ,  $\beta$ '—Diazole Derivatives.'

George Barton Cutten: 'Psychology of Alcoholism.'

Arthur Lyman Dean: 'Studies on Inulin and the Enzyme Inulase.'

Frank Eugene Hale: 'Starch and the Dextrins in Relation to Iodometry.'

George Arthur Hanford: 'Studies on the Physiological Action of Cæsium Compounds.'

Julius Olsen: 'An Experimental Investigation into the Existence of Free Ions in Aqueous Solution of Electrolytes.'

Leo Frederick Rettger: 'Experimental Studies on the Inter-Relation of the Spleen and Pancreas.'

Lyman Brumbaugh Stookey: 'Studies on Glycogen Formation.'

Ralph Gibbs Van Name: 'Analytical Applications of the Sulphocyanides.'

Lynde Phelps Wheeler: 'On the Reflection of Light from Mercury in Water.'

#### JOHNS HOPKINS UNIVERSITY.

Friend Ebenezer Clark: 'The Action of Substituted Ammonias of the Aliphatic Series on the Chlorides of Orthosulphobenzoic Acid.'

Arthur Byron Coble: 'A Study of the Ternary Quartic in its Relation to Conics.'

Charles Fowler Lindsay: 'A Study of the Conductivity of Certain Salts in Water, Methyl, Ethyl and Propyl Alcohols, and Mixtures of these Solvents.'

Louis Alexander Parsons: 'The Spectrum of Hydrogen.'

Henry Farnham Perkins: 'The Development of *Gonionema Murbachii*.'

Percy Goldthwait Stiles: 'On the Rhythmic Activity of the Oesophagus and the Influence upon it of Various Media.'

William Stone Weedon: 'An Investigation of the Oxidation Products of Phenylthiosalicylic Acid.'

John Boswell Whitehead, Jr.: 'The Magnetic Effect of Electric Displacement.'

Kisaburo Yamaguchi: 'An Investigation of the Hydrated Oxides of Manganese derived from Electrolytically-prepared Permanganic Acid.'

#### UNIVERSITY OF MICHIGAN.

Joseph William Tell Duval: 'Conditions Influencing Vitality and Germination of Seeds.'

Charles Edward Marshall: 'The Aeration of Milk.'

Raymond Pearl: 'The Movements and Reactions of Freshwater Planarians.'

Raymond Haines Pond: 'The Biological Relations of Aquatic Plants to the Substratum.'

Harrison McAllester Randall: 'The Determination of the Coefficients of Expansion of Nickel and Quartz at High Temperatures.'

#### UNIVERSITY OF PENNSYLVANIA.

Alfred Lewis Kammerer: 'Electrolysis of Bismuth Salts.'

Allen Rogers: 'Derivatives of Complex Inorganic Acids.'

Arthur Bertram Turner: 'Secular Perturbations Arising from the Action of Jupiter on Mars.'

Edwin Burkett Twitmyer: 'The Normal Knee-jerk.'

Levi Parker Wyman: 'The Purification of Tungstic Acid.'

#### UNIVERSITY OF WISCONSIN.

Benjamin Horace Hibbard: 'The History of Agriculture in Dane County, Wisconsin.'

Harrison Eastman Patten: 'Influence of the Solvent in Electrolytic Conduction.'

Oswald Schreiner: 'The Sesquiterpenes.'

Allyn Abbott Young: 'Studies in Age Statistics.'

#### BROWN UNIVERSITY.

George Ellett Coghill: 'The Cranial Nerves of *Amblystoma Tigrinum*.'

Millett Taylor Thompson: 'The Metamorphoses of the Hermit Crab.'

#### UNIVERSITY OF MINNESOTA.

Paul Maurice Glascoe: 'Derivatives of Camphor Oxime.'

George F. Wilkin: 'Social Control.'

## LELAND STANFORD JUNIOR UNIVERSITY.

Ralph Arnold: 'The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro.'

Thomas Andrew Storey: 'Some Studies on Voluntary Muscle Contraction.'

## BRYN MAWR COLLEGE.

Margaret Baxter MacDonald: 'A New Class of Disulphones.'

## UNIVERSITY OF CALIFORNIA.

Alice Robertson: 'The Embryology and Embryonic Fission in Cyclostomatous Bryozoa.'

## CLARK UNIVERSITY.

Andrew J. Kinhaman: 'Mental Life of two *Macacus Rhesus* Monkeys in Captivity.'

## COLUMBIA UNIVERSITY.

Nevil Monroe Hopkins: 'Some Experiments on Electrolytic Conductivity with Reference to the Ion Theory.'

## SYRACUSE UNIVERSITY.

William Erastus Taylor: 'On the Product of an Alternant by a Symmetric Function.'

## UNIVERSITY OF VIRGINIA.

Heber D. Curtis: 'Definitive Determination of the Orbit of Comet, 1898, I.'

*RECENT PROGRESS IN ASTRONOMY.\**

THE opening years of the twentieth century are full of remarkable and most striking evidences of man's power over the forces of nature, and yet with this feeling of might there comes to the thoughtful student, and perhaps especially to the astronomer, a deep reverential feeling of man's utter insignificance, and the littleness of his knowledge, in comparison with what is necessary for the complete mastery of the problems that present themselves.

Heat, light and electricity are the forces which have been so grandly made use of by the scientific man and the practical engineer. It is enough for me to refer only to the stupendous developments of the machinery making use of steam for locomotion on land and sea; to the great labor-saving

devices used in the manufacture of steel and other needed things.

Still more marvelous are the applications of electricity; and the promises for the near future are most startling. I do not desire to develop these lines of thought, because I am aware that the young men of this institution, and especially those of the graduating class, have minds well stored with apt illustrations; and their imaginations can rapidly construct dreams of the future, based upon their own intimate knowledge of what has been done, and what is just on the point of being accomplished, by the application of heat and electricity.

This morning in my short address I wish to call your attention to *some* of the triumphs lately achieved by the use of light. And inasmuch as my work is mainly astronomical you will, I know, permit me to dwell entirely on the matter of celestial photography.

The United States has many reasons to be proud of what her astronomers have done both in the improvement of photographic telescopes, and in the results of photographic research; but the whole world has been active in applying this comparatively new instrument. The promise of future developments is indeed very gratifying. Every one is deeply interested in the study of the make-up of the solar and lunar surfaces. To-day photographic telescopes supply us with most of our accurate knowledge of details.

Exposures on the sun are made, lasting one to several thousandths of a second of time, which on development bring out the texture of the photosphere, the details of spots and spot groups, and the faculæ. These plates are taken with great regularity at several observatories in the world, and are studied at leisure by a trained force of observers. Rutherford in New York City from 1870 to 1874 took many solar photographs, the study of which has given us

\* Commencement Address delivered at the Worcester Polytechnic Institute, June 12, 1902.