This line of separation is supported by the arguments of Strasburger, but even Strasburger has been known to change his opinions. To begin the gametophyte with the germinating spore certainly gives us a much clearer conception of the alternation of generations.

The history of the megasporangium is likewise terminated by the formation of the mother-cells, for their division is a reduction division, which is used as the basis of separation of sporophyte and gametophyte.

In the history of the male gametophyte the view that the tube-cell is the antheridium wall that develops a tubular outgrowth, 'while the generative cell and its products is the spermatogenous part of the antheridium' is given the preference. A careful reading of the chapter on the female gametophyte shows that the germination of the megaspore and formation of the gametophyte is not such a uniform process as most of our standard texts describe. In dealing with fertilization, 'double fertilization' is given due prominence, and the authors object to the use of the term as they consider it far from established that a real fertilization takes place; hence they prefer to speak of it as 'triple fusion.' The disputed centrosome question is touched upon and the authors' views may perhaps be gained from the following quotation: 'To say that all the figures that have been drawn have been mere products of the imagination would be a radical statement and one doubtless very far from the truth.' In the discussion of the endosperm its morphological character is touched upon, and while its exact nature is not considered established, the view that it is 'belated vegetative tissue of the female gametophyte, stimulated in a general way to develop by the act of fertilization,' is held as the most probable, although the possibility that it is a second sporophyte is admitted. Parthenogenesis and polyembryony are treated in the chapter on the embryo, and recent investigations seem to indicate that both are much more common than was formerly supposed.

In connection with each chapter there is a bibliography of the most important literature. An idea of the number of original papers consulted may be gained from the literature cited in the chapter on the female gametophyte, which includes 122 separate articles. The masterly way in which the vast amount of chaotic material has been handled is a commendable feature of the work, and we are inclined to think that the authors of some of our standard texts might consult it with profit.

Several chapters are given on classification, and it is encouraging to note that the authors have not found it necessary to develop a classification of their own but have been contented to adopt the classification of Engler and Prantl as given in 'Die Naturlichen Pflanzenfamilien,' as 'the best expression of our present knowledge, as applied to the whole of the Angiosperms.' The fact that 'this has not been pressed to the dreary details of minor groups,' but that general principles have been emphasized, makes these chapters of special value to the morphologist.

Separate chapters are given to geographic distribution, fossil Angiosperms and phylogeny of Angiosperms. The work closes with two chapters on the comparative anatomy of Gymnosperms and Angiosperms contributed by Professor E. C. Jeffrey, of Harvard University. Only a brief outline of the subject is attempted and perhaps some students will feel that a more extended treatment would have been advisable.

The whole work is illustrated with something over a hundred figures taken in large part from the original articles cited. The book is an admirable presentation of the subject and should be in the hands of every working botanist.

F. D. HEALD.
UNIVERSITY OF NEBRASKA.

*INVESTIGATIONS IN PROGRESS AT THE UNIVERSITY OF CHICAGO.**

IN a former Convocation Statement I endeavored to point out in a general way that the officers of the University were engaged very directly and earnestly in the prosecution of special investigations. It was my purpose to show that a great share of the strength of the University was given to research and in-

* From the last quarterly statement of President Harper.

vestigation, as distinguished from administration and teaching. I desire at this time to indicate specifically, by way of illustration, the thought which at that time I endeavored to express. My illustrations are taken altogether from the Departments of Mathematics and the Natural Sciences. On a future occasion I shall use material which has been gathered from the departments ordinarily classed as the humanities.

The proposition which I wish to present is this: Nearly every member of every department in the university is to-day engaged in investigative work in which effort is being put forth to make new contributions toward the better understanding of the subject studied. I think it best under all the circumstances not to mention in this statement the specific names of persons thus engaged. In most cases, however, the mention of the subject itself will carry with it a knowledge of the person engaged in the work.

THE DEPARTMENT OF ASTRONOMY AND ASTROPHYSICS.

Mr. A is engaged in a systematic study of double stars with the forty-inch telescope. His great general catalogue of all known double stars in the northern heavens, which he has been preparing during the past twenty-five years, is about to be published by the Carnegie Institution.

Mr. B is engaged in a spectroscopic study of stellar motions with the forty-inch telescope. The results he has already published represent the highest degree of precision hitherto attained in this field. Through his initiative several observatories in Europe, Africa and the United States are cooperating in the observation of certain standard stars. The results of his investigations will serve as a basis for general studies of stellar relationships and motions, and also of the motion of the solar system with respect to the stars.

Mr. C is at work upon a triangulation of nearly 700 stars in various star clusters. These observations will serve as a basis for future investigations of the internal motions of these clusters. His observations of the Fifth Satellite of Jupiter are the only ones that have been obtained during the last five years, on account of the difficulty of observing this exceedingly faint object. In the cooperative plan of observing the minor planet Eros, participated in by many observatories in all parts of the world, he has obtained the most extensive series of observations, comprising over 1,500 measures on 73 nights. In addition to many other micrometrical observations with the large telescope, he has undertaken an extensive photographic survey of the Milky Way and other objects with the Bruce photographic telescope.

Mr. D is engaged in investigations on the motions of the minor planets, with particular reference to the characteristic planets of the Hilda type. He is also continuing his researches on effective potential forces.

Mr. E is engaged in a variety of theoretical investigations, most of which involve the application of the methods of modern mathematics to problems of celestial mechanics. He is giving special attention to a critical study of the nebular hypothesis on dynamical grounds, and is also at work on the theory of telescope objectives, with special reference to the use of non-spherical surfaces.

Mr. F's work on the design and construction of reflecting telescopes, and his photographs obtained with the two-foot reflector of the Yerkes Observatory have exercised a wide influence among astronomers. His color-screen method of converting a visual telescope into a photographic one has yielded excellent results with the forty-inch telescope and is being adopted in other observatories.

Mr. G is engaged in spectroscopic studies of various stars with the large telescope. This work relates particularly to certain very close double stars discovered by Mr. B and Mr. G with the Bruce spectrograph.

Mr. H is engaged in determining the brightness of a large number of stars, particularly those which vary in their brightness and which at minimum are beyond the reach of ordinary telescopes. Part of this work on very faint stars has been done in cooperation with two or three of the largest observatories in this country.

Mr. J's investigations relate to the general subject of stellar evolution, and are threefold in character:

1. Photographic studies of stellar spectra for the purpose of determining the physical and chemical condition and the order of development of certain great classes of stars. With the collaboration of two other members of the department, he has just completed an investigation of one of the two classes of red stars, including their chemical composition, physical condition, motion in the direction of the earth, order of evolution and relationship to the sun and other classes of stars.

2. Studies of the sun made for the purpose of elucidating both solar and stellar phenomena.

3. Laboratory investigations bearing on problems of solar and stellar chemistry and physics. With the collaboration of another member of the department, an investigation of spark spectra in liquids and compressed gases, and their bearing on the theory of temporary stars, has just been completed.

THE DEPARTMENT OF PHYSICS.

Mr. A is engaged in work upon a ruling engine for the production of diffraction gratings of a high order of perfection. Serious difficulties have been encountered, but considerable progress has been made upon this most important piece of work, and at present the prospect of attaining the end sought is highly encouraging. The efficiency of the gratings which it is hoped this machine will make will be at least twice that of the best gratings which have yet been produced. The difficulty of making a grating with twice the efficiency is as much greater than that of making the gratings which have been produced as the difficulty of making a telescope objective of eighty inches diameter is greater than that of making one of forty inches diameter.

Mr. A has also just begun an investigation of the effect of various agencies upon the position, breadth, distribution of light and intensity of spectral lines. He further expects to take up soon the problem of the velocity of light.

Messrs. B and C are engaged in the publication of a series of text-books which contain the most important of the undergraduate courses in physics which have been developed here. This work is considered necessary in order that the university may exert an adequate influence upon physics-teaching throughout the country. Two of these texts have already appeared and two more are nearing completion.

Mr. B is also cooperating with the Departments of Mathematics and Pedagogy in an endeavor to improve the teaching of mathematics and physics in the secondary schools, and is about to begin the collection of Mr. A's scattered works for publication in a single volume.

Mr. C is, in addition, engaged in an investigation of the nature of electric discharge in high vacua. This investigation is designed to test an important point in the modern electron theory of matter.

Mr. D is in the midst of a research upon the relation of the sparking potential and the spark distance for distances of the order of the mean free path of the molecule.

Mr. E is assisting Mr. A in the perfection of the ruling engine, and is also cooperating with Mr. C in the production of a physics text-book for elementary schools.

Mr. F is engaged upon two pieces of research: (1) an examination of the conditions which govern the coherence between metals; and (2) the influence of hysteresis upon electric resonance. Preliminary results of these investigations were presented by Mr. F to the American Association for the Advancement of Science at its recent meeting in Washington.

Mr. G is determining the index of refraction of sodium vapor for that portion of the spectrum which contains the sodium lines.

THE DEPARTMENT OF CHEMISTRY.

Mr. A is at present engaged upon a study of dissociation phenomena in the glycerine-glycol series, as well as in the sugar group.

Mr. B is making a study of equilibrium conditions in calomel vapor, and also between amorphous and soluble sulphur.

Mr. C is conducting two lines of work: (1) studies on molecular rearrangement, and of saponification and hydrolysis of organic compounds by physico-chemical and synthetic-organic methods; and (2) studies on the existence of positive halogen ions.

Mr. D is conducting work upon the dissociation constants of dibasic acids.

Mr. E upon the constitution of salts of organic cyanogen compounds.

Mr. F upon dialkyl derivatives of hydroxylamine.

THE DEPARTMENT OF GEOLOGY.

Mr. A is engaged in the investigation of the Kinderhook faunas of the Mississippi valley.

Mr. B is engaged upon the graphical expression of the chemical composition of igneous rocks, with reference to their mineral constitution and their classification.

Mr. C has under investigation the glaciation of the western mountains and the geology of the coastal plain.

Mr. D is working upon a group of problems relating to the origin and early stages of the earth and upon the system of dynamics connected therewith.

THE DEPARTMENT OF ZOOLOGY.

Mr. A is studying (1) the evolution of species as indicated in the genetic relations of color-patterns, voices, instincts, and general life-histories; (2) experiments in hybridizing species, to ascertain, if possible, general laws governing the transmission of hereditary characters, and the conditions necessary to creation of new species.

Mr. B (1) the method of evolution. The quantitative study of the changes that a species undergoes in different localities and in different geological periods at one locality. Illustrated by studies on the shells of the mollusk known as the 'scallop' (*Pecten*) from different points on the coast of North America and Europe and from fossil beds in Virginia.

Mr. C is working on problems in embryology: (1) the rôle of cell-division in development; the relation of the process of cleavage of the ovum to the formation of an embryo; (2) the investigation of the problem of correlative differentiation, *i. e.*, the influences exerted by parts of an embryo upon the development of other organs; more particularly, at present, the mechanics of development of the amnion in the chick; and allantois; and the influence of the nervous system in the formation of organs.

Mr. D is engaged in experimental study of problems connected with regeneration: (1) the factors influencing regeneration and the effect of altered conditions; (2) the differentiation of the regenerating structures and the differences between regenerated and original structures; (3) the physiology of form and form-regulation, *i. e.*, the return to normal or typical form, after experimental alteration of form and especially the effects of physical factors, *e. g.*, pressure, tension, etc., upon form in the lower invertebrates.

Mr. E is making experiments and statistical investigations of the relations existing between some of the factors of the environment, *i. e.*, temperature, humidity, food, topography, etc., and the production of variations in insects, especially in the color-patterns of coleoptera; (2) investigating the evolution of large genera and of groups of small genera, to determine if possible what causes are the dominant ones in the production of new races and species, and the conditions necessary for their preservation; based upon the experiments and statistics (1) and the ontogeny and phylogeny of color-patterns, color variations, and geographical distribution.

THE DEPARTMENT OF ANATOMY.

Mr. A is conducting research in problems of anatomy and pathology of the nervous system and in infectious diseases.

Mr. B has completed, since coming to the university, two papers: one on the structure of the cardiac glands of mammals; the other, the structure of Brunner's glands in mammals. He has under way three other researches: (1) on the structure of Paneth cells; (2) on the histology of the gastric glands of vertebrates; (3) on the structures of the human stomach. It is to be

noted that these researches deal with the finest structures of the digestive tract.

Mr. C has made extensive researches in general anatomy, especially in vertebrate embryology. His experiments on the formation of the embryo in fish and amphibia are well known. More recently he has taken up the study of histogenesis, especially of fibrillated muscle cells and their nuclei. At present he is engaged upon a study of spermolysins and ovolysins.

Mr. D has been making contributions to our knowledge of the anatomy of the spleen, especially its framework, but is better known through the work of the last year and a half, conducted chiefly with Professor Ehrlich in Frankfurt, upon the nature of poisons which act upon the blood, especially snake poison. His studies have attracted international attention and have a wide bearing upon blood poisons in general.

Mr. E has made a special study of the anatomy of the ducts and blood-vessels of the pancreas of the hog and their origin in the embryo and has published part of the results. He is now engaged upon the study of the framework and wandering cells of the mucous membrane of the human stomach.

Mr. F is engaged upon the study of the arrangement of the connective tissues in the mammalian larynx and the study of the histogenesis of the laryngeal glands in the pig.

Mr. G is engaged upon the study of the morphology of the head in vertebrates, and on the study of the changes in the structure of the mucous membrane of the stomach following the operation of gastroenterostomy.

Mr. H is making important observations in methods of staining nerves with methylene blue and with Bethe's neuro-fibril method. These studies have been concerned chiefly with the degeneration of axones and nerve endings after nerve section or local pressure; and further with the effect of electrical stimulation on the structure and vital staining properties of nerve endings.

Mr. J has worked out the distribution of the blood-vessels in the labyrinth of the ear of *Sus scrofa domesticus*, the results appearing in the Decennial Publications of the University. He is now engaged upon the study of the structure and function of the *stria vascularis*. He spent a great deal of time and care in the preparation of casts and injections to form material for his special course.

THE DEPARTMENT OF NEUROLOGY.

Mr. A is at work on the change in the percentage of water in the nervous system of the white rat during the period between birth and full maturity.

Mr. B is making a study of the relative activity of the white rat at different ages and at different hours of the day.

Mr. C is working on the effects of lecithin on the growth of the central nervous system.

Mr. D: on the law for the distribution of the nerve fibers which innervate the leg of the frog.

Mr. E: on an enumeration of the medullated nerve fibers in the dorsal and ventral roots of the spinal nerves of man.

Mr. F: on the psychical development of the young white rat correlated with the growth of its nervous system.

Miss G: on the mode in which the white substance of the spinal cord of the rat increases in area.

Mr. H: on the healing of wounds of the brain at different ages between birth and maturity.

Mr. J: on the axone reaction as observed in the nucleus of the third cranial nerve of the white rat.

THE DEPARTMENT OF BOTANY.

Mr. A is engaged in studying problems connected with the origin and evolution of seed plants. A book, just going through the press, for the first time organizes the subject for the benefit of advanced and research students.

Mr. B is at present investigating the problems of fertilization among the lower plants. The results are distinctly pushing out the boundaries of our knowledge of one of the most fundamental life-processes.

Mr. C is investigating cytological problems among plants, and is completing an important contribution to our knowledge of the methods of nuclear division.

Mr. D is a large contributor to plant ecology, and is now engaged in organizing the

subject for its first publication as a university text.

Mr. F has been investigating certain important problems presented by the club-mosses, among which the origin of the seed-habit is prominent.

Mr. G is engaged in investigating the causes of the forms assumed by plant bodies, as shown chiefly by lower plants. He has shown experimentally that form is in the main a phenomenon of chemistry and physics, and not to be explained by any mystical vitalistic theory.

Mr. H is investigating the ecological problems that underlie scientific forestry, his field of operations having been chiefly in the Rocky Mountains of Montana. He has just made an important report to the government on that region.

Mr. J has in preparation a book for students of plant physiology in which for the first time the subject will be considered from the standpoint of modern chemistry and physics.

THE DEPARTMENT OF BACTERIOLOGY.

Mr. A is engaged upon a study of some of the poisonous substances produced by bacteria, especially those that affect the red blood-corpuscles. He is also preparing evidence to be used in the suit between the states of Missouri and Illinois concerning the Chicago Drainage Canal.

Mr. B. has nearly completed a piece of work upon some disease-producing organisms found in human blood and closely related to the typhoid bacillus.

THE DEPARTMENT OF PALEONTOLOGY.

The work upon which Mr. A is at present engaged, and which will occupy the large part of the next two years, is a monographic study of the extinct orders of Mesozoic reptiles known as the Pterodactyls and Plesiosaurs. This investigation is aided by a grant from the Carnegie Museum.

Under the combined direction of Mr. A and Mr. B, and with Mr. C's cooperation, Mr. D, a fellow, is engaged upon a study of the fossil diptera of America, based chiefly upon a collection loaned to the Department by the U. S. National Museum.

THE SCHOOL OF GEOGRAPHY IN THE SUMMER SESSION OF CORNELL UNIVERSITY.

Interest in geography as a school subject has grown rapidly within the past ten years. Courses have multiplied in the summer sessions of the universities, and an increasing number of teachers in secondary and grade schools have awakened to their need of better training both in subject matter and in methods of treatment. More than a dozen of the larger universities now accept the subject for admission, and examinations are regularly offered by the College Entrance Examination Board.

These facts give special meaning to the organization of the Cornell School of Geography under the direction of Professor R. S. Tarr. Although following upon the discouraging typhoid epidemic of last winter, the health of the school was excellent, and the attendance much larger than was expected, including grade, normal and high school teachers and superintendents from seventeen states.

The courses and instructors were as follows: Physiography and geography of Europe, Professor R. S. Tarr; dynamic geology and geography of the United States, Professor Albert P. Brigham, of Colgate University; home geography and type studies in geography for grammar grades, Dr. Chas. A. McMurry, of Northern Illinois Normal School; commercial geography, Principal Philip Emerson, of Lynn; class-room problems and laboratory methods for the grades, Supervisor R. H. Whitebeck, of Trenton State Normal and Model Schools; laboratory in geography, Assistant Principal Frank Carney, of Ithaca; laboratory in geology, Mr. Geo. C. Matson, of Cornell University.

A large number of field excursions were made, in the vicinity of Ithaca, and to more remote points such as Watkins Glen, Lake Ontario and the coal region about Wilkesbarre. On one evening of each week a round table conference gave opportunity for informal dis-