be more limited in extent and restricted to certain tissues or locations. Wassermann succeeded in affecting the endothelial cells of the pleura by direct pleural inoculation of typhoid bacilli so as to increase their power to produce antibodies above that of the other tissues of the body, and Noguchi succeeded by localizing a tetanus infection in the subcutaneous tissue of the thigh to make it impossible for tetanus toxin to enter the body from that location while all other avenues of entry were left unaffected. And, as a parallel to these states of immunity, we see in the phenomenon of Arthus that the subcutaneous tissues of the rabbit can by repeated injections of horse serum be sensitized and thus made to react with a degree of vigor and inflammation which may cause their destruction, the rest of the body meanwhile showing no increase of sensitiveness.

The hypersensitiveness of the tubercular state would appear to be localized in tissues far removed from the seat of the infecting tubercle bacilli, and probably every part of the tuberculous organism is in a potential hypersensitive condition. In any case, the ophthalmo-reaction of Calmette and the cuti-reaction of v. Pirquet, both of which are yielding good service in the diagnosis of tuberculosis and taking the place of the more serious general reaction of hypersensitiveness following upon tuberculin injection, show that in the conjunctiva and the skin the cells are sensitized and react rapidly and in a characteristic manner to tuberculinization.

It will be clear to you that in following the diverse reactions of the body to foreign substances, among which parasitic microorganisms play in pathology the chief part, there is gradually being discovered a wide range of phenomena, some desirable and beneficial, some objectionable and injurious, which together constitute the effects of natural disease or of efforts to thwart and overcome it. It will become the particular quest of the immediate future to attempt the unraveling of those biological conditions which underlie one or the other of these, and to secure to the use of medical practise those effects which may be beneficial and to remove from it those which are injurious. Were there still time at hand, I should present to you certain newer facts in protective inoculation with bacteria and of serum therapy which are not without good augury for preventing certain infective diseases of man and animals, and of overcoming them by specific serum therapy once they have developed. And then I should try to interest you in the remarkable progress which has been made, and is being made almost daily, in the discoveries in specific chemical therapeutics which make the control of certain protozoan diseases—trypanosomiases and spirilloses especially—very hopeful for the future. I must, however, not detain you longer from the enjoyment of the interesting scientific program which has been prepared for this hour.

SIMON FLEXNER

CHARLES A. YOUNG

THE past five months have brought severe losses to astronomy in the deaths of five of its distinguished men: in Germany, Vogel, of Potsdam; in France, Loewy, of Paris, and Janssen, of Meudon; in this country, Asaph Hall; and now Charles A. Young, who died at Hanover, N. H., on January 3.

There is some consolation, however, in the fact that all of these men had reached advanced years,[1] and had in a measure rounded out their scientific careers, although the three first named were still in active service as directors of large observatories.

Charles Augustus Young was born on

[1] Average age, 75 years.

December 15, 1834, at Hanover, where his grandfather and father successively occupied the chair of natural philosophy in Dartmouth College during the period from 1810 to 1858. He entered college early and graduated with distinction in 1853 as bachelor of arts. During his student days he assisted his father in astronomical observations and accompanied him in 1853 on a trip to Europe to purchase instruments for the Shattuck Observatory, then in course of erection. For two years after graduation he taught the classics at Phillips Academy, pursuing at the same time theological studies at the Andover Seminary. In 1857 he went to Hudson, Ohio, as professor of mathematics and natural philosophy at Western Reserve. During several summer vacations he assisted in the governmental survey of the great lakes. Responding to the call of patriotism in 1862, he was for four months Captain of Company B in the 85th Regiment of Ohio Volunteers, which was largely recruited from students.

In 1866 he returned to Dartmouth as professor of natural philosophy and astronomy, thus continuing the family tradition.

The next few years were stirring times in astrophysical research. The spectroscope was just beginning to be applied in the study of celestial objects, with results of surprising interest. The eclipse of 1868 was made memorable by the discovery by Lockyer and Janssen of the method of observing the solar prominences. In spite of heavy duties as teacher, Young applied himself assiduously to solar research. He observed the eclipse of 1869 at Burlington, Iowa, establishing the fact of the gaseous nature and truly solar origin of the corona. Employing what was for those days a very powerful spectroscope, he quite accurately located the position of the green corona line, which was thereafter known as No. 1,474 on Kirchhoff's map of the solar spectrum. It was not until the eclipse of 1898 that the position of the line was more correctly located, by Professor W. W. Campbell observing in India, and was shown not to be represented by a dark Fraunhofer line. At the eclipse of 1869 Young also looked for, but failed to detect, the reversal of the dark lines at the moment of internal tangency of moon and sun. But he realized his expectations at the Spanish eclipse of the next year, when he discovered the "flash spectrum." He describes it in these words: "The moment the sun is hidden, through the whole length of the spectrum, in the red, the green, the violet, the bright lines flash out by hundreds and thousands, almost startlingly; as suddenly as stars from a bursting rocket head, and as evanescent, for the whole thing is over within two or three seconds."[2] This phenomenon was subsequently observed visually in a more or less satisfactory way by different astronomers at other eclipses, but it was not photographically recorded until 1896, when it was caught by Mr. W. Shackleton at Nova Zembla with the prismatic camera.

In the early seventies Professor Young gave much attention to the spectrum of the chromosphere and to the prominences. Many of his delineations of these have become classics from their reproduction in various works and text-books. He devised an improved form of solar spectroscope which served his purpose very effectively. His assiduity was rewarded by his observation of a number of rather unusual solar phenomena: such as the highest recorded prominences, extraordinary velocities indicated by distorted lines, up to 320 miles per second; violent solar agitation associated with magnetic storms. He was the first to attempt to photograph the prominences and attained a partial success (1870). With the wet plates then neces-

[2] *The Sun*, p. 82.

sarily employed an exposure of four minutes was necessary with the use of the dark blue line of hydrogen (H_γ). This degree of insensitiveness of the films made it undesirable to spend time on such photographs.

In 1876 he made the first use of a grating spectroscope in astronomical work, and measured the rate of rotation of the sun by the displacement of the lines at the east and west limbs.

Professor Young successfully observed the transit of Venus of 1874 at Peking, and went to Russia for the eclipse of 1887, but was prevented from work by clouds. He had clear skies at the eclipse of 1878 at Denver, and in 1900 at Wadesboro, N. C. He also particularly studied the chromospheric lines, and made a list of 190 which he had noted with the spectroscope attached to the Dartmouth nine-inch telescope. The advantage of a high elevation becoming evident, he made an expedition in the summer of 1872 to Wyoming, where with the apparatus taken from Hanover, at an elevation of 8,000 feet, he added another hundred lines to his list. The subsequent increase in these lines, aside from those found in eclipse photographs, has been chiefly due to his own observations at Princeton.

In 1877 he accepted a call to Princeton, where much larger instrumental facilities were offered to him, with less confining teaching duties. He gave, however, much time to the organization and equipment of the students' observatory, making it then probably the best in this country. A powerful spectroscope was provided for the 23-inch equatorial of the Halsted Observatory, and with this he made important observations of the chromosphere and sunspots. He discovered in 1883 that the absorption spectrum of the sunspot umbra may be resolved into "countless and contiguous" dark lines, a difficult observation later amply confirmed by others. With the Halsted refractor he also made micrometric observations of planets and satellites. He carried out an extensive program of observations of the transit of Venus in 1882 at Princeton.

His admirable work "The Sun," of the International Scientific Series, appeared in 1881 and presented in a clear and interesting manner the known facts and theories of solar physics. It includes many of his own interpretations of difficult points and is the authoritative work on the subject. It is characteristic of his modesty that many of his own discoveries (such as that of the reversing layer) are there given without mention of his own name, and would only be recognized as such by those familiar with the circumstances, who could read between the lines, or by those who happened to consult the index. Several editions of this work appeared, and it was translated into several foreign languages. The last, thoroughly revised, edition was published in 1895.

His "General Astronomy," the first of his important series of text-books which have been used by more than a hundred thousand students, was issued in 1888. It represents much more than a mere text for students, and has been widely used as a work of reference. The "Elements of Astronomy" and "Lessons in Astronomy," adapted for more elementary students, were published a little later. The "Manual of Astronomy," comprising most of what was in the General Astronomy, but with more illustrations and with the inclusion of the latest data, was issued in 1902.

The fundamental idea in Professor Young's text-books, popular articles and lectures, was that statements should be accurate as far as they go. He was no special pleader, and in his public utterances always fairly stated both sides of dis-

puted matters, and he avoided controversy in a manner exemplary to younger men. His public lectures were not popular by reason of any eloquence of delivery or of rhetorical skill, but because of their clearness, simplicity and convincing quality of accuracy. As a teacher he was particularly successful; having himself a splendid grasp of the fundamentals of mathematics and physics, he presented his subject logically, with emphasis on the essentials; and his humor enlivened the class room. It is doubtful if any teacher in this country has enlarged the intellectual horizon of a greater number of undergraduates than has he, in his culture courses in astronomy. "Twinkle" will never be forgotten by any of his students.

Professor Young's eminent services in research and education received recognition in numerous academic degrees, membership in and awards from various learned societies.

He had suffered from Bright's disease for a number of years; but by good care had kept himself fairly comfortable. The loss of his wife seven years ago, after forty-four years of a particularly happy married life, came as a crushing blow to him; and to his sorrow was lately added the death, after a year of distressing illness, of his widowed daughter, who made her home with him.

The retirement from his position at Princeton in the summer of 1905 was made the occasion of a grateful recognition by his colleagues, and the appreciation shown by his friends at that time must have been a source of much gratification to him. He then returned to Hanover, where he lived quietly, until he succumbed to a brief attack of pneumonia on January 3. Two days later he was gathered to his fathers in the old cemetery close to the house where he was born.

EDWIN B. FROST

YERKES OBSERVATORY,
January 14, 1908

SCIENTIFIC BOOKS

Experimental Zoology. By THOMAS HUNT MORGAN, Professor of Experimental Zoology in Columbia University. New York, The Macmillan Company. 1907.

In a recent number of SCIENCE there appeared an extensive review of this book, which, in the opinion of the writer, does scant justice to an important and valuable work. It is with the thought, therefore, of calling attention to some of the many valuable features of the book that the following supplementary review is written.

Although experimental zoology is one of the youngest of the sciences it has grown so rapidly that it is practically impossible for one not working in this field to keep pace with its development. Until recently there was but one journal devoted to this subject and much of the literature pertaining to it is scattered through publications which are more or less inaccessible. From time to time there is needed in every science, and especially in one not well organized, some general work, which will not only summarize results and bring many scattered observations under one point of view, but which will also awaken interest in the subject and point out the direction of needed research.

Such a book is this of Morgan's—a book which is not only full of information, but which is also illuminating and stimulating. The writer of this notice has made this book the basis of a course of reading for graduate students in zoology with the most satisfactory results. The book discusses in a very concise and direct manner a great range of experimental work in zoology, much of which, it is safe to assume, is relatively unfamiliar to many zoologists. Although these discussions are usually brief, they go straight to the heart of the matter under consideration, and they generally exhibit a critical insight and a breadth of judgment which indicate a thorough acquaintance with the phenomena in question. By the variety and extent of his own experimental work Morgan is probably better fitted than any other man in America to write a general work on experimental zoology.