or juvenile impressions with a teleological background or bias.

Without elaborating, I wish to point out briefly that there is to-day abundant evidence showing that the differences, distinguishing the characteristics of one wild-type or variety from others, follow the same laws of heredity as do the so-called aberrant types studied by geneticists.

Even this evidence may not satisfy the members of the old school because, they may still say, all these characters that follow Mendel's laws, even those found in wild species, are still not the kind that have contributed to evolution. They may claim that these characters are in a class by themselves, and not amenable to Mendelian laws. If they take this attitude, we can only reply that here we part company, since *ex cathedra* statements are not arguments, and an appeal to mysticism is outside of science.

There remains still the question of the causal origin of mutations. Here also some progress has been made, but the subject is admittedly by no means on the same footing as is our knowledge of the laws of inheritance. It behooves us, then, to be careful, for our progress in this respect has been slow and to some extent erratic. I mean by this that we have not yet found a method of producing specific results—*i.e.*, a method by which particular genes can be changed in a particular way.

Even here, however, something has been done. In the work with x-rays and heat the same mutants appear that are already known, and that have come up without treatment. In addition, new mutants appear, as they do also without treatment. If it can be shown on a large scale that the same ratio for known mutations holds for x-ray and for spontaneous mutations, we may have found an opening for the further study of the causes of certain types of mutation.

I have been challenged recently to state on this occasion what seemed to be the most important problems for genetics in the immediate future. I have decided to try, although I realize only too well that my own selection may only serve to show to future generations how blind we are (or I have been, at least) to the significant events of our own time.

First, then, the physical and physiological processes involved in the growth of genes and their duplication (or as we say their "division") are obviously phenomena on which the whole process of reproduction rests. The ability of the new genes to retain the property of duplication is the background of all genetic theory. Whether the solution will come from a frontal attack by cytologists, geneticists and chemists, or by flank movements, is difficult to predict, although I think the latter more promising.

Second: An interpretation in physical terms of the changes that take place during and after the conjugation of the chromosomes. This includes several separate but interdependent phenomena—the elongation of the threads, their union in pairs, crossing over, and the separation of the four strands. Here is a problem on the biological level, as we say, whose solution may be anticipated only by a combined attack of geneticists and cytologists.

Third: The relation of genes to characters. This is the explicit realization of the implicit power of the genes, and includes the physiological action of the gene on the rest of the cell. This is the gap in our knowledge to which I have referred already at some length.

Fourth: The nature of the mutation process—perhaps I may say the chemico-physical changes involved when a gene changes to a new one. Emergent evolution, if you like, but as a scientific problem, not one of metaphysics.

Fifth: The application of genetics to horticulture and to animal husbandry, especially in two essential respects; more intensive work on the physiological, rather than the morphological, aspects of inheritance; and the incorporation of genes from wild varieties and species into strains of domesticated types.

Should you ask me how these discoveries are to be made, I would become vague and resort to generalities. I would then say: By industry, trusting to luck for new openings. By the intelligent use of working hypotheses (by intelligence I mean a readiness to reject any such hypotheses unless critical evidence can be found for their support). By a search for favorable material, which is often more important than plodding along the well-trodden path, hoping that something a little different may be found. And lastly, by not holding genetics congresses too often.

OBITUARY

RALPH HOFFMANN

RALPH HOFFMANN, director of the Santa Barbara Museum of Natural History, met sudden death in a fall from a cliff on San Miguel Island, California, on July 21.

He was born in Stockbridge, Massachusetts, in 1870, was educated at Williston Academy, and graduated from Harvard University in 1890. After graduating he taught at the Browne and Nichols School in Cambridge. In 1910 he became head master of the Coun-

try Day School in Kansas City, Missouri, and in 1917 of the Country Day School in St. Louis. From 1920 to 1927 he taught in the Santa Barbara School for Boys, but in 1923 accepted the title of honorary director of the Santa Barbara Museum of Natural History and devoted his spare time to its development. In 1927 he was elected director, a position he held at the time of his death.

Although ornithology and botany were avocations during his years of teaching, he became well known throughout the country in both fields. In addition to contributions to the Nuttall Ornithological Club, *The Auk, Rhodora, Bird Lore* and *The Condor,* he published "A Guide to the Birds of New England and Eastern New York" in 1904 and "Birds of the Pacific Coast" in 1927.

Whenever he exhausted the birds of a region he turned to its plants. After his New England "Guide," he published the "Flora of Berkshire County." After his "Birds of the Pacific Coast," he began work on the flora of Santa Barbara County and especially that of the Channel Islands. Though the fall that resulted in his death came while he was collecting the island flora, his notes were in such shape that the list is appearing in the *Bulletin* of the Southern California Academy of Sciences.

Ralph Hoffmann possessed not only the thoroughness of the scientist, but also an enthusiasm so contagious that those who knew him, especially children, left his presence either with a newly awakened love for birds and plants or with an old interest doubled.

E. H.

RECENT DEATHS

DR. ULYSSES SHERMAN GRANT, professor of geology at Northwestern University since 1899, died on September 21, at the age of sixty-five years.

DR. THOMAS G. LEE, professor emeritus of comparative anatomy at the University of Minnesota, died on September 8, at the age of seventy-two years.

OUTRAM BANGS, curator of birds in the Museum of Comparative Zoology at Harvard University, died on September 22, in his seventieth year.

DR. JOHN WYNN GILLESPIE, professor of botany at the Arizona State Teachers College and formerly National Research fellow, died of pneumonia at Albany, Georgia, on September 13. He was on his way home from a summer's vacation spent in study at the Kew Herbarium.

DR. FRANK BILLINGS, dean of the faculty of Rush Medical College since 1899 and emeritus professor of medicine in the University of Chicago, died on September 20. He was seventy-eight years old.

DR. ASTLEY PASTON COOPER ASHHURST, professor of clinical surgery at the Graduate School of Medicine of the University of Pennsylvania, died on September 19. He was fifty-six years old.

THE REV. GEORGE W. LAY, of Chapel Hill, North Carolina, a member of the American Association for the Advancement of Science, who contributed articles to SCIENCE on scientific terminology, has died, at the age of seventy-two years.

THE deaths are announced of two distinguished British surgeons: Sir Henry Simpson, the obstetrician, on September 13, in his sixtieth year, and Sir Chester James Symonds, known for his work in abdominal surgery, on September 14, at the age of eighty years.

DR. FREDERICK HENRY HATCH, a past president of the British Institution of Mining and Metallurgy and a member of the governing body of the Imperial Institute, died on September 22, at the age of sixty-eight years.

SCIENTIFIC EVENTS

THE DAVID DUNLAP OBSERVATORY

THIS observatory, which, when completed, will be presented to the University of Toronto, to be conducted by its department of astronomy, is being erected by Mrs. Jessie D. Dunlap as a memorial to her husband, David Alexander Dunlap, who died in the autumn of 1924. It is located near the village of Richmond Hill, fifteen miles north of Toronto, one half mile east of Yonge Street, Ontario's great highway to the north.

There are two chief buildings. One, sixty-one feet in diameter, of metal, will house a reflecting telescope of aperture seventy-four inches. This instrument is being built by Sir Howard Grubb, Parsons and Co., of Newcastle-on-Tyne, England, and its construction is well advanced. The building is also being supplied by the same firm. It is intended to put in the cement foundations for the building and also the pier for the great telescope this autumn in order to let them weather the storms of winter. The building will be erected next spring and the telescope a little later. This telescope will be used chiefly for spectrographic work, though some direct photographs may be taken.

The administration building will contain offices, library, lecture room, laboratories, computing rooms and workshop. Plans for it were prepared by Mathers and Haldenby, of Toronto, and the corner stone was laid on September 10. It will be 91 feet long