REMEMBERING STURTEVANT*

Alfred Henry Sturtevant (1891–1970) was the youngest of six children of Alfred Henry and Harriet (Morse) Sturtevant. His grandfather, Julian Sturtevant, was a Yale graduate, a Congregational minister, and one of the founders and later president of Illinois College in Jacksonville, Illinois. Sturtevant's father taught mathematics for a while at that college, but later took up farming, first in Illinois and later in southern Alabama, where the family moved when Sturtevant was seven years old. Sturtevant went to a one-room country school and later to a public high school in Mobile.

At the age of 17, Sturtevant entered Columbia University, where his brother Edgar, who was 16 years older, was teaching at Barnard College. Edgar and his wife took the young Sturtevant into their family, and Alfred lived with them while attending the University. Edgar was a scholar who later became a professor of linguistics at Yale and an authority on the Hittite language. Sturtevant said that he learned the aims and standards of scholarship and research from Edgar. It was a great pleasure for Sturtevant when he and Edgar were awarded honorary degrees at the same Yale commencement many years later. Also present at the ceremony were Sturtevant's nephew, Julian (Edgar's son), Professor (now Emeritus) of Organic Chemistry at Yale, and Sturtevant's elder son, William, then a graduate student in Yale's department of anthropology and now curator of anthropology at the Smithsonian Institution in Washington.

Sturtevant said that he became interested in genetics as the result of tabulating the pedigrees of his father's horses. He continued this interest at Columbia and also collected data on his own pedigree. At Edgar's suggestion he went to the library and read some books on heredity, with

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the result that he read the textbook on Mendelism by Punnett.

Sturtevant saw at once that Mendelism could explain some of the complex patterns of inheritance of coat colors in horses that he and others before him had observed. Edgar encouraged Sturtevant to write an account of his findings and take it to Morgan, who at that time was Professor of Zoology at Columbia, and from whom Sturtevant had taken a course in zoology during his freshman year. Morgan encouraged Sturtevant to publish the paper, and it was submitted to the *Biological Bulletin* in June, 1910, at the end of his sophomore year. The paper appeared that same year (Sturtevant 1910). The connection between the genetics of horses and that of Drosophila will be familiar to readers of this column from the *Perspectives* by Snell and Reed (1993) on the mouse geneticist W. E. Castle.

The other result of Sturtevant's interest in the pedigrees of horses was that he was given a desk in the famous fly room at Columbia University where, only three months before, Morgan had found the first white-eyed fly. These stories and more about the early days at Columbia, when modern genetics was in a very real sense born, are a matter of record, especially in the writings of Sturtevant himself (1965a,b).

Sturtevant once wrote that he knew of no one else at the time who was so thoroughly committed to the experimental approach to biological problems as was Morgan. It was Morgan's aim to produce a mechanistic, as opposed to a purposive, interpretation of biological phenomena. A great deal of this approach clearly rubbed off on Sturtevant.

Sturtevant had a remarkable memory. It was as if his memory were composed of a plethora of matrices waiting to be filled with any data that lent themselves to classification into discrete categories. The data might be in the form of numbers and kinds of bristles missing in a mutant fly; numbers of snails with a right-handed coil vs. a left-handed coil, the genetics of which Sturtevant was the first to explain; the relation between inversion sequences in different species; or the host of other characteristics he investigated not only in Drosophila, but in irises, evening primroses, snails, moths, and many other creatures, including human beings. Whatever form the data took, the observations fell into the appropriate matrix in his memory, from which they were readily retrievable to a degree that was truly phenomenal. Sturtevant liked to refer to this as the "blockhead" approach.

The Caltech period was a time of collaboration, especially with Sterling Emerson, Theodosius Dobzhansky, George Beadle, and Jack Schultz. It was Sturtevant's style, at least after he came to Caltech in 1928 with Morgan and Bridges, to spend his mornings doing experi-

ments. Afternoons were spent in the biology library checking on any incoming journals, few of which in any phase of biology he did not at least dip into. The pace of science was not so frenetic as it is nowadays, so there was time for extended afternoon tea sessions at which Sturtevant might bring up a paper he had read that afternoon and that had attracted his attention. These sessions were very stimulating for the graduate students in genetics and embryology who usually attended them; among the faculty in genetics, Schultz, Emerson, and Dobzhansky were likely to be present in addition to Sturtevant, and in embryology, Albert Tyler, who was working on the biochemistry of fertilization. Although a rift had developed between Sturtevant and Dobzhansky, there was no sign of it in front of the graduate students.

Sturtevant taught the undergraduate course in genetics at Caltech for many years. From time to time he also gave a course for undergraduates in entomology, complete with a field laboratory session. His lectures on topics in advanced genetics were scholarly reviews of special areas of genetics, often dealing with organisms with bizarre genetics, such as the protozoa. His lectures were especially valuable because he covered areas of research not ongoing at Caltech. The elementary course in genetics that Sturtevant taught was based on a textbook that he and George Beadle wrote (1939). It was not so widely used as perhaps it should have been, probably because it was considered too difficult for the average student. It was tailored for Caltech students, and the problems especially were a challenge, even for Caltech undergraduates.

Sturtevant and Beadle planned to revise the textbook, but the pressure of other work and the rapidity of developments that followed the discovery of the role of DNA prevented the revision. Sturtevant also liked to point out that both he and Beadle found after writing the book that each had used the term "gene" differently. For example, the white gene to Sturtevant was the specific white mutant, but to Beadle it represented the constellation of white alleles including the wild-type allele. Sturtevant facetiously blamed their inability to get out a second edition on this difference in thinking about the gene. Characteristically, he would ask each geneticist whom he met how he or she used the term, and he then promptly catalogued such persons according to whether they thought of the gene the way he did or the way Beadle did. The person asked did not, of course, need to worry about his answer being in good company in either case.

Sturtevant read widely and kept abreast of many topics of current interest, especially politics. He would, for example, read the Sunday *New York Times* and the *Manchester Guardian Weekly* virtually from cover to

cover. He was especially happy if he could do the crossword puzzle in the *Guardian* at one sitting. Those who know those puzzles will understand that only a very special breed of person attempts them, let alone solves them in one sitting. In the evening he would browse through the *Encyclopedia Britannica*, which was shelved next to his easy chair. He complained one time, and he was not bragging, that he had difficulty in finding an article which he had not already read.

Sturtevant was fascinated with puzzles of all kinds, especially puzzles involving three-dimensional objects. When Anne Roe (1953) made a study of what makes scientists tick, she chose Sturtevant as one of her subjects. He was not only flattered, but overjoyed at the opportunity to take the tests, which he viewed simply as a new set of puzzles to work out.

Sturtevant would develop a topic logically and succinctly, whether he was publishing a paper or giving a formal lecture. In private conversation, however, he always seemed to assume that the listener was at least as well versed in the subject as he was, so he would leave out the preliminaries and get right to the point. This could be mystifying to some. For others it was a challenge to try to become sufficiently versed to profit by listening to his ideas or tapping the tremendous store of information at his fingertips on almost any topic of substance. His papers were so well written that one would assume that he had labored over each word. His penciled manuscripts rarely contained more than a few minor changes inserted into the original draft, which was done in longhand on foolscap. When asked how he did this, he told me that he usually spent many days mulling the paper over in his mind until all the words fell into place, and then all he had to do was write it down from memory.

Sturtevant developed a keen interest in the history of science; his book, *A History of Genetics* (1965a), is a classic. His main purpose in writing it, I believe, was to give credit where he thought it was due, always a difficult task, and at the same time to trace the history of the ideas underlying scientific discoveries. I believe he would have decried a tendency in some quarters to relate scientific discoveries to the sociopolitical views of the discoverers themselves. His fascination with pedigrees, including his own, led him to compile an appendix that contained a series of "intellectual" pedigrees. Sturtevant, of course, was a direct descendant of T. H. Morgan and of E. B. Wilson, another eminent biologist who was a contemporary and friend of Morgan's at Columbia. Morgan and Wilson were, in turn, direct descendants of Martin and Brooks, two men who were at Johns Hopkins University where Morgan had obtained his doctorate; Martin was descended from T. H. Huxley and

Brooks from Louis Agassiz; and so it went.

Sturtevant had a fund of aphorisms and anecdotes that he liked to spring whenever an occasion arose. Three of his favorites were from Morgan: "Establish a point and publish it;" or, when trying to overcome the difficulty in starting to write a paper, "Compose a flowery introduction, then throw it away and write the paper;" or, when a Drosophila experiment gave a totally unexpected result, "They will fool you every time." Sturtevant had one that pertained to his own marriage to Phoebe Reed Sturtevant and to that of a number of their friends, namely, "Marriages are made in heaven but there is a branch office in Woods Hole." A few were deliberately outrageous in order to make a subtle point: "Too bad graduate students are people;" or "Vertebrates are a mistake and should never have been invented." He liked to deflate pomposity whenever he ran across it and referred to pompous persons as "stuffed shirts." Echoing his contempt for profundity, he would say, "Something is profound if it reaches conclusions which I like by methods I don't understand."

Sturtevant's love for all living things, including people, was expressed in many ways. For example, in 1954 he gave the presidential address before the Pacific Division of the American Association for the Advancement of Science, where he warned of the potential hazards to human beings of the fallout from the atmospheric testing of atomic bombs. What had provoked Sturtevant was a strong statement issued by the executive branch of the government that the fallout levels from testing were far below any that could cause damage to human beings. This assumption, that there is a threshold for damage from ionizing radiation, had no evidence to support it and clearly was being used to justify testing of nuclear weapons.

Although I know that some assumed that the only purpose of Sturtevant's remarks was a desire to see a halt to bomb testing, this was not the case. He took a neutral stance and, although he felt there might be a need for testing, the public should be given the best estimate that scientists could make about the nature of the danger to the unborn from fallout levels of radiation. In "Quarreling Geneticists and a Diplomat," Crow (1995) has described in more detail the ways in which Sturtevant and other geneticists interacted in assessing radiation risks to the germ plasm.

I am indebted to Sturtevant's son, William, for pointing out in a personal communication that his father "had deep disdain for eugenics and a strong contempt for all forms of social discrimination," sentiments that perfectly sum up Sturtevant's position on these matters. Indeed, most of the chapter on the "Genetics of Man" in Sturtevant's *History of Genetics*

(1965a) is devoted to a balanced treatment of the nature-nurture question.

Sturtevant's scientific accomplishments have been reviewed elsewhere, by himself (1965a); by Sterling Emerson (1971), who first became acquainted with him in 1922; by G. W. Beadle (1970), who first came to Caltech in 1931 as a National Research Council Fellow; and by me (1976). Some of his most important papers were reprinted in a book, *Genetics and Evolution* (1961), on the occasion of his 70th birthday. Sturtevant was invited to make addenda to those papers as he saw fit; characteristically, he made only the briefest possible ones.

In a *Perspectives*, J. F. Crow (1988) stressed Sturtevant's remarkable contributions to virtually every branch of genetics. One of Sturtevant's most enduring scientific interests was that of evolutionary theory and how to approach it experimentally. One of his first contributions relevant thereto was his discovery and analysis of hybrids between *Drosophila melanogaster* and *D. simulans*, for which there is a valuable *Perspectives* by W. F. Provine (1991).

Sturtevant's research style was to let the experiments lead the way. In this respect he was not restrained by having to write grant proposals, and a decline in his rate of publishing after 1945 might have resulted in a low score anyway. Bateson is often cited for having said, "Treasure your exceptions." I believe Sturtevant's admonition would be, "Analyze your exceptions," for it is his remarkable analytical ability that shines through all his work.

For Sturtevant, science must have been an exciting and rewarding journey into the unknown. It was fortunately a long journey, with detours to many realms, and I am sure he savored every minute of it.

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