

A modern astronomer who took fees for casting horoscopes would be legitimately suspected of deceiving victims who pay because they are deceived. A paragraph on the "Fourth Centenary of the Birth of Tycho Brahe", in *Nature*, Nov. 23, p. 740, suggests that earlier astronomers of those days earned a living by palming off horoscopes on the credulous; this ignores the persisting grip of astrological beliefs when Tycho Brahe and Kepler lived.

The Copernican system had an astrological part at first, though the movements of the earth, rather than the stellar motions, influenced destiny. When the "De Revolutionibus" was published on behalf of Copernicus in 1543, it was stripped of this astrology. Osiander's editing tried to soften any papal opposition to the new astronomy (Thorndike, l.c., 1941, 5, 413f.). If the astrology was stripped off to assist the softening, an astrological astronomy deferred, in this instance, to possible papal protests against horoscopes.

Tycho Brahe does not surprise the historical sense by vindicating astrology, or by compiling annual predictions for the Court at Copenhagen, or by casting horoscopes for the royal family. Astrology was still rife when he died in 1601. Sir Francis Bacon accuses astrology of many errors; but he also exhorts science to reconstruct it justly.

Astrology is losing its grip in "The Anatomy of Melancholy" (1621), but has not yet lost it. Robert Burton seems to admit in one place that the stars are the most remote causes of "Heroical Love". In another he does not try to decide between astrological physicians and their opponents. He exclaims against the vanity of "genethiacal studies", but he notes that Saturn was lord of his geniture, that he had Jupiter in his sixth house, and that Mars had a hand in the matter. The stars do incline: Burton retains this astrological faith. They incline too gently, however, to compel those whom reason rules: he softens down the astrological power to decree or enforce. Christian astrology had frequently refused to place man's freedom at the mercy of the stars or planets. A prolonged powerful grip is perceptible in Burton's many references to astrological lore; his attempt to believe in astrology without believing too much suggests a loosening of the grip.

Sir Thomas Browne, in "Religio Medici" (1643), seems, somewhat ambivalently, to believe and disbelieve. No laborious argument against astrology is needed, for any truth it may have does not injure divinity. If astrology has any truth, Sir Thomas notes, he may "outlive a Jubilee". He does not "revolve Ephemerides and Almanacks in expectation of malignant aspects, fatal Conjunctions and Eclipses", but he does suspect a piece of the "Leadend Planet" in himself since he was born "in the Planetary hour of Saturn". In the "Pseudodoxia Epidemica" (1646), he does not condemn astrology as a popular error when he warns men against the pretentious astrologer who abuses the "worthy enquiry" of the stars. Satan also deceives men, Browne thinks, by "conceits of stars and meteors" other than "their allowable actions". In "Christian Morals", published in 1716 after his death, Sir Thomas commends the "celestial aspects" for admonition and advertisement, though they should not determine men's ways.

Bacon restricts "celestial operations" to "masses of things" and excludes the "calculation of nativities" from rational astrology. Burton and Browne obviously knew their own nativity horoscopes, and many others thought it at least prudent to know

theirs. The degree of belief in the accuracy of the casting or in the horoscope when cast probably varied; but, as Browne hints, the horoscope might contain wholesome warnings. Any astrologer could conscientiously cast horoscopes under such conditions. The horoscope, precautionary or more trusted, did not necessarily involve an insistence on fatal necessity in the stars. The more prudent astrologers, Bacon admits, had always denied such fatal necessity.

The astrology which had prevailed widely among the intellectual elite since Ptolemy persisted pertinaciously. A Kepler who checks his own horoscope on the events of his own life, and, as Singer says, keeps in effect an "astrological diary", is historically quite intelligible. He is equally intelligibly an honest caster of horoscopes for the many who still believed in them—wholeheartedly or with varying qualifications.

## OBITUARIES

Dr. F. F. Blackman, F.R.S.

FREDERICK FROST BLACKMAN was born on July 25, 1866, and died on January 30, 1947. His was a full life, which resulted in valuable contributions to botany, and to his University and College, of which he was a member for nearly sixty years.

His first published contributions to botany were two papers in the *Philosophical Transactions of the Royal Society* in 1895. They began a series entitled "Experimental Researches on Vegetable Assimilation and Respiration", of which the twenty-first paper appeared in 1933. Only a few of the series bear Blackman's name, but all reveal the impress of his mind. They are a record of some of the investigations carried out by him and by the students working under his leadership. In all these researches he played an important part not only during the experimental work but also in marshalling the results for publication. In 1928 a new series commenced with three papers entitled "Analytic Studies in Plant Respiration". Other papers for this series have for some time been in a state which those with a less exacting standard than Blackman's would consider ripe for publication. These two series record the main field of his scientific activities. The views and discoveries he has already recorded have been so incorporated into the body of biological knowledge that their epoch-making character may be forgotten. It is a commonplace to elementary students that most of the gaseous exchange between leaves and the atmosphere takes place through stomata; but although this was suggested so long ago as 1832, it was much disputed until convincing experimental evidence was provided by Blackman in 1895. Whatever may be decided concerning the degree of generality of his Theory of Limiting Factors there is no doubt that the paper on "Optima and Limiting Factors", which he published in 1905, provided an outstanding clarification of biological thought and has had far-reaching effects. He was the last person to think that he had achieved finality in his formulations; as he liked to express it, he was making a first approximation to the truth, and he hoped it would pave the way for a closer approach. He was a pioneer in the application of precise quantitative methods in plant physiology and in the application of physico-chemical laws to the interpretation of biological processes. Yet he never failed to realize

the complexities of the organisation of biological systems, and he retained his interest in these problems to the end.

Blackman's other major contribution to botany was the effect he had on those who had the privilege of listening to his lectures and on those who had the even greater privilege of doing research under his guidance. His lectures were masterly presentations of experimental results marshalled in such a way as to illuminate his theme. Much of the material was drawn from investigations made under his guidance, while that garnered from biological literature often appeared in a completely new form after having been subjected to his analytical mind. To experience to the full the discipline of his ways it was necessary to work on a problem under his guidance; his was a precise mind which gently indicated the right path. To see one's presentation of the results of an investigation analysed and then synthesized into a new form was indeed an education. He performed this service for many others who sought his advice.

Blackman was a member of the staff of the Cambridge Botany School from his appointment as demonstrator in 1891 until his retirement from the readership in botany in 1936, and as such he undertook a full share of the administrative work of the department. This, together with his wise advice, which continued after his retirement, contributed largely to its smooth running. He was a perfect colleague, and he had the gift of inspiring all, both staff and assistants, to give of their best. When the time came for the extension of the Botany School in 1933, he devoted as much thought to the planning of the new facilities as he had done to the running of the old department. He not only formulated his own requirements down to the smallest detail but also stimulated others to proceed in the same way.

When, in recognition of the active school which had developed under Blackman's inspiration, a Sub-Department of Plant Physiology was created in 1931 with the aid of a benefaction from the Rockefeller Fund, he naturally took charge, and but for complications of age and date of retirement he would have become the first professor of plant physiology in Cambridge. On relinquishing the readership his old students and associates presented him with his portrait, painted by Henry Lamb, which now hangs in the Botany School.

Elected a fellow of the Royal Society in 1906, he was awarded a Royal Medal in 1921, and gave the Croonian Lecture in 1923. He was president of the Botany Section of the British Association in 1908 and president of the Section of Plant Physiology at the International Botanical Congress held in Cambridge in 1930.

He devoted much time and thought to the affairs of St. John's College, of which he was steward for several years and in which he lived as a bachelor fellow until 1917. His advice on a wide range of subjects, including the preservation of old buildings, the erection of new ones, pictures, plate and many others, was sought and respected.

In 1917 he married Elsie Chick. They planned and built a house and surrounded it with a garden which gave them and their friends great pleasure, and provided opportunities for the exercise of his artistic and botanical interests. Mrs. Blackman and their son survive him.

Blackman had the same approach to all problems. He collected the facts and considered them carefully

and dispassionately before giving his opinion. It was done so thoroughly and unobtrusively that there was a temptation not to notice the care that he had bestowed. He was as gentle as he was wise. To those who knew him well Blackman was a great man.

G. E. BRIGGS  
F. T. BROOKS

### J. W. Sandström

JOHAN WILHELM SANDSTRÖM, meteorologist and oceanographer, who died in January 1947, was born on June 6, 1874. He was chief of the Meteorological Division of the Meteorological and Hydrological Institute of Sweden during 1919-39.

After leaving school, Sandström began life in a factory, but he came under the notice of I. Bendixson, professor of mathematics in the University of Stockholm. Bendixson managed to arrange that Sandström should have time off to go to lectures at the University. He took a keen interest in the promising young man, and the development of Sandström's mathematical talent was largely due to Bendixson's influence.

In 1898 Sandström became a pupil of V. Bjerknes, and his first substantial contribution to meteorology was a paper in the *Meteorologische Zeitschrift* (April 1902) on the "Relation between Temperature and Wind in the Atmosphere under Stationary Conditions", in which he applied to this problem a development by Bjerknes of Kelvin's classical paper of 1869 on vortex motion. Sandström arrived at the conclusion that in Europe, cyclones usually have a cold centre and anticyclones a warm centre, and he indicated the significance of the 'thermal wind', though he did not give it that name, which came nearly sixteen years later. He noted also, what has recently been rediscovered, that North American cyclones are in a much earlier stage of development than European cyclones.

Sandström next collaborated with Helland-Hansen in computing exhaustive tables for the application of Bjerknes' circulation theory to the currents of the ocean. He was also joint author with V. Bjerknes of the first volume of "Dynamic Meteorology and Hydrology", published by the Carnegie Institution of Washington in 1910—the first instalment of a treatise designed to present in an ordered and rational form the principles and development of meteorology and hydrography from the point of view of a mathematical physicist. The treatise was completed by the publication in 1932 of the magnificent three volumes on "Physical Hydrodynamics with applications to Dynamical Meteorology", in which V. Bjerknes had the assistance of J. Bjerknes, T. Bergeron and H. Solberg. But Sandström's help and encouragement had been outstanding and were fully recognized by V. Bjerknes, who acknowledged in the preface that without it he would scarcely have ventured on this great work.

Later in life, Sandström was occupied almost entirely with investigation into the Gulf Stream and its influence on climate. He was not content to use only theory and the observations of others: he made expeditions to test for himself the application of his theory. He prepared a very complete memoir embodying the results of his work. A part of this memoir is being printed by the Swedish Academy of Science and was in the press at the time of his death.

Sandström was a big, genial man. One of his colleagues describes him as a man "with a very vivid and vital interest in Nature and in the problems