

with the influence of the ordinary forces of Nature which are constantly modifying the animal life of a country. There is a constant ebb and flow within a fauna, a swing of numbers due largely to seasonal changes and fluctuating about a mean—the “balance of life”; and where man’s interference is temporary in its incidence it falls into this category. But there is, besides, a definite faunal evolution, a faunal drift; and where man’s influence is persistent in one direction it must be reckoned as sharing with the great secular forces of Nature in propelling a fauna upon a path along which there is no return.

The nature of man’s interference, directly or indirectly exercised upon the animal life of Scotland, is of great complexity, but it may be conveniently grouped according to results. In some ways man has reduced the numbers of animals, in some ways he has increased their numbers, and in some ways he has modified their habits and even their structures. Reduction of the fauna, which, commencing with a mere cutting off of the numbers of a species, may proceed to a marked limitation in the range of distribution and finally to extinction, has been brought about directly by deliberate destruction, as in the cases of the polecat and the urus, and indirectly by cultivation, which has destroyed feeding grounds and breeding haunts, driving away such as the great bustard and the bittern, as well as by destruction of the forest, with which disappeared the capercaillie and the red squirrel, both since reintroduced. Increase in the quantity of the fauna is largely due to an intensive cultivation which has provided bounteous food-supplies for such as rabbits and sparrows, and to deliberate protection of other creatures for food, sport, or amenity. The quality of the fauna has been increased by the addition of new elements from other

lands, either introduced deliberately, like pheasants and the common rabbit, or carried hither by mischance of international commerce, like the black and brown rats and many an insect pest. Habits have been changed: the one-time cliff-dwelling swallow has been converted into an inhabitant of houses; and structures have been changed in converting wild into domesticated animals, and by the alteration of habitats, whereby the red deer has lost many points from its antlers and several cubits from its stature.

It must not be imagined, however, that a simple enumeration of first effects exhausts the tale of man’s interference. The story of the effect produced, by protecting a few black-headed gulls, upon the vegetation of a heather moor and its fauna (which I have described elsewhere) illustrates how the slightest interference with wild life may produce complicated and far-reaching results, and that in a remarkably short space of time.

A final comparison of the modern fauna of Scotland with that found by Azilian man on his arrival on these shores, shows that the modern fauna is much more rich in numbers than the old fauna, and that in addition, in spite of the extermination of many forms, it is also more varied in species. The consistent tendency throughout the period of man’s presence has been for the larger animals, which formed the most impressive contingent of the wild life, gradually to be rooted out; while the additions consist largely of lesser creatures, many of which have gained entry only because their minuteness has enabled them to escape detection. The great change therefore has been a notable diminution in the standard of size of the wild fauna, and this tendency is still strongly marked in the evolution of the Scottish fauna at the present day.

### Obituary.

MR. S. S. HOUGH, F.R.S.

MR. SYDNEY SAMUEL HOUGH, H.M. Astronomer at the Royal Observatory, Cape of Good Hope, died on Sunday, July 8, at Gerrard’s Cross. He had visited Europe last summer and had attended the meeting of the International Astronomical Union at Rome, but after his return to South Africa he was in poor health and ultimately cancer was diagnosed. He came back to England under the care of a nurse in the spring of this year and succumbed to the disease after a painful illness.

Mr. Hough was born at Stoke Newington on June 11, 1870. After distinguishing himself at Christ’s Hospital School, he proceeded to St. John’s College, Cambridge, as a foundation scholar. At Cambridge he had a brilliant career and graduated as third wrangler in 1892. He was awarded the first Smith’s prize in 1894, and soon after was elected to an Isaac Newton studentship and to a fellowship at his college.

After taking his degree, Mr. Hough devoted himself to research work in astronomy and geophysics. It had recently been found by Küstner and Chandler that the free period of the variation of latitude differed from that predicted by Euler, and the investigation of this subject was undertaken by Mr. Hough. He passed on under the guidance of Sir George Darwin to an investigation of the tides on dynamical prin-

ciples, and succeeded in deriving a more complete solution of the tidal problem than had been previously obtained, and indeed in making the most important contribution to this theory since Laplace. In his work he introduced the mutual gravitation of the water, and he determined the periods of free oscillation of the ocean. At this time he also did some work on periodic orbits.

When Mr. Finlay, chief assistant at the Cape Observatory, retired in 1898, Sir David Gill, who was then H.M. Astronomer, pointed out to the Admiralty the importance of selecting as his successor a man with the highest scientific qualifications who might be expected ultimately to become director of the observatory. In accordance with this plan Mr. Hough was selected for the post and he proceeded at once to take up his duties. He became H.M. Astronomer in 1907.

Mr. Hough threw himself into the work of the observatory and made valuable contributions to astronomy in organising and discussing observations, particularly those relating to the exact positions of the stars. This work is of a kind which does not attract much public notice, but it is absolutely fundamental to astronomy. Soon after his arrival at the Cape he was entrusted with the reduction of a triangulation of close circumpolar stars made with the

heliometer. These observations were carefully discussed for systematic errors and combined with meridian and photographic observations so as to give accurate positions of all the brighter stars in this region. The subject of the accurate positions of southern circumpolar stars engaged Mr. Hough's attention to the end, and four parts of Vol. XI. of the Cape Annals deal with these stars.

Mr. Hough's chief work was done with the new Cape Reversible Transit-Circle. This instrument is probably the best of its kind in existence and was designed by Gill with a view of the elimination of all conceivable sources of error. The principal parts of the instrument arrived at the Cape in 1901, but a considerable time naturally elapsed before it was ready for use with its collimators and underground azimuth marks in position. In 1903 and 1904 Mr. Hough spent a large part of his time in the determination of the constants of the instrument, in particular the error of every one of the 5' divisions of the fixed circle was determined. The new transit circle was brought into regular use in 1905. Under Mr. Hough's direction two catalogues of fundamental stars based on observations for the years 1905-11 and 1912-16, containing respectively 1293 and 1846 stars, have been published. Each star has been observed at least sixteen times, four times in each of the four positions of the instrument, and the resulting star places must be among the most accurate we have.

Under Mr. Hough's direction, rapid progress has been made in the completion of the Cape Astrogographic Catalogue, Declination  $40^{\circ}$  to  $52^{\circ}$  South. Five volumes of measures have now been issued, and this year a magnificent volume giving the spherical co-ordinates of all stars down to and including the 9th magnitude of the C.P.D. scale. There are in all 20,843 stars in this catalogue, and the places have been deduced from all the material available both from the meridian observations and the photographic plates. The overlapping parts of the plates have been carefully compared and the plate constants adjusted so as to give the best agreement possible. This volume has entailed a large amount of work and must prove of the greatest value in the future.

It is impossible to enter here at length into the different phases of Mr. Hough's work. The meridian observations of the inner planets and the heliometer observations of the outer planets have been carefully collected and discussed. In conjunction with Mr. Halm he discussed the motions of the Bradley stars, and he has derived an accurate value of the solar parallax from the radial velocities of stars as observed at different seasons of the year. Besides giving observations of the greatest accuracy the Cape Publications contain valuable discussions for the derivation of the fundamental constants of astronomy.

Mr. Hough's contributions to astronomy were recognised in various ways. In 1902 he was elected F.R.S. He was president of the South African Philosophical Society in 1907, and on the reconstruction of that society as the Royal Society of South Africa he was elected its first president. Last year he was elected British vice-president of the International Astronomical Union. His death at the age of fifty-three is deeply felt by astronomers throughout the world.

J. J.

SIR HENRY H. HOWORTH, K.C.I.E., F.R.S.

By the death of Sir Henry Hoyle Howorth on July 15, at the age of eighty-one, scientific circles lose a characteristic figure belonging to a generation which has almost passed away, while his many friends mourn the loss of one for whose qualities all had an intense respect and admiration. A man of strong individual character, he had foibles which he himself was not the last to regard with some humour. His most remarkable characteristic, however, was his wide intellectual range and the vast, and sometimes surprising, extent of his knowledge. A constant attendant at the meetings of many scientific societies, there were few subjects on which he was not prepared at a moment's notice to make a real contribution to discussion.

Born in Lisbon on July 1, 1842, Howorth was educated at Rossall School and called to the Bar by the Inner Temple in 1867. He soon, however, turned his attention to politics and historical and archæological studies, which became his main interests in life. Of the large number of scientific and historical works on a variety of topics which he published, the first were two papers dealing with the races of Northern Russia and the extinction of the mammoth respectively, which were presented to the British Association in 1868 and 1869. They were followed by a number of papers published in rapid succession in the journals of scientific societies such as the Royal Anthropological Institute, the Royal Historical Society, the Royal Asiatic Society, and the like. They dealt, among other subjects, with the ethnology and history of the peoples of Central Asia and Eastern and Central Europe and with geological topics connected with the polar areas, and may be regarded as preliminary studies for the works with which his name will mainly be associated in the future. Of these, one, his "History of the Mongols," of which the first volume, dealing with the Kalmucks and Eastern Mongols, was published in 1876, the second, dealing with the Tartars, in 1880, and the third, on the Mongols of Persia, in 1888, brought him recognition in the form of the K.C.I.E. in 1892 and election to the fellowship of the Royal Society in the following year. He also published a "History of Chengis Khan and his Ancestors" in the *Indian Antiquary*. He had begun to rewrite his "History of the Mongols"; but the revision was incomplete when he died.

For the ordinary individual these detailed studies of Asiatic history and ethnology might well have sufficed; but they were not adequate to satisfy the needs of an intellectual energy so indefatigable as that of Howorth. He took up the study of glacial problems with equal zeal, and, be it said, with his usual love of controversy. "The Mammoth and the Flood" appeared in 1887, and "The Glacial Nightmare" in 1893, both being parts of a vigorous attack on Lyell's glacial theory, based upon palæontological, geological, and archæological evidence and suggesting that the deposition of drift and boulders was due to wave, rather than glacial, action. He followed this up with "Ice or Water?" which appeared in 1905. At the time of his death he was engaged on the revision of "The Mammoth and the Flood."

Sir Henry was also keenly interested in the history of the Church, and was the author of a valuable and