most places in the north of Scotland, where the average excess was about 0·5° F. At Bath the deficiency amounted to 5° January had a deficiency over the whole of the United Kingdom, the defect being greatest in the midland, southern, and western parts of England and in Ireland, exceeding 5° in a few places. February had a slight excess of temperature in the Shetlands, Orkneys, and Hebrides; elsewhere it was deficient, the deficiency exceeding 7° at Hereford, and being more than 5° at many places in different parts of England and at a few places in the south of Ireland. March had a deficiency of temperature over the entire area of the British Islands, exceeding 5° at some places in the midland and eastern districts of England. April was everywhere cold, the deficiency of temperature exceeding 5° in many parts, and amounting to 6·6° at Aspatria, in Cumberland.

London is represented by eight stations, including Greenwich and Kew Observatories. The mean temperature, the arithmetical mean of the maximum and minimum readings, from the eight stations for the five months December, 1916, to April, 1917, is 38·0°, which is 3·6° below the average for the whole period. The highest of the several means for London was 39·3° at South Kensington, the observing station of the Meteorological Office, and the lowest Hampstead, 35·9°. The mean of the minimum, or night, readings at Hampstead was below the freezing point in each of the months from December to March, and in April the mean minimum was 33°. At Greenwich the mean of the maximum for the five months was 43·3°, the mean of the minimum 32·3°, and the mean was 37·8°, which is 3·8° below the normal. The means for January and February were both 35·3°, and April, with a mean of 42·7°, had a deficiency of 4·5°, the greatest deficiency from the normal in any of the five months. The mean temperature for the five months was 0·2° higher than for the corresponding period from December, 1890, to April, 1891, and it was 0·1° lower than for December, 1878, to April, 1879, the next lowest mean since 1841, and 0·2° lower than from December, 1844, to April, 1845.

Taking six representative stations in the midlands, for the five months the mean temperature was 36·8°, and the difference from the normal was *minus* 3·9°. At Brighton the mean temperature was 38·6°, a deficiency of 3·9° from the average. In Dublin the mean temperature for the five months was 40·0°, and the deficiency 3·5°; at Jersey 40·7°, and deficiency 4·2°. Three representative stations for Scotland give the mean temperature 37·9°, and the mean deficiency from the average was 2·3°.

Meteorological information from western and northern Europe shows that other parts were similarly affected with prolonged cold.

Dr. Mill, of the British Rainfall Organisation, in a letter to the *Times* of June 4, directs attention to the month which has just closed as being the warmest May at Camden Square, London, since the establishment of observations in 1858. He gives the mean temperature on a Glaisher stand as 59·1° F., or 5·1° above the average, whilst April was just 5° below its average At Camden Square May, 1868, had a mean temperature 58·9°, a trifle cooler than the recent May, and it was followed by a very hot summer. Dr. Mill quotes several warmer Mays according to the old London records, and mentions that only in 1809 did an extremely warm May follow, as this year, an extremely cold April. At South Kensington, the observing station of the Meteorological Office, the mean temperature in a Stevenson's screen for May was 59·6°. The Greenwich observations give 58·8° in 1841 and 1848 as the previous highest May temperatures, from maximum and minimum readings, since 1841, and in 1893 the mean was 58·4°. In 1908 at Greenwich the mean temperature for April was 44·3°, which is 4° below the average, whilst that for May was 56·7°, or 3° above the average. The following summer was by no means fine or hot. CHAS. HARDING.

THE COOLIDGE X-RAY TUBE.

THE Coolidge X-ray tube has been on its trial in this country during the last two years, and it may be said with some confidence that it has gone a very long way towards justifying the claims which have been made concerning it. Whether the tube be judged from the laboratory or from the clinical point of view, it marks a new era in the history of the X-ray tube. There is now to the hand of the experimenter or of the radiologist a source which provides him with a beam of X-rays which can be varied in the course of a few seconds, as regards both quality and output, over a very wide range; such radiation, moreover, may be repeated with certainty.

The work of Sir E. Rutherford and his colleagues, which was directed to find the shortest wave-length of the radiation emitted by the Coolidge tube, disclosed the fact that a limit was set to the penetrating power of this radiation when the potential difference between the terminals of the tube was about 150,000 volts. The Coolidge tube can be run at a higher working voltage than the ordinary X-ray tube owing to the absence of any measurable quantity of gas within the former, and the range of radiation emitted by it extends rather further into the region of the shorter wave-lengths than is obtained with the older type of tube.

There is a considerable clinical use of such very penetrating rays, which are rather more penetrating than the γ rays from radium-B, but less so than those emitted by radium-C. The difficulty of protecting those who apply such radiation is considerable, but the necessity for so doing is no less urgent than it is apparent, and we are glad to see that prominence is given to this question in a descriptive leaflet of the Coolidge tube, dated October 31, 1916, issued by the British Thomson-Houston Co., Ltd.

This memorandum contains a description of the tube, its mode of construction, and the methods which are now generally employed in its manipulation, both for radiographic and for radio-therapeutic work.

Considering the ease with which the Coolidge tube may be manipulated, and the short time which is required by anyone conversant with X-ray matters to acquire the necessary technique, it must be inferred that the only hindrance to its more general adoption in this country is the high cost of the tube.

The Coolidge tube may perhaps be looked upon as the most successful practical application which has yet been made of the classical work of Prof. O. W. Richardson on thermionic currents. We trust that the British Thomson-Houston Co., Ltd., which states that it is the owner of the English patents of this tube, will be instrumental in putting the Coolidge X-ray tube within the reach of a wider public than exists to-day.

THE ROYAL OBSERVATORY, GREENWICH.

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was presented at the annual visitation of the Observatory on June 1. A few of the matters dealt with in the report are here summarised.

The catalogue of stars down to 9·0m. on the B.D. scale between the limits of 24° and 32° of north declination has been completed by the determination of

the proper motions of about 12,000 stars. These have been obtained by comparison of the Greenwich positions with those given in the catalogues of the Astronomische Gesellschaft and the earlier catalogues of Bessel and Lalande. For the latter catalogues systematic corrections were determined for each separate night's observations.

A determination of the mean parallax of stars of different magnitudes has been made from these proper motions and published in the Monthly Notices of the Royal Astronomical Society. The results confirm very closely the formula given by Kapteyn. It is hoped to communicate to the society a short discussion of the proper motions with reference to star streaming. The publication of these summaries of results by the Royal Astronomical Society is specially valuable because of the delay in the printing and publication of the catalogue itself.

During the year 222 photographs were taken with the Cookson floating zenith-telescope, 216 for latitude groups and six for scale determination. The measurement of the photographs to the end of 1916 is completed, and the results for the variation of latitude for 1916 were communicated to the Royal Astronomical Society, and published in the Monthly Notices for March, 1917.

Throughout the year the 28-in. refractor was at the disposition of M. Jonckheere. Fifty-nine new close double stars were detected, making 259 since October, 1914. Up to November 22, 1916, the observations mainly consisted of the measurement and verification of stars discovered to be double since 1905, the date to which Mr. Burnham's catalogue extends. Since November 22 the programme of work has comprised (1) the measurement of stars from Burnham's General Catalogue which had been previously observed at the Lille Observatory, and (2) the re-measurement of double stars in vol. lxi. of the Royal Astronomical Society's Memoirs. Altogether 604 double stars have been measured during the year. Of these stars—

213	have a separation	under 2″.
156	" "	between 2″ and 3″.
132	" "	" 3″ " 4″.
62	" "	" 4″ " 5″.
41	" "	greater than 5″.

The catalogue of double stars discovered since 1905 has been published by the Royal Astronomical Society in vol. lxi. of the Memoirs.

With the Thompson equatorial, in accordance with the programme of previous years for the determination of stellar parallax, a first exposure has been made on eighty-six plates, and a second one on 154 plates. At the request of Dr. de Sitter the series of photographs commenced at the Cape Observatory for the determination of the constants of the four Galilean satellites of Jupiter has been continued at Greenwich.

With the astrographic equatorial during the year 109 plates have been taken on thirty-five nights for the determination of proper motion by comparison with earlier plates. Of these nine have been rejected; eighty-five plates, of which fifty-two have two fields on them, have two short exposures, usually of 4m. and 2m.; fourteen have a single exposure of 12m.; one is for focus of the instrument.

The plates with short exposures are being compared in the duplex micrometer, but only for the stars contained in the *Bonn Durchmusterung*. The plates with longer exposures are being compared with earlier plates—usually chart plates—by Mr. Innes at Johannesburg, using a blink microscope. With the duplex micrometer 177 pairs of plates have been measured during the year. From the results obtained all proper motions greater than 10″ a century and many smaller ones are being determined. Simultaneously the proper motions of the brighter stars are being determined by comparison with earlier meridian observations.

In the year ended May 10, 1917, photographs of the sun were obtained on 208 days. Photographs have been received from the Royal Observatory, Cape of Good Hope, and supplementary photographs have been received through the Solar Physics Committee, from Dehra Dûn, India, in both cases to the close of the year 1916. Two days in 1916 still remain unrepresented, viz. June 19 and September 29. From 1910 to 1916 inclusive there are only two other days unrepresented in the combined series of photographs for measurement, one in 1911 and one in 1912.

The mean daily spotted area of the sun continued to increase during the past twelve months, and there is no indication as yet that the maximum has been reached.

The mean values of the magnetic elements for 1916 and five previous years are as follows:—

Year	Declination W.	Horizontal force (C.G.S.)	Dip
	° ′		° ′ ″
1911	15 33·0	0·18549	66 52 6 (3-in. needles)
1912	24·3	0·18548	51 46 " "
1913	15·2	0·18534	50 27 " "
1914	15 6·3	0·18518	49 27 " "
			51 13 (inductor)
1915	14 56·5	0·18508	51 50 "
1916	46·9	0·18494	52 45 "

It will be noticed that the annual diminution of declination increased considerably about 1910, its average value from 1900 to 1910 being 4·9′. The horizontal force, which had been increasing since measurements at Greenwich were begun in 1846, reached a maximum about 1910, and is now diminishing. The dip, which has been diminishing since measurements were begun in 1843, appears also to have recently reached a turning point. There were no days of great magnetic disturbance in 1916, but three were classified as of lesser disturbance.

The principal features of interest in the meteorological conditions at Greenwich during the year ended April 30, 1917, are:—(i) The continued cold weather from December to April—the latter month had a mean temperature 1° lower than any other April since 1841; and (ii) the general deficiency of sunshine.

The scientific work of the observatory has necessarily been somewhat curtailed, but it has been found possible to keep up all observations of the sun, moon, and planets; sun-spots; latitude; magnetic and meteorological registers—observations which would otherwise have been permanently lost.

One special piece of work to which a good deal of attention was devoted this year was the preparation of magnetic charts. In 1912 it was arranged that the compilation of the Admiralty charts of magnetic variation, hitherto undertaken by the Compass Department, should be transferred to the Royal Observatory. A card catalogue of magnetic declination data from all parts of the world was formed. From this and published data of various surveys the charts for 1917 have been prepared during the past year. They are now in course of publication by the Hydrographic Office.

RESEARCHES ON KALA-AZAR.[1]

I HAVE chosen the subject of twenty years' research on kala-azar for the main portion of my address to-night, both because of the great importance of this disease in a large area of India, and also of the ignorance of the general public regarding it. Most people have fairly definite ideas about malaria and

[1] From the presidential address delivered to the Asiatic Society of Bengal on February 8 by Sir Leonard Rogers, F.R.S.