rainfall in London exist since 1774, and they show that the maximum value was 35·54 in. in 1903, and the minimum 12·50 in. in 1921. Taking groups of 10 years there were periods of general deficiency from 1780 to 1809, 1850 to 1859, 1890 to 1909, and 1920–1922, while periods of general excess were 1810 to 1849, 1860 to 1889, and 1910 to 1919. Of course, no real importance can be attached to these particular groups of ten years, and individual years in them are much above or below the average, yet the numbers show no continuous change either one way or another. The relatively dry period which began in 1919 was preceded by four years in each of which the rainfall was well above the average, and the excess for the 10 years 1910–19 was much greater than for any of the other ten-year groups since 1780.

The association of snow with Christmas, common in Christmas stories and almost an essential feature of Christmas cards, is one for which little meteorological evidence exists so far as London and the neighbourhood is concerned. In the period of eighty-three years since 1840, snow has been recorded on Christmas Eve at the Royal Observatory, Greenwich, on two occasions only, namely, 1846 and 1849. There are only six years in which snow has fallen on Christmas Day and ten on Boxing Day. Grouping all three days together, the chances against snow in and near London are nearly five to one, or taking Christmas Eve and Christmas Day together, not in one year in ten has a fall of snow been recorded. The snowy Christmases of imaginative writers and artists have thus now but rare existence in the south of England.

It must be remembered, however, that, on account of the change from the Julian to the Gregorian calendar in 1752, Christmas Day now occurs eleven days earlier than it did. Records of the mean air temperature for 24 hours of Christmas Day in London since 1814 show that, in these 109 years, there were only 23 years in which the mean temperature was at freezing point or below. The lowest mean temperature was 18·6° F. in 1830, and the next 19° F. in 1860 and 1870. There are only three periods in which three or more successive Christmas Days had a mean temperature at freezing point or below, namely—1814–20, 1829–31, and 1890–92. Not for a single Christmas Day since 1892 has the mean temperature in London been down to 32° F., and in this 30 years the minimum temperature has only been at freezing point or below in 10 years—one year in three. The highest mean temperatures on Christmas Day were 1824, 53·1° F.; 1837, 51·5° F.; 1852, 50·7° F.; and 1920, 50·6 F. Though mild and severe Christmases have occurred at irregular intervals since 1814, there has not been such an unbroken series of Christmas Days with a mean temperature above freezing point as that recorded since 1892 in London.

The origin of the belief in a progressive and permanent change of climate in historic times is probably to be found in the fact that temperature and rainfall everywhere have a tendency to vary in a period having an average length of thirty-five years. This cycle was referred to by Francis Bacon in his essay "Of Vicissitude of Things," and was worked out in detail by Prof. E. Brückner some years ago. Neglecting individual years, it may be stated that for about half this period of about thirty-five years the weather is warmer and drier than the average, and for the other half colder and wetter. The groups of years for which Brückner found clear evidence of these characteristics are as follows:

Warm.	Dry.	Cold.	Wet.
1746–1755	1756–1770	1731–1745	1736–1755
1791–1805	1781–1805	1756–1790	1771–1780
1821–1835	1826–1840	1806–1820	1806–1825
1851–1870	1856–1870	1836–1850	1841–1855
..	..	1871–1885	1871–1885

It will be noticed that the interval from the beginning or end of one period to the beginning or end of the next of the same kind varies from twenty to fifty years, but the average is about thirty-five years. The series of wet years which culminated in the black year of 1879, memorable to all who were then engaged in agriculture, was matched by the wet period of 1910–1918. If the cycle holds good we may expect that, on the average, the weather will be warmer and drier than usual for a few years, but any single year may depart from this rough generalisation.

Records of the mean annual temperature for various meteorological districts in Great Britain from 1878 to 1920 show that, while the lowest values occurred in most districts in 1879, the highest were mostly in 1898, thus following the order of Brückner's cycle. Taking the districts as a whole, the greatest deviation from the normal was −2·3° F. in 1879 and +1·6° F. in 1898.

Sir Richard Gregory concluded from this and other evidence surveyed in his address that, while there have been abnormal periods of British weather in historic times, there is no decided indication of progressive change either for the better or worse, and that no cycle of practical service can be said to be established, though several of academic interest seem to exist.

The Chemical Composition of the Prehistoric Bronzes.[1]

By Prof. JOHN SEBELIEN, Norwegian Agricultural Institute, Aas, Norway.

IN a paper read a year ago before the Scientific Society at Christiania, I discussed the old doubts of the greater age of bronze in comparison with iron. The relative slight reducibility of the oxidised iron ores, and the difficulty of the preparation of metallic copper from its most common (sulphuretted) ores, as well as the high degree of human civilisation required for making an alloy such as bronze, are circumstances weighing very heavily in favour of the greater antiquity of the Iron Age. Nevertheless, the paradoxical nature of the theory of the greater antiquity of the Bronze Age is somewhat mitigated by recent researches.

It is now admitted by leading archæologists that metallic iron certainly was *known* a long time before bronze to the old Egyptians, but only as a curiosity for jewellery and decoration purposes (as beads), and not as a metal in common use. Also, it is generally assumed that in many countries a period with pure copper as a commonly used metal preceded the Bronze Age. A Copper Age is generally shown in Central Europe, and even in Northern Europe it is shown that the Stone Age of Sweden and Denmark was followed directly by a Copper Age. Norway, however, seems to be an exception to this. I have analysed samples from all the very oldest findings from the Norwegian Bronze Age, among them a piece of a metal looking like copper from an old Stone Age place, but they were all real tin-bronzes.

[1] Substance of a paper read before Section H (Anthropology) at the Liverpool meeting of the British Association.

Even in England, according to Sir Hercules Read, there has not been a pure Copper Age, but the bronze must have been made directly from the copper ores containing tin. Similarly, we find antique Roman brass implements many centuries before the isolation of the metallic zinc.

Of special interest are the old metallic objects from Egypt and Mesopotamia, the cradle of the culture. M. Berthelot has shown that the old bronze objects from these countries contained no tin, but consisted of pure copper. I lately had the opportunity, through the kindness of Sir Flinders Petrie, of analysing 29 samples from old Egyptian objects, with the result that 24 of them, among the very oldest, belonging to the earliest dynasties, were practically pure copper without any trace of tin. The accessory impurities were mostly traces of iron, zinc, nickel, arsenic, lead, but never antimony. In some cases there were very small traces of silver or bismuth. Objects from a later period were real tin-bronzes of normal composition, and might contain traces of antimony besides the arsenic.

Most of the old Egyptian copper no doubt came from Sinai, and there is a good accordance between the impurities we have found in the copper objects and the accessory metals in a slag from Sinai. But other copper objects, *e.g.* those containing traces of silver and bismuth, must have another origin. An old metallic nail of Sumerian age in Mesopotamia was practically pure copper also, but an X-ray spectrogram showed a trace of cobalt, besides traces of nickel, iron, lead, and arsenic.

The bronze bands from the gates of the palace of Shalmanesir II., now in the British Museum, belong to a much more recent period. Through the kindness of Sir Ernest Wallis Budge, I obtained a sample for analysis from these bands. They are real tin-bronzes with about 9 per cent. tin, and here, too, the X-ray spectrogram showed a trace of cobalt besides the traces of nickel, iron, lead, and arsenic. It is not unreasonable to assume that even the old Chaldæans obtained their copper from the ores of Sinai. But the presence of cobalt in both the objects from Mesopotamia is not in accord with the definite absence of the same substance from any of the old Egyptian objects analysed. We have been unable to get a sample of the original ore from the Sinai mines.

We have, however, obtained a sample of a very old copper ore, that possibly may have been used for Mesopotamian copper and bronze objects. It is from an old mine in Kurdistan. By X-ray spectrographic analysis, it was found that it contained, besides copper, the accessory metals zinc, iron, lead, and arsenic, and not insignificant quantities of cobalt and, furthermore, manganese, but no nickel. The presence of cobalt would be in good accord with the result of the analyses of the Mesopotamian objects, but the complete absence of nickel prevents us from assuming a connexion between the Kurdistan ore and the metallic objects from Mesopotamia.

Paris Academy of Sciences.

LOUTREUIL FOUNDATION.

FORTY-ONE requests for grants were received and the following twenty-seven grants were approved:

I. Grants made at the request of establishments named by the founder:

(1) Muséum national d'histoire naturelle: 10,000 francs to Pierre Teilhard de Chardin for the exploration from the geological and palæontological point of view of the regions which extend to the borders of Mongolia.

(2) Conseil central des Observatoires: 3000 francs to Armand Lambert for assistance in printing the catalogue of fundamental stars of the Paris Observatory.

(3) École nationale vétérinaire d'Alfort: 3000 francs to François Maignon for the continuation of his researches on the physico-chemical constitution of the diastases (biological catalysts) and the mechanism of their action; 850 francs to P. Dechambre for the purchase of an apparatus designed for the study of wool; 3000 francs to André Delmer for researches relating to the physiology of the breast; 3000 francs to Adrien Panisset and Jean Verge for the continuation of the researches which they have undertaken on the chemicotherapy of infectious diseases of animals; 5000 francs to Émile Nicolas for the purchase of a centrifuge.

(4) École national vétérinaire de Lyon: 2000 francs to Prof. Douville to continue his researches on the etiology of distemper and other canine diseases, and for the purchase of apparatus for ultra-microscope work; 2000 francs to G. Marotel for the continuation of his researches on parasitic diseases of domestic animals; 4000 francs to Joseph Bassett to complete his researches on typhoid fever of the horse; 2000 francs to L. Jung to continue his researches on the transformations of food albumins in the organism, particularly their rôle in fat formation; on the chemical function of mixed saliva in different species and on the origin of salivary amylase and the possible factors of its activation.

(5) École nationale vétérinaire de Toulouse; 3000 francs to Albert Daille for research on a preventive and curative serum against epizootic diarrhœa in newly born calves; 500 francs to Charles Hervieux for a study of intestinal putrefaction and coprology; 1500 francs to Clément Bressou for researches on the lymphatic system of domestic animals.

II. Independent requests: 2500 francs to Henri Colin for the purchase of a Bruhat apparatus and its accessories, especially a mercury vapour lamp, for his researches on the hydrolysis of the carbohydrates; 5000 francs to the Comité de la Carte géologique d'Afrique (secretary, Emanuel de Margerie) for the purposes of this map; 4000 francs to Gaston Fayet for printing the catalogue of intermediate stars of the Nice Observatory; 10,000 francs to the Fédération Française des Sociétés de Sciences Naturelles for the publication of the fauna of France; 6000 francs to Edmond Friedel for his work on the diffraction of X-rays; 10,000 francs to Guillaume Grandidier for completing the printing of the fourth and last volume of the "Ethnographie de Madagascar"; and for continuing the publication of the "Histoire de Madagascar"; 2000 francs to Benjamin Jekhowsky for the "Études des clichés de l'Observatoire d'Alger, au point de vue de la recherche des petites planètes"; 10,000 francs to the Laboratoire Central d'Électricité de Paris for its researches on the international ohm standards; 10,000 francs to Charles Marie, general secretary of the "Tables annuelles de constants et données numériques de chimie, de physique et de technologie," for this publication; 5000 francs to the Office Central de Chauffe Rationnelle for the study of the measurement of high temperatures in industry and the improvement of the instruments employed in practice; 8000 francs to Georges Perrier for collating the work of astronomical and geodetic order, carried out by the Equator expedition; 1000 francs to Claude Pierre for completion of a monograph on the Tipulidæ of France; 4000 francs to Joseph Jean Rey, for his researches on radiogonometry.

In all, the grants recommended amount to 120,350 francs.