exists at the present time, particularly as regards such terms as "brass" and "bronze." A system of nomenclature was put forward in which alloys are classified according to the system of binary alloys to which they approximate most closely, and class names for such binary systems were advocated.

Prof. T. Turner dealt with the behaviour of certain alloys when heated *in vacuo*. It was observed, a year ago, that on melting brass *in vacuo* the whole of the zinc volatilises, leaving the copper. This separation is quantitative if the heating is not too prolonged and the temperature not above 1200° C. The behaviour of other copper-zinc alloys was therefore investigated. A sample of "poisoned" brass—*i.e.* brass containing iron, lead, tin, arsenic, and other impurities—was heated *in vacuo* at 1200° C., and the residue examined. All the zinc, lead, and arsenic, and a little of the tin, volatilised, leaving a residue of copper, iron, and most of the tin. It is suggested that heating *in vacuo* might be advantageously applied for the refining of crude copper, brass scrap, &c. "Hard" zinc may be refined by heating *in vacuo* to 500° C., *i.e.* to a scarcely visible red heat. Zinc distils readily in glass vessels *in vacuo*, the vapour being colourless and transparent. The zinc condenses in globules, having the appearance of mercury.

Prof. H. C. H. Carpenter described further experiments on the critical point at 470° C. in copper-zinc alloys. The so-called β constituent in copper-zinc alloys is to be regarded below 470° C. as a minute and uniform complex of α and γ particles. Even after six weeks annealing at 445° C. no coalescence of the particles has been observed in an alloy of exactly the eutectoid composition. When, however, a few crystallites either of α or γ are initially present in an otherwise pure eutectoid alloy, then, on annealing at 445° C., this stability is easily destroyed. The structural stability of the pure eutectoid alloy can be explained by supposing that, at the inversion temperature on cooling, the resolution of β into α plus γ takes place throughout the entire alloy almost, if not quite, simultaneously.

Mr. F. Johnson, in his paper on the effect of tin and lead on the micro-structure of brass, records the results of experiments made with the object of ascertaining the structural relations which exist between lead and tin when present in brass where the ratio of copper to zinc is 2 : 1. He strongly advocates a very thorough annealing of all cast material of the 70/29/1 and 62/37/1 compositions (Admiralty and Naval brass respectively) before subjecting it to rolling or drawing.

OXFORD METEOROLOGICAL OBSERVATIONS.[1]

WE are glad to see the appearance of the volume referred to below, containing as it does the meteorological observations made at the Radcliffe Observatory, Oxford, for the years 1900 to 1905 inclusive, because there has been difficulty in obtaining the necessary funds for printing. Fortunately the Radcliffe Trustees, by means of a grant of a special character, have been able to overcome this difficulty; and not only will the arrears of printing be made good, but, as the director remarks, "we hope before many months are past to be able to clear those off and in future to publish the results of our meteorological observations promptly in a regular annual form." This is really good news, because meteorologists—and there are now many of them—who discuss meteorological observations desire to include the most recent data, and in a great number of cases these are impossible owing to the values not being published. The meteorological observations made at the Radcliffe Observatory, some of which date from the year 1850, form a most valuable, continuous, and homogeneous series, so that it is most important that this series should be published as soon as possible. Even now the present volume goes only so far as the year 1905, so that the observations for the years 1906 to 1911 are still missing in a published form.

In recent years attention has been directed to the peculiar position the Radcliffe observations hold with regard to the large question of the Thames flow. It was found by Sir Norman and Dr. Lockyer that the rainfall at Oxford represented variations from year to year which corresponded closely with the variations determined from a large number of combined stations, and these corresponded in nearly every feature with the variations of the level of the Thames as recorded at the numerous gauges on the river. This fact showed that by simply taking the Oxford rainfall records alone a good approximation to the subsequent flow of the Thames could be gathered, because the natural flow of the Thames has a lag of four to five months on the rainfall. It is noticed in this report that weekly values of rainfall are communicated directly to the Thames Conservancy Board, no doubt in consequence of this relationship.

The volume is arranged on the same lines as that previously issued for the period 1892 to 1899, with the following important differences:—First, that the readings of the fine underground platinum thermometers, which were commenced in the year 1898 (October), and continued daily throughout the six years dealt with in this volume, have been omitted, as it is intended to publish them later in a separate form, with a full discussion of the results; secondly, that the tabulated daily results and monthly means derived from the photographic and self-recording instruments have been included; thirdly and lastly, that the results of the hourly readings of the barograph, thermograph, and hygrograph have also been incorporated in the volume, with a discussion of the mean diurnal inequalities in the readings of the three instruments for the period under consideration, and a comparison of these inequalities with similar quantities deduced for the period 1880 to 1887.

[1] "Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Six Years 1900–5." Under the direction of Dr. A. A. Rambaut, F.R.S. Vol. xlix. Pp. xx+304. (Oxford: Henry Frowde; London: Oxford University Press, 1911.)

AMERICAN ARCHÆOLOGICAL PROBLEMS.

MR. ALFRED P. MAUDSLAY delivered his presidential address at the annual general meeting of the Royal Anthropological Institute on Tuesday, January 23. Mr. Maudslay said that even at the present day the idea that the origin of man does not form a fit subject for scientific inquiry has not yet entirely died out, and this feeling has militated against anthropology becoming a popular study. Meanwhile, the immediate and energetic prosecution of anthropological studies is of vital necessity, since the material with which this science deals is becoming rarer every year, as primitive customs yield to civilisation. The fact that man's physique is less subject to alteration gives a permanent value to the study of physical anthropology. An example of the far-reaching effects of a change in culture is, let us say, the introduction of writing, which has a democratic tendency, since it places the tribal law, formerly preserved in the memories of the elders, at the disposal of the younger members of the tribe. Upon the present occasion attention may be confined to certain points of the archæology of America, where there are traces of many extinct civilisations. The word civilisation is used for want of a better; such a people as the Aztecs, though civilised in some respects, were barbarous, or even savage, in others. In fact, our terminology requires revision, for the existence of a savage custom, such as cannibalism, does not necessarily imply a low stage of culture. Want of recognition of this fact has caused many misunderstandings between Europeans and the "barbarous" races. Such misunderstandings might be avoided by a knowledge of elementary anthropology, and this institute has not ceased to press upon the Government the advisability of establishing in this country an Anthropological Bureau, which would be of material assistance to colonial administration.

There is no better test of the antiquity of American culture than the fact that maize and other vegetable foods had been gradually evolved by patient cultivation from obscure wild plants. The indigenous nature of that culture is shown by the fact that they were unknown in other continents before the discovery, though their value to man led to their introduction all over the world immediately afterwards. The languages of America, moreover, bear a closer resemblance to one another than to those of the rest of the world.

In solving the many problems presented by America,

where race has overrun race and culture succeeded culture, archæology is not self-sufficient, but it may often point the way to further research. For instance, at Ixkum, in northern Guatemala, a stone relief shows two typical Maya standing on two individuals of a totally different type. The latter probably represent a conquered race. Near the city of Guatemala stone figures have been discovered closely resembling this non-Maya people. Ruins in the neighbourhood bear an interesting resemblance in plan to those at the famous site of Teotihuacan in Mexico, but the site still awaits proper investigation.

Another point from which the antiquity of American culture may be argued is the distinctive nature of American art; but while general similarities exist all over Central and South America, local developments occur, *e.g.* at Mitla, which are not only *sui generis*, but are, apparently, accompanied by no remains which indicate how they were evolved. Certain motives appear to be almost universal, such as the serpent, and the *quetzal*-bird, which occur in various combinations, and also the water-plant, which is interesting as being the only vegetable form in American art. A few instances such as these show what a vast field for investigation is offered by America, the study of which has been rather neglected in this country. This year, in May, we shall be welcoming the International Congress of Americanists to London, and though we possess in England more pre-Columbian objects of interest than any other European country, it is the first time that we have acted as hosts to the leaders of American research.

THE USE OF PHOSPHATIC FERTILISERS IN FRANCE.

SOME years ago M. Risler took an inventory of the soils of France, classing them as complete if they contained sufficient food material to yield fair crops, and incomplete if they were markedly deficient in any particular food constituent. Out of a total agricultural area of 49,000,000 hectares, no fewer than 36,000,000 were deficient in phosphates, and could not be made to yield profitable crops without liberal dressings of phosphatic fertilisers—a state of affairs that was not the result of previous bad cropping, but of lack of phosphorus in the original rock material.

In order to make good this deficiency, French agriculturists use both basic slag and superphosphates, but very little of the rock phosphates so popular in America. More than a quarter of a million tons of basic slag are used annually on the grass land, especially where the soil is derived from granite and schists, while about one and a half million tons of superphosphate are used annually on the arable land, and a good deal of phosphate is also contained in the guano applied as fertiliser.

But, vast as these quantities are, they are insufficient, and consequently there has been a marked increase in the price of phosphatic fertilisers during recent years. The various factors coming into play have been recently analysed in an article by M. Hitier in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (No. 6, vol. cxv.).

Superphosphate, as is well known, is made by treating rock phosphate—an impure tri-calcic phosphate—with sulphuric acid, and in order to overcome transport and other difficulties, the sulphuric acid is usually made on the spot at the factory itself. Both the raw phosphate and the pyrites from which the sulphuric acid is made have increased in price; the world's consumption of phosphates, which was four and a half million tons in 1898, had in 1908 increased to ten million tons. The price of superphosphates in France has usually been lower than in England, but now that the French deposits of rock phosphate are giving out, it has been necessary to look elsewhere. At present nearly half of the world's supply comes from North America, North Africa, however, also furnishing a great deal. Other supplies come from the Pacific Islands and the north of France and Belgium.

Investigations have shown that dressings of phosphates not only raise the quantity of the crop, but also improve the quality. Müntz showed that dairy produce, particularly butter, of the finest quality was obtained only from pastures exceptionally rich in phosphates. More recently M. Paturel has traced a clear connection between the quality of wine and the supply of phosphates. Analyses of numerous samples during the last ten years show that the best wines are richest in phosphoric acid, of which they contain about 0·3 gram per litre, whilst the second, third, and fourth classes are successively poorer. Further, if the vintages for different seasons are arranged in order of their phosphoric acid content, the list thus obtained is almost identical with the order of merit assigned by the wine merchants.

THE CARBONISATION OF COAL.[1]

II.

HAVING gained an idea of the results desired in the manufacture of illuminating gas and furnace coke, we can pass on to the thermal conditions existing during carbonisation, and at the outset we are met by the difficulty that little is known as to the heat of formation of coal, and that a variety of opinions exists on this point.

It is evident that, as the composition of coal in a mine will vary not only in different seams, but even in the same seam, there is no definite composition, and that nothing can be known as to the heat of formation except by direct determination, which necessitates experimental estimations of so complicated a character that the introduction of errors is extremely likely to vitiate the results.

Probably the most valuable work done in this direction is to be found in a report presented by M. Euchêne on the thermic reactions which occur during the distillation of coal, which is in the Transactions of the International Gas Congress in Paris, 1900, in which he determines the thermo-chemical data coming into play during the distillation of coal in the manufacture of gas, with careful estimations of the heat of formation of the products of the distillation as compared with the heat developed by the fuel needed for the distillation; that is to say, a balance is struck, showing on the one side the heat generated, and on the other the heat expended, the difference found representing the heat of the decomposition of coal.

Mahler also determined the calorific value of a coal and of the products obtained on carbonising it, and both these observers found that the calorific value of the coal exceeded that of the products—that is, that coal is endothermic, and that its decomposition evolves heat—but it is quite clear that in the determination of a factor of this kind, which is dependent upon the difference between two figures obtained from a highly complicated set of determinations, each with its own source of error, and all tending in the same direction, these will be borne by the resultant, and it is not surprising, therefore, to find that with a coal of the same type Mahler found the heat of decomposition to be +254·83 calories, whilst Euchêne found it to be +63·51 calories.

In Mahler's work the result was arrived at by deducting the heat of combustion of the products from the heat of combustion of the coal, whilst Euchêne's determinations were obtained by taking the difference between the heat supplied and the heat consumed during distillation, so that the difference between the two would be likely to be increased by errors leading in opposite directions.

M. Euchêne has determined in this way the heat liberated during the distillation of three types of coal, these results showing in a striking way that the heat liberated increases in nearly regular ratio with the amount of volatile matter in the coal, and that the more oxygen the coal contains, the more endothermic its reaction, a fact which points clearly to its being the oxygen-bearing compounds in the coal which give it its endothermic character.

It seems likely that when the oxygen in the coal falls below 3 per cent., all endothermicity will disappear, or at any rate become negligible, whilst with gas coals of the type most used in England, containing about 32 per cent. of volatile matter and 7 to 8 per cent. of oxygen, it will approximate to 250 calories or 450 B.Th.U. per pound of coal, but all the evidence as to this property in coal is of an unsatisfactory character.

When a coal is carbonised, it decomposes into gases

[1] From a course of Cantor lectures given at the Royal Society of Arts in November and December, 1911, by Prof. Vivian B. Lewes. Continued from p. 368.