It is therefore very desirable that any new bit of evidence bearing upon the case should be placed on record, and, from this point of view, a discovery recently made at Didlington Hall seems to be of value, especially as the conditions which it indicates are exceptional in the district and the facies of the animal remains found is unusual. The bones and shells were carefully collected by Lady Amherst and are now preserved in the museum at the Hall.

Didlington Hall is built on the margin of an extensive bed of Boulder Clay, into which the river has cut back, forming a cliff which now rises from 26 feet, the level of the water in the lake, to about 38 feet above ordnance datum. It is no longer seen as a cliff just here, because the original form of the ground has been much modified by natural and artificial operations. Down the valley, however, this cliff forms a well-marked feature along the right bank, but up stream it is generally softened down into a gentle slope. Owing to the overlap of the artificial soil and rainwash near the Hall, nothing was known of the character of the marginal deposits of the river until, in carrying out some alterations in the boat-house, it was found necessary to cut off and dry a portion of the bed of the lake and remove some of the clay close to the original bank.

The lowest part of the bed was full of large stones out of the Boulder Clay, most of them covered with glacial striæ. With them were the bones of large animals which had probably been also washed in from the bank in floods. It appeared to be a deposit thrown down in an embayed curve of the river, perhaps even cut off from the stream so as to form a pond or "broad." The velocity of the stream cannot have been great, for the rest of the deposit consisted of fine blue mud and the shells were well preserved, as were also the plant remains, though these were very fragmentary. There were, moreover, no signs of sorting by water in any part of the deposit exposed, which was not more than 18 inches or two feet in thickness. The river must have been diverted or its velocity somehow checked and this small patch left as a record of some of its latest efforts in this part of the valley.

This clay was covered by a few feet of later deposits from the existing lake, and was penetrated by the roots of water lilies and other aquatic plants.

The following shells were found in it and determined by Mrs. McKenny Hughes:—*Sphaerium Corneum*, Linn., *Pisidium amnicum*, Müll., *P. fontinale*, Drap., *Unio sp.* fragments only, *Bythinia tentaculata*, Linn., *Valvata piscinalis*, Müll., *Planorbis carinatus*, Müll., *Limnaea peregra*, Müll. (several varieties), *L. auricularia*, Linn. (and varieties), *L. stagnalis*, Linn., *L. palustris?* Müll., *Succinea putris*, Linn., *Helix* (*Fruticicola*) *hispida*, Linn., *H.* (*Xerophila*) *Ericetorum*, Müll., *Pupa marginata*, Drap. The larger animals were:—*Elephas primigenius*, *Equus caballus*, *Bos longifrons*. *Cervus elaphus* of very large size has been found in a similar deposit in the immediate neighbourhood.

We notice the absence of the older forms of Bos, viz. *Bison priscus* and *Bos Urus*; whereas a strain of *Bos longifrons* occurs here, though it has never been found associated with the mammoth in the gravels.

Bos longifrons has not yet been satisfactorily described. There is certainly a larger and a smaller variety in the peat of both Ireland and England, but whether they were wild or all domesticated or derived from a domesticated breed is not clear.

It may be that further search would yield some of the forms whose absence we remark, but the evidence, so far as it goes, points to the Didlington Clay being more recent than the gravels in which the mammoth occurs elsewhere in East Anglia. It might be, of course, that it was made up of the washings of earlier deposits of various age, but there is nothing in the condition of the mammoth bones to suggest that they are not of the same age as the other remains found here. Moreover, several consecutive vertebræ of the mammoth found together in their natural order prove that the ligaments had not perished when the bones were buried in the clay.

Some of the bones, especially those of horse, were grooved and striated in such a manner as to remind one of ice action, and of course the close proximity of the Boulder Clay suggested the possibility of their being derived from it; while we have to bear in mind also the probability of the agency of river ice at a later period.

On the other hand, similar striæ on the bones found in other sections in East Anglia have undoubtedly been caused by settlements in the stony mass by which the gravel has been squeezed against and even into the inside of the bones while the process of decomposition was going on. This fact and the occurrence of similar striæ on the bones of saurians in Jurassic clays throw great doubt upon the inference that the scratches on the Didlington bones are due to any kind of ice action. None of the plant remains have been determined.

There is much evidence in favour of the view that after that not so very remote yet very exceptional episode, in which glacial conditions prevailed over this area, the whole of the district stood at a higher level. Then the basin of the Wash and its tributaries was re-excavated and extended, and a considerable resultant river found its way into the sea through the chalk escarpment between Hunstanton and Skegness. Into this river the Wissey and other streams of west Norfolk found their way. Some time later the area was depressed, and the rivers, which had descended with considerable force, especially in times of flood, were met by the tides at higher and higher points as their valleys gradually sank to sea-level. But this was not a sudden or even a rapid change, and the species of plants and animals disappeared by degrees as the conditions became unsuited for them. The Didlington Clay belongs to this period of changing conditions and is a late Pleistocene formation laid down after the arrival of *Bos longifrons*, but before the mammoth had ceased to inhabit, or at any rate to be a visitor in, the district.

Almost all the remains of the earlier Pleistocene times have been obtained from sands and gravels of a torrential character, and we have seldom had any opportunity of examining the embayed corners where they have been preserved in fine mud. This is partly due to the fact that the sand and gravel are of commercial value, but the mud is only excavated to get at something below it, as, for instance, at the marl for cement, or the gault for bricks, or, as in the case to which attention is now called, where the excavations were made for a new boat-house which exposed this blue river clay at Didlington Hall.

But another, and perhaps the more common, reason is that it was generally near the mouths of the sinking river valleys which have been since submerged and buried under later deposits that the velocity of the stream was checked so as to allow of the deposition of fine mud instead of sand and gravel.

T. McKENNY HUGHES.

SOME SEASONAL VARIATIONS IN THE BRITISH ISLES.

IN a paper just published by the Royal Society[1] attention is directed to a peculiarity in the seasonal variation of temperature in the British Isles disclosed by the resolution into harmonic components of the curves of day to day variation derived from the 25-year means of the 24-hourly readings at Kew, Falmouth, Aberdeen and Valencia. The peculiarity in question is the second harmonic component which is represented by a curve with two maxima and two minima in the year. In the 25-year curves for each of the observatories the maxima of the second components come within four days on either side of January 31 and August 1 respectively, and the minima are in the first week of May and November. They represent a temperature effect which exaggerates the height and shortens by nearly two weeks the duration of the summer portion of the compound curve; it also moderates the depth and lengthens by an equal amount the duration of the winter portion. The effect has a range of nearly 3° F. at Kew in the 25-year mean curve, out of a whole range of 24° F. Its magnitude at the other stations is approximately the same fraction of the whole range at those stations. It is much larger in curves for single years at Kew, but the epoch varies somewhat. It is called meteorological, as distinguished from planetary, because in the mean curves for the Continental stations Vienna and Agra it is quite different either in magnitude, or epoch, or both.

An attempt is made to account for this peculiarity by the prevalence of winds from different quarters at different times of the year. The mean temperatures of 3288 successive days (nine years) at Kew are grouped according to wind direction from eight compass points or, more strictly speaking, according to the direction at right angles to barometric gradient. The method

[1] "On the Seasonal Variation of Atmospheric Temperature in the British Isles and its Relation to Wind-direction, with a Note on the Effect of Sea Temperature on the Seasonal Variation of Air Temperature." By W. N. Shaw, F.R.S., and R. Waley Cohen. Read before the Royal Society, June 20.

of reference of the temperatures is unusual. The temperature for any day is not referred to the ascertained 25-year mean for that day, but to the corresponding point of the first component in the harmonic resolution of the 25-year curve, and it is the differences from this standard which are considered. To obtain trustworthy means for the several winds the differences for each ten days of the year or for each month are grouped, and the winds are also grouped according to their average annual effect upon temperature, which is tabulated in the paper. Thus N., N.E., and E. winds (E., S.E. and S. gradients) are grouped as "cold winds," S., S.W. and W. winds as "warm," and N.W. and S.E. as "temperate."

A series of diagrams exhibits the results obtained, and it is noteworthy that the chief characteristics of the peculiarity which it is sought to explain, viz. maxima of warming effect in January and July with maxima of cooling effect in May and November, are traceable in different ways in the temperature curves for separate winds and still more markedly in those for the groups of winds. Thus the peculiarity is only partly attributable to the prevalence of warm or cold winds; part is due to a similar peculiarity in the seasonal variation of temperature of the individual winds themselves. Thus the May minimum is shown to be due partly to the special prevalence of "cold winds" and partly to the relative coldness of those winds at that season: the corresponding November minimum is attributed to the prevalence of "temperate winds" and the exceptional coldness of those winds at that period of the year. The July maximum corresponds to the exceptional warmth of the usually cold or temperate groups of winds and the January maximum corresponds especially to the frequency of occurrence of "warm winds."

The half-yearly component of the variation of temperature in individual winds remains unexplained, but the following facts are noted in connection with it: first, a similar effect is found in the temperature variation of sea-water at stations surrounding these islands and, secondly, a similar second order component with similar epoch is found in the seasonal variation of the barometric gradient between London and Valencia and still more conspicuously in the barometric gradient between London and Aberdeen.

The data as to the relation between wind, or gradient, and temperature have been obtained for Kew only.

The paper also contains an account of the variation of temperature with the type of weather prevailing, whether cyclonic or anticyclonic, and it is shown that the effect in question cannot be ascribed to the differences of frequency of these types at different seasons.

To the paper is appended a note on the effect of sea temperature upon the seasonal variation of air temperature. In this an attempt is made, by the application of the principle of the vector composition of sine curves of the same period but with different epochs, to resolve a resultant annual temperature oscillation into components corresponding to the "original oscillation" and the superposed effect of sea or land. By the application of the principle in the case of Kew, it is shown that the amplitude of the "original oscillation" at Kew cannot be less than 5·3° F. and the effect of the surrounding sea corresponds to an oscillation which cannot exceed 8·3° F. in amplitude. The resultant oscillation at Kew ought, however, to be resolved into three components—the original component, that due to the surrounding land and that due to the sea; but there are not sufficient data to determine them directly.

Application is also made of the same principles to the resolution of the temperature variation at Scilly and at a station in Siberia. The numerical results are not to be regarded as final on account of the inadequacy of the data used.

RESEARCH IN UNIVERSITY EDUCATION.

THE development of higher education in the direction of research was the keynote of the address delivered by Prof. J. G. Macgregor, F.R.S., at the University of Edinburgh on October 15, in opening the Natural Philosophy Class as the late Prof. Tait's successor. Research methods should be used in education from the Kindergarten to the University; because the spirit of self-help, of inquiry and of inventiveness which they encourage is at the foundation of all progress in science and industry. When science began to be studied in our schools and colleges about forty years ago, the schoolmen of the day followed, with few exceptions, the methods which they used in teaching the humanities. Lectures and books provided the material and examinations the test of retentivity. The system was fundamentally wrong when applied to science though sound for studies of literature. Investigation is necessary in both cases if progress is to be made, but, as Prof. Macgregor remarks, "while in science the outfit of the laboratory consists of apparatus and tools, in language it consists of the text and the lexicon."

The neglect of the spirit of research in the study of science is largely responsible for the want of public sympathy with work of investigation and the inadequacy of provision made for it. Nations like those of America and Germany which have recognised that research is not only an educational discipline but exercises a powerful influence upon industrial development, now take the initiative where we were once the leaders. Formerly, it was necessary for the young American to go to Germany to obtain the pioneer spirit, but the need no longer exists, for the leading universities of the United States have been remodelled on modern lines. In Great Britain the conservative spirit prevails and has prevented the course of university development demanded by the requirements of the age. The characteristic attitudes of the German, American and British peoples are as old as the prophets, from whom Prof. Macgregor derives an appropriate illustration.

"The German," he remarks, "may be said to have sought wisdom for her own sake as being more precious than rubies, and he is finding now that she has length of days in her right hand, and in her left riches and honour. The American, though he sought her not, heard her crying at the gates: I, Wisdom, dwell with prudence and find out knowledge of witty inventions; and having heeded her cry, he too is reaping his reward. We Britons have neither sought her for her own sake nor heeded her cry, but have said to ourselves: There is no new thing under the sun. He that increaseth knowledge increaseth sorrow, and much study is a weariness to the flesh. The sleep of the labouring man is sweet. Yet a little more sleep, a little more slumber, a little more folding of the hands in sleep. And now we fear that poverty is coming as one that travelleth, and want as an armed man."

It is the duty of those of us who are awake to national necessities to exert ourselves in the endeavour to arouse the British people to action, and our political leaders to a sense of responsibility for future welfare. More liberal provision must be made for the increase of knowledge, and men who devote themselves to research must be prized as highly as those who have contributed in other ways to the progress of the nation. There must be increase of funds and increase of freedom in the universities and the guiding principle of the work must be research. Prof. Macgregor emphasises these points in the following concluding part of his address.

Research is costly. It means increased teaching staff and adequate provision of all the requisite appliances. Much good work, it is true, may be done with a comparatively small outfit; but to obtain the best result, the outfit, if not lavish, must at any rate be generous. And as the importance of research by students has never been recognised amongst us, the present outfit is meagre.

It will perhaps occur to most of you that the princely gift of 2,000,000*l.* which Mr. Carnegie has made to the Scottish people for reducing the cost of the higher education and increasing its efficiency may be drawn upon for the present purpose, and may be sufficient. Doubtless it will be drawn upon, but it will certainly not be sufficient. When we think of the number of colleges which are to be assisted, and of the number of different departments in each, we see at once that the amount which any one department may expect to receive must be comparatively small. The moiety of the Carnegie fund which is devoted to equipment would build, equip and maintain perhaps about twenty laboratories of the more expensive kind such as are required in the various sciences and in their numerous applications. It becomes obvious, therefore, both how munificent a gift the Scottish people have received, and, since each university ought to possess many of these laboratories, how inadequate it is for the introduction of research study into the various departments of university work.

In Germany the nation itself provides for research, and does so generously, because it is, and has long been, an investigating nation. We are not; and if we introduce research into our universities it will be because, like the Americans, we have