figured in that paper, but there are in some specimens crystals which show all the principal appearances enumerated by Professor Judd, and which cannot, I think, be explained satisfactorily in any other manner than that which he has given us.

NOTICES OF MEMOIRS.

I.—The Oolitic Rocks at Stowe-nine-Churches, Northamptonshire. By Beeby Thompson, F.G.S., etc. (Journ. Northamptonshire Nat. Hist. Soc. Vol. VI.)

IN this paper Mr. Thompson describes a section of especial interest, as it shows the sequence of beds from the Northampton Sands to the Oxford Clay. The tract near Stowe, situated about seven miles west of Northampton, is a faulted one, and to this cause is due the preservation of the Great Oolite and higher beds, which elsewhere in the immediate neighbourhood have been removed by denudation. The beds have been quarried chiefly to supply limestone for fluxing purposes to the Heyford furnaces near by.

The chief new points in this paper concern the identification of the small area of beds overlying the Great Oolite, as these were not indicated on the Geological Survey Map. The highest bed beneath the Drift soil is a blue clay grouped as Oxford Clay. There can be little doubt that this represents the clay usually found between the Cornbrash and Kellaways rock, and sometimes designated the Kellaways Clay.

The Cornbrash contains some of the usual fossils met with in the formation, and it rests on a series of beds grouped with the Forest Marble and Great Oolite Clay. The presence of beds of flaggy limestone resembling varieties of Forest Marble is of interest, as they are only occasionally met with in the country to the north-east of Bicester, in Oxfordshire.

The Great Oolite Clay is not, as Mr. Thompson thinks, the bed to which the term 'Cornbrash Clay' has been applied; that Clay, where it occurs, overlies Cornbrash rock, partly replaces it, and passes up into the Kellaways Clay.

The Great Oolite Limestone and lower beds are described by Mr. Thompson, and lists of fossils are given from these as well as from the higher strata. A photographic plate and a plate of diagram-sections illustrate the paper. H. B. W.

II.—Notes on the Fossil Aphidæ and Tettigidæ.

IN Mr. G. B. Buckton's late Monographs on British *Aphides* and *Cicadæ*, are thoughtful remarks on the known fossil forms of these two great families of Insects, and we here reproduce them as interesting to our readers,—premising that these Insects belong to the *Homoptera*, whose zoological relationship is as follows—

Hemiptera: A. Homoptera: *Aphides, Coccidæ, Cicadæ, Fulgoridæ*, etc.

B. HETEROPTERA: *Hydrocorinæ* (Water-bugs), *Geocorisa* (Land-bugs).

II. In the "Monograph of the British *Aphides*," vol. iv. 1883, Ray Society, at pages 144—178, Mr. Buckton gives a sketch of the geological occurrences of Insects in general, and of the *Aphidinæ* in particular, and finds that the *Hemiptera* are nearly as ancient as the *Coleoptera*, and apparently preceded the *Diptera*, *Hymenoptera*, and *Lepidoptera*. The earliest known *Aphides* have been recognized by Westwood, as collected by Brodie in the Purbeck beds of Wilts and Dorset. In the Eocene Tertiaries of Europe Aphis occurs fossil; and even if not present, its enemies who fed on it (*Syrphidæ* and *Coccinellidæ*) and others (Ants) that sought its honey-dew, have left their remains. At Radaboj in Croatia, and Œningen in the valley of the Rhine, *Aphides* are present in Miocene strata. Indeed in the Swiss Miocene 136 species are known. The *Aphididæ* of North America have been described by Scudder from the White-River District in Utah, and the Green-River-Station in Wyoming; also from the Florissant-Lake strata in Colorado, the last giving eight species of *Aphidinæ*. The many species of *Aphides* found in Amber have occupied the author's attention (pages 160–168). He gives a lucid account of what has been published about Amber and its origin; and indeed he also alludes to what geologists have determined about the Tertiary and other strata in which *Aphides* occur, and especially about the flora represented by the plant-remains accompanying these Insects at the several localities.

Plate cxxxi. contains figures (after Berendt) of Germar and Berendt's species from Amber; namely, three of *Aphis* (?) and two of *Lachnus* (?), carefully described in the text.

In plate cxxxii. Mr. Buckton figures, from earlier drawings, one *Aphis* (?) from the Purbeck; one from the Tertiary of Amberieux (Ain); one *Aphioides* from Amber; four of *Aphis* (?) and three of *Lachnus* (?) from Radaboj; and a *Pemphigus* (?) from Œningen.

Some fossil *Aphides* from Florissant, Colorado, are figured (after Scudder) in plate cxxxiii. Five new genera are described by Buckton, at pages 176–178, as *Siphonophoroides* (2 spp.), *Archilachnus*, *Anconatus*, *Schizoneuroides*, and *Pterostigma* (1 sp. each).

III. In Mr. G. B. Buckton's "Monograph of the British *Cicadæ* or *Tettigidæ*," 1891, Macmillan & Co., London and New York, some fossil forms are referred to in vol. ii. at pages 164–184.

After some remarks on the bibliography of Fossil Insects, their occurrence in freshwater rather than in marine deposits, their local abundance in isolated groups or masses, and the possible conditions of preservation, the author observes that the *Hemiptera* lived in Carboniferous times in the American and British areas, contemporaneously with the gigantic *Dycteoptera* (Cockroaches) and *Coleoptera* (*Buprestidæ*) which crawled amongst the Equisetums and Tree-ferns of that early period. A few Hemipterous remains are described by Scudder from beds below the Lias or Rhætic in Colorado; and some specimens from the Rhætic at Schönen in Sweden have been referred to *Cimex* and *Cicada*. From the Rhætic (?)

of Schambelen (Aargau), Switzerland, O. Heer enumerates 143 fossil Insects, of which 12 are *Hemiptera*. The Jurassic *Palæontina oolitica*, from Stonesfield, was referred by Mr. A. G. Butler to *Lepidoptera*, but others believe it to belong to *Cicadæ*. In some of the Purbeck beds of Wilts and Dorset Insects are known to be abundant, as shown especially by Brodie and Westwood, in 1844 and 1854. Of the *Tettigidæ*, Prof. Westwood determined remains of a small *Cicadellina*, and of a *Cercopis* and *Bythoscopus*. Though Insect remains are plentiful in many Eocene Tertiary beds, only in the gypsum of Aix-en-Provence have discoveries of *Cercopidæ*, *Cixiidæ*, and *Cicadellinæ* been made.

To the Oligocene period Mr. Scudder refers the remarkable fresh-water insectiferous deposits of Colorado, which form part of islets in the Florissant Lake. The fauna and flora agree partly with those of Œningen near Schaffhausen, and Radaboj in Croatia, which belong to the Miocene. In British Columbia, Dr. G. M. Dawson discovered some lacustrine insect-bearing strata, believed also to be Oligocene in age; and they have yielded to Mr. Scudder 19 *Hemiptera*, of which only two are truly Hemipterous; whilst there are eleven Homopterous *Cercopidæ*, three *Fulgoridæ*, and two *Aphidæ*. All are of larger size than the usual Tertiary Insects. Of all the American fossil insects, from areas far apart, 612 species have been described, of which the *Hemiptera* form the large proportion of 266 species, and Mr. Scudder regards the known European species of *Hemiptera* as numbering 218.

The Miocene of Switzerland has yielded multitudes of fossil Insects, mostly discovered and described by O. Heer. Among them are 636 Hemipterous species; and by far the majority of these are larval forms. The presence of at least one *Cicada*, and the numerical preponderance of *Reduviidæ*, *Scutata*, and *Coreodeæ*, also the occurrence of several fine *Cercopidæ* and large Water-bugs, give good evidence that a warmer climate (especially milder winters) then prevailed over Central Europe than now. O. Heer thought also that as these insects undergo an incomplete metamorphosis, and are more or less active in their pupal conditions, they were better suited to regions not subjected to the rigours of long cold winters.

From the Miocene of Greenland and Spitzbergen examples of *Cercopis* and *Pentatoma* have been obtained. From New South Wales Mr. R. Etheridge, jun., has described (1890) the fossil *Cicada Lowei*.

The Amber of the Baltic and elsewhere (pp. 171–173; see also "Monogr. Aphides," pp. 160–165) contains many specimens of *Tettigidæ*, of these Mr. Buckton's Plate G illustrates two specimens of *Typhlocyba*, two (?) of *Jassus*, one of *Tettigonia*, and four of *Cixius*; also one *Cicada* in copal-resin from Zanzibar.

Of other fossil *Tettigidæ*, Mr. Buckton's Plate F illustrates Butler's *Palæontina oolitica* (elytron); two species of *Cicadellium* and one of *Cercopidium*, from the Purbecks; one *Cicada* and two species of *Cercopodium* from the Swiss Miocene; one *Agallia*, one *Petrolystra*, and one *Palæcphora*, from the Oligocene of Colorado; also

a *Thammotettix*, a *Dawsonites*, and a *Stenecphora* from the Tertiary of British Columbia.

At pages 178–181 Mr. Buckton refers to geological speculations as to the changes of land and climate affecting Insect-life in late Tertiary and Quaternary times; also to possibilities of development and of degeneration among Insect forms in geologic times, and he hesitates to offer any outline of the phylogenetic descent of the *Homoptera* in particular. T. R. J.

REVIEWS.

I.—The Cause of an Ice Age. By Sir Robert Ball, LL.D., F.R.S., Royal Astronomer of Ireland. Pp. 180. (Kegan Paul, Trench, Trübner & Co. 1891.)

THIS little book contains a very clear and agreeably written exposition of the commonly received Astronomical theory of Glacial periods. But it goes further than that, because it offers an explanation of a difference of the mean temperatures of either hemisphere during the summer and winter seasons, reckoning from equinox to equinox, which has not hitherto been taken due account of in estimating the effects of the earth's position with reference to the sun. The author proves, by a short calculation given in an Appendix, that owing to the obliquity of the ecliptic the quantity of heat, received from the sun upon one hemisphere during its summer, bears to the quantity received during its winter the invariable proportion of 63 to 37. This will be the case always, whatever be the position of the equinoctial line with respect to the major axis of the orbit, and whatever be the eccentricity of the orbit. He points out that, in consequence of an inadvertence in a statement in Herschel's Outlines of Astronomy, the proportion has hitherto been regarded as one of equality; and it is obvious how great a difference this consideration will make in estimating climatic effects.

The greatest eccentricity which the earth's orbit can have is about 0·07. When with this eccentricity winter in the northern hemisphere occurs in aphelion, taking the mean daily heat for the whole year received by that hemisphere, as unity, the mean daily heat received by it in a short summer of 166 days will be represented by 1·38; and the mean daily heat received in its long winter of 199 days will be only 0·68. This, the author says, will produce a severe glacial epoch, when the summers will be short and very hot, and the winters long and very cold. While the eccentricity remains the same (for it changes very slowly) when the axis of the earth is next carried round by precession until the winter occurs in perihelion, the mean daily heat received in a long summer of 199 days will be 1·16, and in a short winter of 166 days will be 0·81. This he believes will produce an interglacial period—interglacial because two or three such reverses may occur before the eccentricity is sensibly altered. It must be remembered that the unit of heat here used is a very large one, being that which raises the mean temperature of