"Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire," New Series, Part 3; from the Society.

The following were elected Members of the Association :—

Ernest Candelier, Esq.; Timothy Curley, Esq., F.G.S.;
Thomas Jones, Esq., F.G.S.

The following Papers were read :—

1. ON THE INSECT FAUNA OF THE TERTIARY PERIOD AND THE
BRITISH AND FOREIGN STRATA IN WHICH INSECT REMAINS
HAVE BEEN DETECTED.

By HERBERT GOSS, Esq., F.L.S.

2. ON THE FORMS OF THE GENUS MICRASTER COMMON IN THE
CHALK OF WEST KENT AND EAST SURREY.

By CALEB EVANS, Esq., F.G.S.

The Chalk with bands of flint nodules is characterised in West Kent and East Surrey by the great number of Echinoderms belonging to the genus *Micraster* that it contains, and a brief notice of the distinctive characters of the forms of that genus* common in the Chalk in the neighbourhood of London, and of the stratigraphical position in which these forms are found may, therefore, be of some use.

In Professor Morris's Catalogue, 2nd Edition, the following list of forms of *Micraster*, met with in the English Chalk, is given :—

Micraster acutus.
 „ *cor-anguinum.*
 „ „ variety *rostratus.*
 „ „ variety *gibbus.*
 „ *cor-bovis.*
 „ *Mantelli.*

* For a general description of the Echinoderms of the Chalk see Mantell's "Medals of Creation," and other works.

A valuable description of *Micraster cor-anguinum*, the typical species of the genus, was published by the late Professor Edward Forbes, in Decade V. of the "Memoirs of the Geological Survey," and a complete Monograph of the genus is in course of publication by Dr. Wright, in the series of the Palæontographical Society.

The shell of this species is tolerably substantial, and is distinctly heart-shaped, as the furrow on the anterior side is deep, and the mouth is situated very near to the anterior margin of the under side. The lateral ambulacral areas are moderately depressed, and have a longitudinal groove extending down the centre of each depression, and transverse grooves extend from the central one to the margins of the ambulacra, and in these transverse grooves the pores are situated. The shell of this form is somewhat variable in shape, but by one or other of these characters the species may be recognised. The variety *rostratus* is very common, and is composed of those specimens in which the edges of the posterior interambulacral plates are somewhat raised, and form a kind of keel from the apex to the posterior end of the shell. In the variety *gibbus* the posterior interambulacral plates are depressed, giving a more conical shape to the shell. This form is less common than the typical form or the variety *rostratus*.

With regard to *Micraster acutus*, Professor Forbes observes* that it is difficult to understand how it is to be separated from *M. cor-anguinum*, and that it is "a specimen of the normal form in which the caudal extremity is slightly more produced than usual, a variety not uncommon."

Of *Micraster Mantelli* Professor Forbes observes that "the specimens with this name attached do not differ in any respect from those recognised as the young of *M. cor-anguinum*. At this age they are always very tumid, and the dorsal ambulacra are scarcely at all depressed."

A more distinct form is that described by Professor Forbes† under the name of *Micraster cor-bovis*. This form is not uncommon in the lower part of the Chalk with flints. It equals and even surpasses *M. cor-anguinum* in size, but it can be well distinguished from the last-mentioned form by its more elongated shape, by the thinness of the shell, by the more delicate character of the

* "Memoirs of the Geological Survey," Decade V.

† Dixon's "Fossils of Sussex," Plate xxiv., and Decade iii.

tubercles, and especially by the ambulacral areas being without ridges or furrows.

Among the various forms of *Micraster*, noticed by Professor Forbes, is one which has been described by Goldfuss,* and has been recognised by Continental geologists under the name of *M. cor-testudinarium*. Of this form Professor Forbes remarks that it is "a very slight variety of the normal form" of *M. cor-anguinum*, "constructed out of specimens having the mouth slightly further back than usual, a feature not unfrequently seen in depressed specimens." This form is further distinguished by the anterior furrow being shallower, and the lateral ambulacral areas deeper than in the normal form.

The typical form of *Micraster cor-anguinum* is common in the Chalk of Gravesend, and also in that of Charlton. At both these localities an echinoderm of another genus, *Galerites albo-galerus* (known to continental geologists as *Echinoconus conicus*) is very common, and is characteristic in West Kent and East Surrey of the Chalk immediately below the Tertiary beds, being found in that position at Lewisham, Chiselhurst, Keston, and Croydon, but it appears to be rare or absent in the lower portion of the Chalk with flints.

In a paper read before the Geologists' Association, on 7th January, 1870, I described some sections of the Chalk with flints seen in the unfinished cuttings of the Surrey and Sussex Railway near Purley and Kenley, villages between Croydon and Caterham. The Chalk in the sections at Purley is probably lower in the series than that of Gravesend and Charlton, since the Tertiary beds are only seen on the highest part of the hills by Sanderstead, while the Purley sections are more than 100 feet below the level of the junction of the two formations. From the Railway sections in the neighbourhood of Purley and Kenley I obtained a large number of specimens of *Micraster cor-anguinum*, and, after comparing these with the figures and descriptions published by Professor Forbes, I considered them to belong to the form *Micraster*, and, under that name included them in my list of fossils from those sections. About the time that I was engaged in preparing that paper my attention was directed by the publication of Mr. Davidson's "Notes on Continental Geology" † to the fact that foreign Geologists had recognised

* Goldfuss, "Petrefacten."

† "Geological Magazine," p. 162, Vol. vi.

in France and Germany two zones of Chalk, characterised respectively by *Micraster cor-anguinum* and *M. cor-testudinarium*, but after comparing the specimens I had obtained from Purley with those from Kenley I failed to observe any distinctive characters between those of each of the two localities. Some time after my paper was published my friend, Mr. Meÿer, informed me that *M. cor-testudinarium* was the characteristic fossil of the Dover Chalk, and that the type-form of *M. cor-anguinum* occurred at Charlton, and on once more examining my specimens from the Purley and Kenley cuttings (the Chalk of which I believed to be on about the same horizon as the Dover Chalk), I found that not a single specimen was of the type of *M. cor-anguinum*, nearly the whole of them being of the form known as *M. cor-testudinarium*. This fact is so striking, and has so important a bearing on the correlation of the sub-divisions of the English Chalk with those established on the Continent, that I am anxious, as early as possible, to correct the error that I made in the description of the Purley and Kenley railway sections, and in the list of fossils contained in my former paper, and to state that in every instance in which "*Micraster cor-anguinum*" is there mentioned as being present in those sections, the name "*Micraster cor-testudinarium*," or "*Micraster cor-anguinum*, variety *cor-testudinarium*," should be substituted.

With regard to *Micraster cor-bovis*, I have only found that form in the lowest part of the Chalk with flints, and I believe it is limited to that horizon, where it is associated with another echinoderm equally characteristic, *Holaster planus*.

The correction of the name of the characteristic fossil of the Purley and Kenley Chalk necessitates a modification of the classification I proposed for the Chalk of the line of sections between Croydon and Oxted.

The lowest beds of the Chalk Marl were very imperfectly seen in the spoil heaps around the shafts of the long tunnel near Marden Park, but these beds are well exposed in the large pit in the escarpment of the North Downs, near Oxted, a little to the east of the line of railway. The highest beds of Chalk of the district were not seen in the Purley railway-cuttings, but are exposed in Chalk-pits at Combe Lane and Crohamhurst, near Croydon.

The classification I am now disposed to adopt for the Chalk of

West Kent and East Surrey is as follows, commencing at the base of the Series :—

Zone of *Holaster* * *trecensis* and *Ammonites varians*—Chalk Marl and Grey Chalk—Chalk of Oxted.

Zone of *Belemnitella plena*—Yellowish concretionary Chalk, and hard White Chalk—Lower Chalk of Marden Park.

Zone of *Inoceramus mytiloides (labiatus)*—White Chalk without flints—Upper Chalk of Marden Park.

Zone of *Inoceramus Brongniarti* and *Terebratulina gracilis*—White Chalk with few flints—Chalk of Whiteleaf.

Zone of *Holaster planus* and *Micraster cor-bovis*—lowest beds of Chalk with bands of flint nodules—Lower Chalk of Kenley.

Zone of *Micraster cor-testudinarium*—Chalk with bands of flints—Chalk of Riddlesdown (or Upper Chalk of Kenley and Chalk of Purley).

Zone of *Micraster cor-anginum* and *Echinoconus conicus (Galerites albo-galerus)*—Chalk with bands of flints—Chalk of Croydon and Charlton.

The Chalk of Gravesend is, perhaps, slightly higher in the series than the Charlton and Croydon Chalk, as *Belemnitella mucronata* is common at Gravesend, the fauna in that respect approaching to that of the Margate Chalk.

In the year 1876 a very valuable memoir on the Chalk of England and Ireland was published at Lille by Dr. Charles Barrois, in which that gentleman described the Chalk of the South Downs and the Hampshire Basin, and of most other parts of England, in so complete and masterly a manner, that little more remains to be done than the filling in of minor details; and he has clearly shown that it is possible to identify in the English Chalk the zones which he has already established in the Chalk of France.

The classification which Dr. Barrois adopts is shown in the middle column of the following table. The left hand column shows the manner in which he has correlated his zones with those proposed by me in 1870 for the Surrey Railway sections, and in the column on the right hand I have shown the classification I am now disposed to adopt for the Chalk of East Surrey and West Kent :—

* *Holaster subglobosus* is usually adopted as the type of this zone, but I have not as yet obtained this fossil from Oxted.

<i>C. Evans (1870)</i> <i>Surrey and Sussex</i> <i>Railway Classification.</i>	<i>C. Barrois (1876)</i> <i>General Classification.</i>	<i>C. Evans (1877)</i> <i>East Surrey and West</i> <i>Kent Classification.</i>
	Assise à Belemnitelles ...	Gravesend Beds ?
Purley Beds	Zone à Marsupites	
	Zone à <i>M. cor-anguinum</i> ...	Charlton and Croydon Beds.
Upper Kenley Beds...	Zone à <i>M. cortestudina-</i> <i>rium</i>	Riddlesdown Beds.
Lower Kenley Beds...	Zone à <i>Holaster planus</i> ...	Kenley Beds.
Whiteleaf Beds	Zone à <i>Terebratulina</i> <i>gracilis</i>	Whiteleaf Beds.
Upper Marden Park Beds	Zone à <i>Inoceramus labi-</i> <i>atus</i>	Upper Marden Park Beds.
Lower Marden Park Beds	Zone à <i>Belemnites plenus</i>	Lower Marden Park Beds.
	Zone à <i>Holaster sub-</i> <i>globosus</i>	Oxted Beds.
	Chloritic Marl	
	Zone à <i>Pecten asper</i>	
	Zone à <i>Ammonites inflatus</i>	

Dr. Barrois states in his memoir that he has not had time to study the Chalk of the Basin of the Thames with the exactness with which he has examined the Chalk of the Southern parts of England, and he has relied to a great extent on the works published by previous writers on the subject, for the purpose of correlating the divisions of the Chalk near London with those established elsewhere. Among the works cited he has included my paper on the Croydon and Oxted Sections, and, trusting to the correct identification of *Micraster cor-anguinum* as the characteristic fossil of the Purley Chalk, he has, I believe, placed that Chalk on too high a horizon. I regret that the error I made in my list of fossils should have been the cause of thus misleading him, and I therefore desire, as early as possible, to correct my mistake, and to confirm his generalisation that the zones of life, which he has in so admirable a manner established for the Chalk of the Hampshire Basin, and in France, can be equally well recognised and studied in the Chalk of the Basin of the Thames.

Micraster cor-testudinarium Goldfuss.
From Purley.

Micraster cor-anguinum. Gmelin.
From Gravesend.

Micraster cor-bovis. Forbes.
From Kenley