Another very interesting subject is the age of the Whetstone beds of the Blackdown Hills, in Devonshire, in which deposits fossils of the Lower Greensand, Gault, and Upper Greensand, beautifully preserved, although completely silicified, seem to be curiously intermixed in such a way as to make the age of the bed very doubtful. In our London museums these fossils are arranged as Upper Greensand. Mr. D. Sharpe considered them of the age of the Gault, and a few geologists have classed them as Lower Greensand.

Time will not permit me to enlarge at present on these questions, but I hope on some future occasion to bring this branch of my subject before you in greater detail, and in the meantime I trust that other members will come forward, and give us some local papers on the Middle and Lower Cretaceous formations.

No. 2. "Notes and Queries on Geological Subjects." By Mr. G. E. Roberts, F.G.S.

After the reading of the paper, it was proposed that "Notes and Queries" should be periodically published by the Association, and that the paper just read form the first number.*

Ordinary Meeting, July 5, 1864.

E. Cresy, Esq., President, in the Chair.

The following papers were read:—

No. 1. "On a Recent Marine Deposit at Boulogne." By Mr. C. B. Rose, F.G.S.

On returning from Paris in the spring of 1862 I slept one night at Boulogne, and on the following day I made a hurried examination of the harbour, piers, &c. In so doing I met with a hillock of sand and débris, enclosing *Cardia*, *Mytili*, and other shells, clearly such as inhabit the adjoining sea.

This circumstance haunted me on my return home so much as to

* Mr. Roberts's "Notes and Queries" have been printed and circulated amongst the members.

induce me to propose to my friend Mr. Wiltshire a revisit on my own part to Boulogne, accompanied by him. He readily assented, and very soon we were on our way. Arriving there about three p.m., and after taking care of the inner man, we proceeded in search of *my* recent marine, which I had no difficulty in finding, and to exploring we went. My friend's piercing and more practised vision not only detected the Cardia and Mytili, but to my dismay fragments of bricks, tobacco-pipes, and soles of dilapidated shoes, proving that it was indeed a *recent* accumulation.

Not discouraged by this discovery, I looked about me for something to repay us for what now appeared to be a wildgoose-chase after a mare's nest: and on going down into the excavation now in progress for the formation of a new basin or dock, we came upon a really recent marine deposit. The dock, when completed, will occupy 70 English acres of ground; in forming it they have opened a bed of sea-sand to a depth of 30 feet, and found that it reposed upon a stiff clay, the Kimmeridge, into which they entered six feet, and which they determined should form the floor of the dock. From the sand we collected a number of shells, a list of which I will append to this paper. Wishing for more information upon the subject, I wrote to M. Bouchard-Chantreux, an eminent naturalist and geologist,* who obligingly informed me that the Lower Town of Boulogne stands upon this sandy deposit, for upon breaking ground to lay the drainage-pipes, they invariably open this bed of shells. He also informed me that this arenaceous deposit containing shells extends along the valley of the Liane up to St. Omer, a distance of 38 miles. M. Bouchard has collected similar shells at that town. From the same gentleman I learnt that at various spots in the above valley a fluviatile deposit containing Limneæ, Cyclades, Succineæ, and Helices has been found lying above the marine deposit. There appears to have been a subsidence of this part of the French coast since the Roman period; for during the occupation of France by the Romans, as I am informed by M. Bouchard, their legions collected the septaria and shaly portions of the Kimmeridge Clay

* Recently deceased, and who at my visit possessed a very fine collection of Kimmeridge and other organic remains.

at low tide to form the kerb-stones to their military roads at spots now covered by more than twenty feet of beach-sand.

And now let me account for the *hillock* of heterogeneous matter (bricks, pipes, &c.), the cause of my second visit to Boulogne. It will be seen by the plan that it lies near the *small* basin, the history of which basin is the following. In 1803 Napoleon I. had it excavated for the reception of his flotilla assembling there to be ready for the transport of his army collected on the heights adjoining the town, for the invasion of England. Nelson was foiled in his attempt to destroy the flotilla, but at the battle of Trafalgar he saved his country the horrors of invasion by destroying the combined fleets of France and Spain. Such is the origin of the strange accumulation of apparently incompatible materials which led to a very agreeable trip with my friend the Rev. Thos. Wiltshire.

I lay before you a specimen of each kind of shell we collected from the sand, and I append a list of them :—

Cardium edule.
 Mytilus edulis.
 ———— var. incurvatus.
 Lutraria compressa.
 Mactra solida.
 Patella vulgata.
 Litorina litorea.
 ——— litoralis.
 Tellina solidula.
 ——— tenuis.
 Donax anatinus.

2nd. "On the Excursion to Bromley." By Mr. A. Ramsay, Junr.

In accordance with the arrangements made by the Committee, a party of our Members made an excursion to Bromley on the afternoon of Saturday, the 18th of June. On arriving at the Bromley Station we were received by Mr. Ilott, who, after drawing our attention to the section of gravel at the station, escorted us to his house, where he had arranged for our inspection a series of fossils, mostly from the strata in the neighbourhood. From his house we proceeded by a field-walk to Elmstead Lane, a distance of about two

or three miles, during which we interchanged a few words of antiquarian gossip.

Geology and archæology so intermingle with one another that it is difficult to say where the one ends and the other begins. The information afforded by the names of places does not extend to a period very far removed from the present, still it sometimes has a little to do with geology. Bromley is from the Anglo-Saxon words *Brom* and *leag*, which mean the district where broom grows. In Chiselhurst we see evidences that our Anglo-Saxon ancestors had noticed one of the marked geological features of the district. In the language used by them a flint or pebble was called *ceosel*, which has become transformed into *chisel* in our modern geographical orthography. Chiselhurst then means the pebble-wood, referring, doubtless, to the great abundance of black pebbles which cover the ground; so in other counties, we have Chiselborough in Somersetshire, Chisledon and Chiselbury Camp in Wilts, Chiselbourne, Chiseldon, and the Chesil Bank in Dorsetshire. I would ask whether all these are connected with any pebbly characteristics in the localities; the last, we know, is what its name implies, a pebble-bank, and the previous name is that of a town or rather village which marks the commencement of that remarkable collection of stones. This would suggest the inquiry whether the pebble-beds round Bromley are the remains of a similar bank on the shores of the old Eocene sea.

At Elmstead Lane we visited the pit in Sundridge Park, where there is a fine section of what was formerly called the Plastic Clay, but which, since the admirable memoir by Mr. Prestwich in the volume of the Geological Society's Journal for 1854, has been called the Woolwich and Reading Beds, which are the oldest Tertiaries in this country, with the exception of the Thanet Sands. The strata of which they are composed are remarkable for the different structural and faunal characters they present in different localities. Upon these variations have been based the division of these beds into three horizontal areas, called respectively, the *west*, the *central*, and the *east*. The west is characterised by its sands and mottled clay, and is developed round Reading and in the Isle of Wight; in the central area the Woolwich series is represented by

pebble-beds, sands, and laminated clays, and occupies the district round Woolwich, Blackheath, and Bromley; and the east area is marked by the quartzose and glauconiferous sands of Herne Bay and the neighbourhood of Canterbury. Looked at from a zoological point of view, the eastern may be distinguished by the marine character of its fauna, the central by its fossils belonging, for the most part, to fluviomarine or estuarine genera, while the district farther west presents freshwater characteristics. In the central area, and immediately north of a line running through Croydon, Hayes, and Orpington, is a district where sands and shingles are largely developed. It might be said that these shingles and sands are non-fossiliferous, were it not that in the midst of them there stands a pit known as the Sundridge Park or Elmstead Lane pit, where the fauna of this period is preserved, and that, too, in great abundance. The strata in this section are exceedingly difficult to trace satisfactorily, in consequence of false stratification. Farther north, as at Charlton, there are one or two sections, the study of which would greatly facilitate the understanding of the pit in Sundridge Park. At Charlton, and most other places where the beds believed to correspond with those we saw, are exposed, the sand is loose; at Sundridge, and at Chislehurst large portions are hardened into a stone-like mass by a calcareous cement. Indeed, we believe it was for the sake of this stone that the pit was opened, and even now it is occasionally worked. The sand occurs in bands, of from 25 to 30 feet thick, of a hard, light-coloured conglomerate; between them a loose sand intervenes abounding in fossils. It is difficult to say what is the precise position of these strata in the Woolwich series; but Mr. Prestwich believes them to be synchronous with the upper sands at Lewisham and the pebbly sands overlying non-fossiliferous sands at Woolwich.

Amidst the great variety presented by the Woolwich series in its horizontal extent, there occurs one feature which is tolerably constant, and that is the presence of a bed or beds of oysters, made up for the most part of shells of *Ostrea belloracina*. Such beds occur at a great many places; it will suffice to mention here, Catsgrove Hill, near Reading; in sand, near Hertford; at Woolwich, near Crayford, at Stone, Camberwell, East Dulwich, and Peckham.

But nowhere is this species better developed, as regards the shell part at least, than at Sundridge and Woolwich. These localities together appear to have formed the capital of this kind of Oyster. Generally these Oysters are in a loose sand, but at Sundridge, Plumstead, and Charlton, they are in a coarse limestone, in which the shells are cemented together by a calcareous base. Mr. Prestwich has satisfactorily determined that some of these oyster-beds are on the same zone; but there still remains considerable doubt as to whether the Bromley oyster-bed is coeval with that at Reading, or those which occur out of the London basin, as at Newhaven, in Sussex, and one or two localities in the Hampshire basin. Whether or not they belong to the same time, it would be interesting to know what has given rise to the conglomeration of the Oysters in the central area, and not in the others. At the Sundridge pit several of the members climbed to places which a local paper reports as being "dangerous," and it adds "that the members seemed to be used to that kind of work." A large number of Oysters and Cyrenæ were obtained, and also a few other shells, such as *Melanopsis*, &c. The Oysters chiefly belonged to the *Bellovacina* species, under which name is included, *O. edulina*, which is scarcely to be distinguished from the modern edible species. In the pit visited by us Cyrenæ occur with the Oysters; but *Pectunculi* are rare. Mr. Ilott says he does not remember to have seen a single *Pectunculus* there, but a little farther on they become exceeding plentiful.

A visit was next made to the top of the shaft, situated about the centre of the tunnel, which is now being driven for railway purposes. The ground about this was covered with large heaps of sand, and a hard conglomerate, probably the same as that occurring in the pit.

At Chiselhurst, as already mentioned, black flint pebbles occur in great profusion. They are very uniform in size (varying from about half-an-inch to an inch and a half), highly polished, and water-worn, indicating the long continuance of some powerfully grinding force, in all probability a strong oceanic tide. They are found in small numbers at most localities where the Woolwich beds exist; but the great depositories for them appear to be in the estuarine and fluvial strata of Woolwich and Bromley. Where-

ever they are found they are associated with yellow sands. At Blackheath, too, the surface-soil is at places entirely composed of these black stones, from which circumstance, probably, the name is derived. The Whiting Shoal in the Thames is a mass of black stones, embedded in a siliceous base, that is, a true pudding-stone. It would be interesting to know if these stones are in their natural position, or if they have been washed up by the action of the river-currents, and subsequently cemented together. In many places on the south-eastern side of London, the masses of sand and pebbles in the upper part of the Woolwich series are also hardened into a true pudding-stone. This may, perhaps, suggest that the shoal in the Thames may be the relic of these old Tertiaries, in the same way that the Hertfordshire pudding-stone is regarded by some as being the remains of the Woolwich beds in that part of England.

Before quitting this branch of my subject I cannot help hinting that it might be interesting to compare the Bromley beds with the Woolwich strata exposed at Herne Bay and Kyson. At the latter place, I believe, *Ostrea bellovacina* has been found associated with Mammalian remains, such as those of the small Pachyderm, *Hyracotherium cuniculus*, and a species of Bat.

Two mineralogical facts may be here alluded to. The one is the existence of a hydrated silicate of alumina, or allophane, in the face of the railway-cuttings. It was, I think, first found in this country in 1856, at the Charlton pit, by Professor Morris. It there occurs in the fissures of the Chalk, and from the circumstances presented, is believed by Professor Morris to have originated from the action of water on the overlying Woolwich beds. At the Chislehurst railway-cutting it lines fissures in the Woolwich beds. The brown sandy clay, which is itself a hydrated silicate of alumina, only impure, appears to have been transmuted into allophane, which is here of a pure white colour like chalk, and of a dull earthy structure. At Charlton its colour is no doubt different, since the workmen know it by the name of "petrified water." At other places on the Continent it is blue, and a number of other tints, from which variation of colour or appearance it derives its name allophane. When ordinary clay is breathed upon, it emits a strong characteristic odour; but with the allophane this odour is scarcely, if at all,

distinguishable. A few experiments on these two substances might, therefore, throw some light on the question as to what is the cause of the odour of clay. This odour, by-the-bye, I find is very perceptible on the oyster-shell, although there is no trace of clay about it, and the specimen was imbedded in a fine whitish sand, stained with a little oxide of iron. For other details on this point I would refer you to a paper on the Plasticity and Odour of Clay, by Mr. Tomlinson, contained in No. 8 of our Proceedings, where an experiment is made in which this odour is referred to the presence of sesquioxide of iron.

The other mineralogical fact is that the mottled clay has a considerable proportion of gelatinous or soluble silica, that is, silica which can be dissolved in alkaline solutions without the application of heat. Since, then, it actually exists in this form in the Tertiaries, it is possible that it may have existed in this form in the Cretaceous period. Indeed it occurs in beds older than the Chalk, namely, in the Lias, and in beds between the Gault and the Chalk. This note scarcely belongs to my subject, but I have mentioned it because, on the hypothesis of the existence of the gelatinous silica during the deposition of the Chalk, we may perhaps understand how shells can have become imbedded in flint. Several excellent examples of such shells were shown to the excursionists. Many other subjects occupied the attention of the party, and the success of the excursion was mainly attributable to the exertions and hospitality of Mr. Hott.

Ordinary Meeting, November 1st, 1864.

Professor Tennant, F.G.S., Vice-President, in the Chair.

The following papers were read:—

1st. "On Metamorphism in certain Strata at Bendigo, Australia."
By Mr. R. Lechmere Guppy.

Among the many remarkable phenomena met with in the gold-fields of Australia, and which have scarcely yet received the attention they seem to deserve, there is one of which I shall attempt to give a short description.

At the south-eastern corner of the great gold-field of Bendigo in Victoria, there is a remarkable range of auriferous hills, known as