The President explained that the adoption of the report would carry the election of the officers recommended therein, and it was resolved unanimously that the report be adopted. Professor Tennant then submitted the following balance sheet, signed by the auditors, and recommended that the life subscriptions should be invested from time to time, so as to form a permanent fund.

GEOLOGISTS' ASSOCIATION BALANCE SHEET.—1859.

To Subscriptions from Three Life Members, at Five Guineas	15	15	0		By Stationery, Postage, &c.	18	5	8
To Subscriptions from Five Life Members, at Three Guineas	15	15	0		By Printing, Advertisements, &c.....	37	16	10
To Subscriptions and Entrance Fees from 218 Annual Members	93	15	0		By Rent and Attendance	19	3	9
					By Cabinet and Cases.....	5	7	0
					By Balance in Treasurer's hands.....	44	11	9
								£125 5 0
	£125	5	0					

(Signed) JAS. TENNANT,
T. GEO. RANCE.

29th Dec., 1859.

It was resolved, That the recommendation of Prof. Tennant be referred to the General Committee, with instructions to take the necessary steps for carrying it into effect.

Ordinary Meeting, 2nd Jan., 1860.

The Rev. T. Wiltshire, M.A., F.G.S., President, in the Chair.

The following gentlemen were elected members of the Association:—Capt. C. S. Bradley; L. Cooke, Jun., Esq.; R. Mortimer, Esq.; H. C. Tomlin, Esq.

The following donations to the Association were announced :

"The Geologist" for January. From the editor.

“Abstracts of Proceedings from the Geological Society of London.” From the Geological Society.

“Dyas et Trias.”

"Sur le Neocomien dans le Jura."

"American Geology."

“Notes pour servir à une Description Géologique des Montagnes Rocheuses.”

“Reply to the Criticisms of J. D. Dana.” From M. Jules Marcou.

Professor Tennant having taken the chair, the President read the following paper by the late Mr. John Brown, F.G.S., of Stanway :—

“On some Fossil Remains of Mammalia lately discovered in Essex; with Remarks on the Position of the Beds of Drift in that County, and in the County of Suffolk.”

The subjects of the present paper are the Upper Tertiary beds which occur in the valley of the river Colne, near Colchester, and also those in the valley of the river Stour, at Ballingdon, both localities being in the county of Essex, and distant from each other about fifteen miles.

We will commence with the valley of the Colne. The right and left banks of this little river, for the greater part of its course, are composed of the common flint gravel of the district, and also of till, or boulder-clay. In December, 1857, while digging through this clay for the purpose of obtaining it for making bricks, five teeth of an elephant were discovered in a bed of black vegetable matter, or peat, about three feet thick, and two others were afterwards found in the same spot; but these latter had lost several of their plates, or laminæ. The right and left branches of the lower jaw of a rhinoceros, the left branch containing two molar teeth, *in situ*, and eighteen upper and lower jaw teeth were found at the same time, all in good preservation; and also portions of the ribs, bones belonging to the legs, and joints of the rhinoceros. Associated with these was a portion of a tusk of an elephant, three feet six inches in length, very deeply curved, its curvature being six and a-half inches deep from a chord line, two feet nine inches in length, and five inches in diameter at each end; it was probably the medial portion of a tusk.

In November last other remains of the elephant and rhinoceros were obtained from the same bed of peat. Those belonging to the rhinoceros were portions of the ribs, bones of the feet, end of a humerus, and the end of a femur. At the same time a larger portion of an elephant's tusk than the one found in 1857 was met with; this was five feet four and three-quarter inches in length from base to

outer point, five and a-half inches in diameter at its larger end, and three and a-quarter inches near its outer point. This portion contained about one foot of its hollow base. Ten feet is not an unusual length for a fossil tusk of the elephant. I found one at Clacton, on the Essex coast some years ago, that was twelve feet long upon the outer curve. The portion lately found in the Colne valley has lost eighteen inches at its external point, and two feet of its hollow base; these added to the five feet four and three-quarter inches form a tusk nearly nine feet in length. According to our best authorities, a tusk of this kind would require a length of three feet of hollow base, at least, to accommodate the fastening necessary to secure so heavy a mass of solid ivory to the head of the creature.

The curvature of the two tusks from the peat of the Colne valley is remarkable, being much deeper than that of the tusks found on our coast and other parts of the county. Several of the latter, of the length of six and eight feet, have come under my notice, whose curvatures have formed segments not more than seven or eight inches deep, while the specimen from the Colne valley forms a curve fifteen inches deep from its chord line to the upper surface of the tusk. The uniformity in the curvature of the tusks, and their correspondence in diameter, and the fact of their being discovered in the same stratum, leave no doubt of their once crowning the head of the same elephant.

While discussing the subject of fossil tusks and other interesting remains of these extinct quadrupeds, I would draw attention to a discovery which was made about three years ago in the valley of the river Stour, at Ballingdon, fifteen miles north of the Colne valley. At Ballingdon bones and teeth of the rhinoceros, elephant, deer, horse, and ox have been discovered from time to time during the last thirty years. The most recent discovery of this kind was about three years ago, when a splendid tusk of an elephant, several teeth of that animal, a humerus of a rhinoceros, teeth of the horse and bones of the deer were found. The tusk was seven feet from the base to the outer point. It had lost three feet of its hollow base, and a small portion of its point, and it was seven inches in diameter at its larger end. This fine tusk is now exhibiting in the Sudbury Museum, the other fossils found at the same time are in the possession of the

owner of the estate on which they were found. The Ballingdon tusk was curved in the same extraordinary manner as the tusks found in the Colne valley, but its curvature was still greater, the depth from the chord line being twenty-one inches, that is six inches deeper than the tusks found in the Colne valley. Whether this deeper curvature of the tusks of the elephant will constitute a different species or variety I must leave to be decided by those better acquainted with the subject than myself; but the difference between the two forms is very striking. Although, however, there is such a difference in the form of the tusks from the two localities above-named, there is a great similarity in the form of the teeth. These so nearly resemble each other in structure as to lead to the conclusion that the teeth from each locality belong to the same species of elephant, and perhaps to the species known as the mammoth. The fossil remains of the mammoth, it is well known, have been discovered in places widely separated geographically.

It was believed not long ago that the elephant's teeth found in the tertiary beds in England were of the same species with the Asiatic elephant, but on comparing them the difference appears very evident; and subsequent investigations have declared them distinct species.

The bones and teeth of the elephant and rhinoceros found in the Colne valley were, as I have observed, embedded far below the surface, in black peat, or vegetable matter, but those of the Stour valley were found in gravel of the coarsest kind, consisting of large flints detached from the chalk, fragments of granite, slate, large angular pieces of oolite, and sandstone. An interesting collection of most rocks in the geological series might be obtained from this gravel. Greenstone, porphyry, and basalt have also contributed very largely to this enormous mass of debris.

The junction of the chalk and boulder-clay is seen in all the pits and excavations here alluded to, forming a line dipping easily towards the south, jagged and broken by sandpipes and hollows. Ballingdon Hill, distant about a mile from the place where the Stour valley remains were found, possesses all the character of true till, or boulder-clay. Here may be seen many blocks and rounded masses of various rocks of the kinds before noticed, lying dispersed

throughout its whole thickness from the junction of the chalk below to its summit, a depth of about eighty feet. The boulder-clay pursues a southerly direction for ten or twelve miles, to the Colne valley, which intersects it at the village of Chapple. Crossing this valley, it is met with again at Copford, but here it is much modified by drifting action. In the cuttings of the Stour Valley Railway, this deposit was much exposed, and many fossils were obtained, both secondary and tertiary, which will be presently noticed. Throughout the whole of this tract the boulder-clay preserves the same character, both lithological and organic, as we see in it at Ballingdon. It is in general unstratified, except on the upper part of hills and in other places where there are unmistakeable evidences of its being modified by drifting action in water, as in the valley of the river Colne.

The following fossils have been found in the boulder-clay of Ballingdon and of the Stour valley :—*Gryphæa dilatata*, *G. incurva*, *Ananchytes ovatus* (cast), *Vertebræ of Saurians*, *Plagiostoma spinosa*, *Ammonites dentatus*, *A. Lamberti*, *A. annularis*, *A. Bakeri*, *A. biplez*, *Pholadomya obtusa*, *Ventriculites*, *Terebratulæ Gibsii*, *Serpulæ*, Sponges.

From Ballingdon southward the chalk dips so as to hide its junction with the boulder-clay, which is immediately over it. Our present observations embrace a line of country of about twelve or thirteen miles in extent ; and within this space, wherever this clay is exposed, large boulders and some angular fragments of stone are sure to be found, most of which have been removed from great distances.

The chalk appears to have been stripped off the surface to a very great extent in this district ; we are guided to this conclusion by the existing patches of that rock occurring *in situ* at various places. In proceeding from Ballingdon in a northerly direction, we meet with no more chalk till we reach the little village of Boxted, seven or eight miles from Ballingdon, where may be seen a small patch or hillock of chalk, level with the surface, which is used for manuring land. On leaving this spot we see no more chalk till we arrive at Bury St. Edmunds, twelve miles distant, where it is used for lime. The same geological feature is observed between Bury St. Edmunds and Norwich. The chalk only appears occasionally until we reach the last named city, where it again comes to the surface.

The intervals between the chalk stations of Ballingdon, Boxted, and Bury St. Edmunds are occupied by boulder-clay, covered by a rich soil. In these intervals the fossils of the boulder-clay are frequently turned up by the plough, and in the process of draining the land. The following have been found, viz., *Ammonites rotundatus*, Hartest; *Phaladomya obtusa*, Whipstead; *Gryphæa dilatata*, Whipstead; Sharks' teeth, Harringer. I have observed that wherever *Ammonites*, *Belemnites*, and *Gryphæa* are found in the surface soil, the boulder-clay is not far from the spot. The same phenomena are seen here as in Suffolk.

It appears to have been in the intervals between the remaining portion of chalk *in situ* at Ballingdon, Boxted, and Bury St. Edmunds that the moving power put forth its greatest energies, when breaking up and sweeping away the solid chalk, and filling up the intervals with boulder-clay. It would be very interesting to know at what depth from the surface this great moving power—water, has acted upon the chalk in this district, grinding it down and liberating its fossils and its flints, and depositing them in the large masses which have been just noticed.

The different beds beneath the Colne valley, taken in descending order, consist of vegetable soil, modified boulder-clay, peat, flint-gravel, and London clay. The strata were measured at the time of the discovery of the teeth and bones of the elephant and rhinoceros already mentioned. The bed of peat in which these lay is about three feet thick, and formed the upper surface in a depression of gravel. This gravel is about seven feet in thickness. The peat is composed chiefly of vegetable matter, in which are numerous seed-vessels and leaves of moss, and remains of insects in bad condition. For this information I am indebted to the kindness of my friend, Professor Henslow.

The gravel which supports this bed of peat, is composed chiefly of flints much broken, and embedded in reddish sand. In it we do not observe any of the boulders which we find so abundant at other places in the till. Its thickness, as just stated, is about seven feet.

Immediately over this bed of gravel and peat, there lies a deposit of modified boulder-clay, forty-seven feet in thickness, in hori-

zontal lines of stratification, and free from boulders, or pebbles. Vast quantities of bricks and pipes for draining land are made of it. Organic remains have not been met with in the modified till of the Colne valley; while at the Copford brickfield, where this clay has been extensively wrought, Gryphæa, Belemnites, Ammonites, various forms of Foraminifera, and remains of elephants have been collected.

A bed of alluvium, from three to four feet thick, completes the section of the Colne valley, a section which is interesting, not only on account of the fossils—the records of times long past—but as establishing the priority of deposition of the red gravel over that of the till, or boulder-clay. This order of superposition of the boulder-clay over the red gravel is repeated in two other localities in this county, viz., in a brickfield near Kelvedon, and in a gravel pit near Thaxted; there is also the same superposition at Muswell Hill, near Highgate.

On the left bank of the river Stour, as we ascend the stream, and between the towns of Bures and Ballingdon, and in the parish of Lamarsh, may be seen seven or eight blocks of greensand, of various sizes, all of which are angular, and the largest of which weighs about a ton. These are lying by the road side, and appear to have been brought from Petersfield, in Hampshire.

On examining the texture of the stone, the particles of greensand which give the name to the formation from whence they come, occur in groups and patches, like the greensand rocks at Petersfield; and the appearance of the stone is unlike that of the greensand generally, in which the particles are distributed more regularly throughout the mass.

In this district, and over all the eastern counties, blocks of various kinds of stone are met with in the boulder-clay, which we often see detached and lying on the surface. Many of them are from great distances, and of considerable weight, as much as a couple of tons. They are of various kinds, Derbyshire marble, Hastings sand, Druid sandstone, calcareous grit from Oxfordshire, porphyry, basalt, granite, syenite from Leicestershire, etc.

A collector who has visited the parent rocks *in situ*, will readily recognize, with feelings of great satisfaction, the portions of rocks which he had previously known in their native places.

Although many detached blocks of stone are to be seen lying on the surface in the eastern counties in various situations, having corners and sharp ridges upon them, still, at the same time, there are other blocks, extremely hard, which are rounded, smoothed, and polished.

Nearly all the instances upon record of the remains of large extinct quadrupeds being discovered in Europe, especially in Britain, have occurred in beds of flint gravel, and in what was formerly called diluvium; and such discoveries have been often repeated in our own country, as in the two recent occasions above stated, in the Colne and Stour districts.

It has been recorded by the late Dr. Buckland, that in more than forty different places in Britain the fossil remains of the elephant, rhinoceros, hyæna, and many other extinct quadrupeds have been discovered either in gravel or in boulder-clay.

The great operations of nature which produced our beds of detritus, and the fate which attended the animals whose fossil remains we have just now contemplated, appear closely related. Are we then warranted in concluding that the cause, whatever that cause might have been, which formed the great beds of detritus, determined the fate of the quadrupeds at the same period?

We learn, from high authority, that a specific difference exists between the teeth of the fossil and recent elephant; and a difference of structure may be seen in the specimens before the meeting.

Many other instances might have been noticed, where the fossil remains of animals, extinct in our latitude at this period, have been discovered from time to time, for some years past, in these comparatively recent beds.

We have not made any remark on the freshwater productions, which have yielded abundant remains of the elephant, rhinoceros, hyæna, lion, deer, ox, etc.; as our principal object was directed to the deposition of the detritus of the eastern part of Essex.

The above paper was illustrated by numerous drawings. Several of the fossil remains, above alluded to, were also exhibited.

A discussion followed, in which the President, Prof. Tennant, Mr. Charlesworth, Mr. Cresy, and Mr. Cumming took part; and it was resolved that, as a mark of respect to the author, the paper should be printed at length in the Proceedings of the Association.