ON THE PLEISTOCENE (NON-MARINE) MOLLUSCA OF THE LONDON DISTRICT.

By B. B. WOODWARD, F.G.S., F.R.M.S., &c.

The object of the present communication, which from many causes has been long delayed, is to deal in as comprehensive a manner as may be with the non-marine* mollusca that occur in the Pleistocene (including in that term both the palæolithic and neolithic) deposits in the neighbourhood of London.

The area covered is practically that included in the Survey Memoir by Mr. Whitaker just published, and hence it might fairly be urged that the undertaking is premature, if not unnecessary, so soon after the issue of that admirable work. Justification is, however, sought in the fact that the scope of the Memoir did not permit of anything like an extended treatment of the subject, fossils, in a work mainly stratigraphical, being, of course, of subordinate consideration, whilst the unfortunate mollusca from these deposits come in for special condemnation on the grounds that there are amongst them no extinct species, and only three not now living in the area. The conclusion that the evidence afforded by the mollusca is of no value in any attempt to determine the relative ages of the several deposits is supported to some extent by the tabulated list of species there given; but that list is a combination of the various records which have been published at different times and in various works, and no systematic checking of the determinations of the several observers is attempted, nor indeed is such practicable in a compilation of the sort.

Now, until comparatively quite lately any *Unio* that was not *U. littoralis* ranked as *U. pictorum*; each *Clausilia* was *C. biplicata*, and every *Planorbis* with a keel, *P. carinatus*; whilst a *Helix* that could not be referred to *H. hispida* or *H. nemoralis* seemed naturally to become *H. rufescens*. Nor is this much to be wondered at since when the older lists were compiled our British Mollusca were by no means so well known as they are at the present day, and the records were compiled by observers who were not always sufficiently acquainted with the living forms, and who certainly never

* This term is selected as being shorter than "Land and Fresh Water," and since it covers the inevitable introduction of brackish water forms like *Hydrobia*.

dreamt of applying to the microscope for aid in the determination of the fossil examples. It was enough that all were of "recent species."

The printer, too, is probably not without blame in some cases, especially in tabulated records, where many an asterisk under his fostering care has doubtless gone astray.

When, however, a careful scrutiny of these old lists is made, and comparison where possible instituted with the specimens themselves, it becomes manifest that if fairly studied and closely investigated, these despised molluscs are probably more likely to yield evidence concerning the history of the beds in which they occur than the mammals which are preferred before them; a result that might certainly be expected from the freshwater species, considering that they must more truly and more readily reflect any change in their natural environment than adventitious mammals can do.

Many obstacles have to be encountered in attempting such a task. Only too frequently a collection that would have been of the utmost value has been lost: for this the innate selfishness of the private collector, who insists on retaining his specimens until they get broken, lost, or dispersed, instead of placing them in some institution where others can study and derive advantage from them, is largely to blame. Where, however, the specimens are forthcoming, the difficulties in the way of a satisfactory determination of the species, despite the progress of conchology and the use of the microscope, are frequently serious if not insuperable; whilst the blunders that can be made even whilst doing one's utmost to avoid them, are both humiliating and exasperating.

In the present instance the method adopted when revising the old lists of collections that can no longer be traced, has been to omit all such names as it was felt sure or reasonably certain were due to error of observation, whilst giving on the authority of the recorder those species which could not justifiably be left out.

Besides, however, revising the collections and work of the past, new material has been laid under contribution, with the result that fresh points have come to light, and further species are added to the lists. That this has been possible is mainly due to the extremely kind assistance rendered on every hand. Dr. H. Woodward gave every facility for working at those specimens which are under his care as Keeper of the Geological Department of the

British Museum (Natural History); Mr. Franks permitted an inspection to be made of those shells which are preserved in his Department at Bloomsbury; Mr. Newton and Mr. Allen, of the Museum of Practical Geology, afforded every aid for the inspection of the examples there preserved; whilst the private collectors who freely allowed their treasures to be overhauled, and readily entrusted them for examination, are Mr. F. C. J. Spurrell, Mr. A. Belt, Mr. J. E. Greenhill, Mr. J. Allen Brown, Mr. C. J. A. Meyer, Mr. R. Nuttall, Mr. T. Warburton, Mr. W. J. L. Abbott, Mr. G. F. Harris.

To all these friends the writer is greatly indebted, and takes this opportunity of cordially returning them his thanks, as also to Professor T. Rupert Jones for determining various species of *Cypris*, and to Mr. C. O. Waterhouse for naming the remains of beetles from the Blackfriars deposits; whilst to Mr. Worthington G. Smith, Mr. E. T. Newton, Mr. E. A. Smith, Rev. E. S. Dewick, and Mr. W. Rupert Jones, he is under great obligation for assistance and advice.

For permission, in all cases most readily granted, to reprint the illustrations of the various sections alluded to, especial thanks are due to the authors of the papers—Prof. Prestwich, Prof. Boyd Dawkins, and Mr. W. T. Blanford; to the Council of the Geological Society, and to the Controller of Her Majesty's Stationery Office; whilst to the editor of the 'Geological Magazine' (Dr. H. Woodward), to Mr. Worthington G. Smith, and to the Essex Field Club the Association is indebted for the loan of the blocks themselves.

The final results as regards the determination of the molluscan species present in the Thames Valley Post-Glacial deposits will be found summed up in the table at the end. For purposes of comparison it has been thought advisable to give in the first column a complete list of the mollusca known in the British Isles (in this the names of the extinct forms have been inserted in their proper position in ordinary type), then in the second column those are indicated which are living at the present day in the area drained by the Thames and its tributaries, and might therefore be expected to be found in the deposits under consideration; whilst the forms which actually do so occur in beds even the most recent are marked in the subsequent columns under the names of the several localities. These are arranged to a certain extent in

what appears to be chronological order, that is to say—Recent, Alluvial (Neolithic), between the several localities for which no difference in age is distinguishable, and River Drift (Palæolithic), in which it is thought some slight difference in age is perceptible.*

BIBLIOGRAPHY.

The bibliography of the subject is not extensive, as the subjoined list (v. pp. 386-7) shows; for it was not until 1813 that such trivial and unimportant things as shells occurring in the brick-earths of the Thames Valley were noted, and then the sole allusion to them that Mr. Trimmer makes is confined to the observation that "snail-shells and the shells of river-fish" were found in company with various bones of Mammals at Brentford. Nor is there more than a mention of the occurrence of shells in the succeeding paper by Professor Morris in 1836, and it was not till 1838 that lists of the species from the various localities then known were published in tabular form by the latter geologist.

For clearness sake, the full titles and references to the several papers are given in the list, and no author having, fortunately, written twice in the same year, subsequent references to these papers will be, for brevity's sake, made by date only, placed after the authors' names.

NOTES ON THE LOCALITIES.

RECENT AND ALLUVIAL (NEOLITHIC).

Erith Marshes.—These specimens were obtained by Mr. F. C. J. Spurrell from the ditches close down by the river. Two species amongst them in the list are found in no older soil—*Helix cantiana* and *Sphærium lacustre*.

Thames Mud, Westminster.—The specimens here recorded were obtained from the section† exposed in 1876, when the foundations of what was to have been the great English Opera House, but is now the new Scotland Yard, were being laid.

* The terms "Alluvial" and "River Drift" adopted by Mr. Whitaker are here followed, though "Neolithic" and "Palæolithic" might possibly have been better, seeing that Alluvial is river drift and River Drift is alluvial. The decision of the Geological Congress Commissioners to adopt "Recent" and "Pleistocene" for these two is still less happy as regards the former, since we do not live in neolithic times, and "recent" has too long been in use to express living as opposed to "fossil" for palæontologists to readily speak of "Recent" fossils.

† 'Proc. West London Scient. Assoc.,' Vol. i, p. 78.

One species, *Planorbis carinatus*, from this deposit is worthy of note, inasmuch as many of the specimens, and they are abundant, were devoid of the prominent keel which is so striking a feature in this species. Its absence gives so peculiar a look to the gathering as at first sight to suggest a new species.

Moorfields.—Some years ago Mr. T. Warburton obtained from an excavation made for building purposes, alongside St. Mary's R.C. Chapel, Moorfields, at a depth of 20ft., a series of shells, which he now kindly allows to be recorded.

Excluding such accidental occurrences as *Mytilus edulis*, *Cardium edule*, and *Helix aspersa*, with the periostracum still adhering, that must manifestly belong to the London kitchen-midden or dust-bin period, the shells are all of fresh-water species.

The excavation would seem to have been made in a portion of the bed of the old Wall Brook, whose name still survives in that of a street within the City precincts. It may even have touched on the deposits of the old marsh that once existed close to the spot.* Judging from the size to which many of the examples attain, the living must have been a fat one indeed. One specimen of *Limnæa stagnalis* attains an altitude of 47 mm., with max. and min. diam. of 28 and 20 mm.

Candona candida has been determined by Professor T. Rupert Jones from this spot.

Staines.—From Mr. J. Allen Brown comes the record of a deposit rich in molluscan remains, which is higher up the river valley than any of those here to be treated of. He writes of it as follows :—

“The section at Staines, where the deposit occurs in which I found the mollusca, is on the left bank of the Thames, fully a mile west of Staines, on the tow-path towards Old Windsor. The present channel of the river has been eroded in its old bed, which was then at a higher level than the present stream. The lower part of the bank is there a mass of shells, intermixed with small fragments of carbonized wood and small nodules of race. The bed is surmounted by brick-earth, three or four feet in thickness. The deposit is so thick in organic remains that I intend at the earliest opportunity to again investigate it, and at a future time to lay a fuller account of it before the Geologists' Association.”

Some of the *Pisidia* have their valves still united. The most

* See Loftie's 'London,' Vol. i, opening chapters.

noteworthy shell is an extremely fine specimen of *Succinea elegans*, which, although wanting the top of the spire, measures 24 mm. in height, and when perfect must have been as much as 26 mm., or just over 1 in. in height, whereas 15 mm. is the average size of recent specimens.

Thames Ditton.—A section here in 1867 (Fig. 1) laid bare an alluvial bed with shells (Whitaker, 1889, p. 425), but no record appears to have been kept of them.

FIG. 1.—SECTION AT PART OF THE FILTER-BEDS OF THE LAMBETH WATERWORKS, THAMES DITTON, 1867.

[Reprinted from 'Geol. Surv. Mem.' London, Vol. i, by kind permission of the Controller of Her Majesty's Stationery Office.]

- a* Made ground.
- b* Alluvial clay and sand, with shells.
- c* Gravel at two levels.
- d* Grey London Clay.

Kew.—The late Mr. T. Belt, so widely known as the author of 'The Naturalist in Nicaragua,' paid very considerable attention to the geology of his own neighbourhood. In addition to his published writings on this subject, he left behind him many unpublished notes, and through the kindness of his son, Mr. A. Belt, the following observation is extracted from his MSS. :—

"January 18th, 1877.—At Kew, by the river-side, in digging for foundation of large boat-house, they have sunk through about 6ft. feet of alluvium, consisting of a loamy clay, with many shells of *Helix*, *Zua*, and *Limnæa*. In the same place saw gravel taken out of the river, in which were many shells of *Unio*. The first-mentioned appears to be what forms in the marshes bordering the river, and only occasionally over-flowed by it, and in both we see that shells are plentiful."

The shells, which are still preserved, are recorded in the table, and include a keel-less example of *Planorbis carinatus*, similar to those mentioned from the Thames mud at Westminster.

Brantford.—Mr. T. Belt has also recorded (1878, p. 335) the

occurrence of the following shells in "laminated sandy clay or silt" near Brentford (Fig. 2):—*Helix pulchella*, *H. caperata*, and *Cochlicopa (Zua) lubrica*.

FIG. 2.—SECTION 30 YARDS SOUTH OF FLORA VILLAS.

[Near Avenue Road, Windmill Lane—After T. Belt, 'Quart. Journ. Sci.,' xv.]

Fulham.—At the eastern end of Bettridge Road, Fulham, a small pocket of loamy silt full of shells was found. From specimens kindly forwarded by Mr. F. Chapman the following species were obtained* :—

<i>Limnæa peregra.</i>	<i>Valvata piscinalis.</i>
<i>Planorbis albus.</i>	<i>Neritina fluviatilis.</i>
— <i>nautilus.</i>	<i>Sphærium corneum.</i>
— <i>carinatus.</i>	<i>Pisidium amnicum.</i>
<i>Bythinia tentaculata.</i>	— <i>fontinale.</i>
— <i>leachii.</i>	

The number being so small, and all the names occurring in the Westminster list, no note is taken of them in the table. Amongst them there is a remarkable example of *Valvata piscinalis*, extremely turreted and having five full whorls, or at least half a whorl more than is usual, even in fine examples.

Westminster.—Below the Thames mud in the section already mentioned, and separated from it by a layer of peat, was some fifteen feet of sand full of shells.†

With these may be taken a quantity of shells, presented to the British Museum by Mr. W. Davies, the label with which reads :—

"Associated with vertebrata in river gravel below level of low-water mark in digging foundation of the river wall at the south-west end of the terrace of the Houses of Parliament. July, 1875."

Both in position and in the nature and state of preservation the shells from these two localities so closely agree that there can be no doubt as to the propriety of thus putting them together.

* Some examples are now in the Natural History Museum.

† Between this last and the London Clay a bed of coarse gravel intervened, probably belonging to the River Drift.

Whitefriars.—In John Carpenter Street, near the Guild Hall School of Music, Mr. W. J. Lewis Abbott has recently observed in a series of sections made in connection with sewage works, and at a depth of from ten to fifteen feet from the present surface, a sandy layer containing shells. This rested on peat, which again overlay the river drift with palæolithic implements. All these shells are fresh-water forms, and the deposit most probably accumulated at the mouth of the old Fleet Ditch in the early days of the city's existence.

That a valve of *Dreissensia polymorpha* should be amongst those found is certainly remarkable, since its occurrence was not noted in this country till about 1824.

Blackfriars.—On the opposite side of the river, at the time of the construction of the Charing Cross railway, a series of excavations were made in Blackfriars revealing a fresh-water deposit containing shells, etc. This was described by the late Mr. C. Evans in the 'Proceedings,' and a list of the shells, as determined by Mr. C. J. A. Meÿer, given (1863, p. 266). Mr. Evans' specimens are now in the writer's possession, whilst Mr. Meÿer most obligingly forwarded his for inspection, thus enabling a complete investigation to be made.*

The following changes have had to be made in the published list :

<i>Helix hispida?</i>	is now	<i>H. concinna</i> .
<i>Succinea pfeifferi</i>	„ „	<i>S. elegans</i> .
<i>Planorbis carinatus</i>	„ „	<i>P. marginatus</i> .
„ <i>lacustris</i>	„ „	<i>P. lineatus</i> .
<i>Pupa</i> [sp.]	„ „	<i>Vertigo antivertigo</i> .

Clausilia was given without specific determination, but an apical fragment was found which cannot be distinguished from the similar portion of *C. biplicata*.

The following are added to the list from Mr. Meÿer's collection :

<i>Hyalinia nitidula</i> .	<i>Pisidium pusillum</i> .
„ <i>nitida</i>	„ <i>fontinale</i> .
<i>Helix arbustorum</i> .	

Professor Rupert Jones has identified *Candonia* (*Herpetocypris*) *reptans* from this deposit, whilst the wing cases of beetles have been referred by Mr. Waterhouse to *Pterostichus vulgaris*, *P. lepidus* (?), and *Donacia lemnæ*.

* A series of these shells is now in the Natural History Museum.

Greyfriars.—In the collection of Mr. J. Allen Brown there is a right valve of *Unio tumidus*, marked as having been “found in Little Britain, full 20ft. below the surface.” Beyond the loss of the periostracum the shell is hardly altered at all.

The Docks.—Mr. W. T. Blanford described, in 1854, a section (Fig. 3) in the West India Docks, and, in a note, alluded also to

FIG. 3.—SECTION EXHIBITED BY EXCAVATIONS IN THE WEST INDIA DOCKS.

[Reprinted by kind permission of the author, and of the Council of the Geol. Soc. from their ‘Quart. Journ.,’ Vol. x.]

another section in the Victoria Docks. From both places he obtained shells which are still preserved in the Geological Society’s Museum. Ten species, besides a fragment of *Unio* (probably *U.*

tumidus), are cited by him from the former locality. Three of these are missing—*Succinea putris*, *Ancylus fluviatilis*, and *Limnæa peregra*. *Sphærium corneum*, which had been overlooked, can now be added. Broken specimens of *Cyrenæ*, that had, of course, been derived from the lower Tertiaries, were also found.

From the Victoria Docks Mr. Blanford cited (p. 435) four species which he had not noticed at Tilbury. An examination of the specimens, still in their original boxes, showed that with *Helix rufescens* were also *H. rotundata*, *H. concinna*, and *Hyalinia nitida*. The specimens marked "*Limnæus auricularis*" were inflated varieties of *Limnæa peregra*; and the "*Planorbis nitidus*" was *P. marginatus*.

In addition to *Neritina fluviatilis*, the following (which were not specially noted by Mr. Blanford, since they also were in his West India Dock section) were present from that locality:—

<i>Helix nemoralis</i> .	<i>Bythinia tentaculata</i> .
<i>Succinea elegans</i> .	<i>Valvata piscinalis</i> .
<i>Ancylus fluviatilis</i> .	<i>Pisidium amnicum</i> .
<i>Limnæa palustris</i> .	„ <i>fontinale</i> .

With these the shells obtained by Mr. F. C. J. Spurrell (1889), from the Albert Dock (Fig. 4), are united in the table. Since his list was published *Limnæa palustris* has been found amongst the material, and added to the record.

FIG. 4.—SECTION IN THE MIDDLE OF THE ROYAL ALBERT DOCK, A LITTLE WEST OF HAM MANOR WAY.

[Reprinted from 'Geol. Surv. Mem.,' London, Vol. i, by kind permission of the Controller of Her Majesty's Stationery Office.]

About 60 yards long and about 15 feet high.

1 Clay	} Alluvium.
2 Peat	
3 Sand, 7 feet	} River Drift.
4 Gravel, 3 feet shown	

Crossness and Tilbury (Sections, Figs. 6, 7, 8), recently described in these 'Proceedings' by Mr. Spurrell (1889), call for no further remark beyond recording the few changes which a further inspection of the material has rendered necessary.*

* A series of the specimens has now been placed in the Natural History Museum.

FIG. 5.—SECTION NEARLY ALONG THE WESTERN SIDE OF THE RESERVOIR, SOUTHERN OUTFALL SEWER, CROSSNESS.

[Reprinted from 'Geol. Surv. Mem.,' London, Vol. i, by kind permission of the Controller of Her Majesty's Stationery Office.]

Scale (vertical and horizontal) 88 ft. = 1 in.

<i>a</i> Soil	}	Alluvium.
<i>b</i> Brown silty clay		
<i>c</i> Peat		
<i>d</i> Blue clay		
<i>e</i> Peat		
<i>f</i> Blue clay		
<i>g</i> Soft sand and clay		
<i>h</i> Soft peat and clay		

<i>i</i> Fine sandy gravel	}	River Drift.
<i>j</i> Grey subangular flint-gravel		

FIG. 6.—SECTION AT CROSSNESS.

[Proc. Geol. Assoc., xi, 217.]

a Gravel	} River drift.
b Sand	
c Sandy clay full of freshwater shells	} Alluvium.
d Peat, lower	
e Tidal blue clay	
f Beds of sand and shells as above	
g Peat, upper	
h Tidal clay	
k Arable soil	
o Boring to the west, showing the same beds.	
- The black marks represent drift wood.

FIG. 7.—SECTION IN TILBURY DOCK.

['Proc. Geol. Assoc.,' xi, 215.]

a Chalk.
b Gravel } River Drift.
c Sand }

d f h l Tidal clay
e g k Peat (with mud and sand containing } Alluvial.
 freshwater and land shells }

FIG. 8.—DIAGRAM-SECTION ALONG THE COURSE OF THE THAMES.

[*Proc. Geol. Assoc.*, xi, 211.]

- a* Layer of old river sands and gravels [River Drift.]
- b* Tidal clay with sand.
- c* Peat.
- d* Tidal clay.
- e* Peat.

- f* Tidal clay.
- g* Peat on which Roman remains lie.
- h* Surface clay.
- k* Clay now accumulating to form saltings.

To the Crossness list are now added *Anodonta cygnæa* and *Helix pygmæa*. *Pupa umbilicata* should have been *P. muscorum*, and *H. concinna* is removed, the specimen seeming on a closer inspection to be rather *H. rufescens*. Professor T. Rupert Jones has recognized *Cytheridea torosa* var. *teres* from this locality, and *Candona candida* from Tilbury.

The only alteration in the Tilbury mollusca is the removal of *Planorbis marginatus* from the list, into which it crept by accident.

Lea Valley — On either side of the Lea, between Walthamstow and Clapton, and close down to the stream, there is a series of peaty and marly alluvial deposits, full of molluscan and vertebrate remains.

A list of the shells from the former locality was given by Dr. Woodward (1869, p. 387), who described the sections (Figs. 9, 10, 11) seen there.

FIGS. 9-11.—SECTIONS EXPOSED DURING THE CONSTRUCTION OF THE RESERVOIRS OF THE EAST LONDON WATERWORKS COMPANY, AT WALTHAMSTOW.

[Reprinted by kind permission from 'Trans. Essex Field Club,' Vol. iii].

Bed No. 1. Surface soil, 12 inches

„ „ 2. Clayey loam, 18 inches

„ „ 3. White shell-marl, 10 inches.

„ „ 4. White-coated subangular gravel encrusted with lime from super-imposed shell-marl, 18 inches.

„ „ 5. Rounded and subangular gravel* stained with oxide of iron (actual depth not ascertained.)

FIG. 9.—Section at the south-east corner of the Eastern Reservoir.

* This gravel (No. 5), which forms the floor of the reservoir, is of very considerable thickness. At one spot, where pumping for "puddling" had been going on, a hole more than ten feet in depth from the surface of the gravel bed still showed the same gravel, with abundance of water.

Bed No. 1. Vegetable mould, 12 inches.

„ „ 2. Stiff brown clay, 24 inches.

„ „ 3. Shell-marl and marly clay, 12 to 36 inches.

„ „ 4. Stiff dark clay, with wood, 18 inches.

„ „ 5. Peat, 24 inches, lying on.

„ „ 6. Thin band of black gravel, stained by over-lying peat, 3 inches.

„ „ 7. Clean red gravel, corresponding with Bed No. 5 in Fig. 1, forming floor of reservoir.

FIG. 10.—Section at south-west corner of Reservoir.

Bed No. 1. Surface soil, 18 inches.

„ „ 2. Stiff clayey loam, 18 inches.

„ „ 3. Very compact black peat, 3 feet.

„ „ 4. Shell-marl, 12 inches.

„ „ 5. White-coated subangular gravel, 12 inches.

„ „ 6. Clean red gravel, forming floor of reservoir, and equivalent to Bed No. 5 in Fig. 1, and to Bed No. 7 in Fig. 2.

FIG. 11.—Section in the Eastern Reservoir, and near the Embankment between the Eastern and Western Reservoirs.

The material is at the Natural History Museum, and having been carefully gone over the following changes are made :—*Helix hortensis*, *H. ericetorum* and *H. caperata* are removed from the list, not having been found; *Clausilia bidens* has been altered to *C. laminata*, *Planorbis carinatus* to *P. marginatus*, and *Bythinia ventricosa* to *B. leachii*. Seventeen new names have been added :—

<i>Hyalinia radiatula</i> .	<i>Vertigo antivertigo</i> .
„ <i>crystallina</i> .	„ <i>pygmæa</i> .
„ <i>nitida</i> .	<i>Planorbis albus</i> .
<i>Helix rotundata</i> .	„ <i>nautilus</i> .
„ <i>lamellata</i> .	„ <i>spirorbis</i> .
„ <i>pulchella</i> .	„ <i>contortus</i> .
„ <i>concinna</i> .	<i>Physa fontinalis</i> .
<i>Pupa muscorum</i> .	<i>Valvata cristata</i> .
	<i>Pisidium fontinale</i> .

Of these *Helix lamellata* is the most noteworthy, the species not having previously been recorded from any Pleistocene deposit so far south. It occurs at Copford and near Chelmsford, in beds of about the same age, and at Barnwell in the older River Drift deposits; but at the present day its southern limit is Yorkshire.*

The beds on the other, or Clapton, side of the stream have been worked out and described by Mr. J. E. Greenhill, whose specimens† have by his kindness been gone over, with the result that his published list (1883, pp. 23 and 24—sep. paper, pp. 3-4) has to be corrected in the following particulars :—

Helix aculeata, *H. hortensis*, and *H. ericetorum*, *Limnæa glabra*, *Pupa umbilicata*, and *Zonites radiatula* are removed from the list, the specimens being non-existent, whilst the names, mostly introduced from older lists relating to the River Drift beds, have been decorated by the printer with the star in the wrong column. One species is retained on the authority of Mr. Greenhill, and so marked in the table.

Clausilia biplicata has been altered to *C. laminata*, and *Succinea gracilis* to its synonym *S. elegans*. Thirteen species are added to the record :—

* It has just been re-discovered in Staffordshire, 'Journ. Conch. Soc.,' vi. (1890), p. 254.

† Some are now in the Natural History Museum.

<i>Hyalinia nitidula.</i>	<i>Ancylus lacustris.</i>
„ <i>fulva.</i>	<i>Planorbis albus.</i>
<i>Helix rotundata.</i>	„ <i>contortus.</i>
„ <i>concinna.</i>	<i>Valvata cristata.</i>
„ <i>rufescens.</i>	<i>Pisidium pusillum.</i>
„ <i>lenticula.</i>	„ <i>fontinale.</i>
<i>Vertigo pygmæa.</i>	

Two examples of *Valvata piscinalis* were very fine, measuring 7 mm. in height by the same in max. diam.

The state of preservation of the shells in the Alluvial beds is pretty much the same in most instances. The periostracum is frequently still preserved, especially in the bivalves, but as a rule all animal matter has been removed, and the shells are not uncommonly stained a bluish black, especially where peaty matter is present. Occasionally, as at Westminster, some are encrusted with tufa, which seems especially to affect *Limnæa peregra*, *Unio tumidus*, and *Neritina*. This last always retains its coloration.

The specimens from Staines, Brentford, and Kew are by exception remarkably white, and free from staining of all sort.

RIVER DRIFT (PALÆOLITHIC).

Brentford.—This, as already mentioned, is the locality where shells are first named as occurring in the London Pleistocenes (Trimmer, 1813—See Belts' sections, figs. 12, 13), but the first list of those found was not published till 1850 by Professor Morris, who remarks (1850, p. 203, section fig. 14):—"The

FIG. 12.—SECTION N.W. CORNER OF MR. TRIMMER'S OLD BRICKFIELD.

[After T. Belt, 'Quart. Journ. Sci.,' xv.]

shells were but few in number in this locality, as compared with the more eastward deposits in the Thames Valley [*i.e.*, *Grays*,

FIG. 13.—SECTION EAST END OF MR. TRIMMER'S OLD BRICKFIELD.

[After T. Belt, 'Quart. Journ. Sci.,' xv.]

FIG. 14.—SECTION OF RAILWAY-CUTTING AT BRENTFORD.

[Reprinted by kind permission of the Council from 'Quart. Journ. Geol. Soc.,' Vol. vi.]

1. Vegetable mould ; 1 foot.
2. Brickearth, a fine brownish loam ; 4 feet.
3. Fine sand, mostly stratified and obliquely laminated, with occasional wavy and irregular veins of small gravel ; 6 feet.
4. Sand, with light-coloured clay and irregular gravel, containing bones ; 6 to 8 inches.
5. Ferruginous gravel and sand, with patches of clay ; 1 foot.
6. Clayey sand and sandy gravel, with occasional large flintstones, partly ferruginous at the upper part, containing bones and shells ; 1 to 2 feet.
7. Ferruginous sand and gravel ; about 6 inches.
8. Light clayey sand and ferruginous gravel, with boulders of quartz, granite, rock with ammonites, etc., also bones, etc., of ox, deer, etc. ; 6 to 7 feet.
9. London Clay.

etc.]. . . . Not even fragments of *Cyrena trigonula* [= *Corbicula fluminalis*] and *Unio littoralis* were observed."

The next and fuller list was that issued by Mr. T. Belt (1878, p. 335) on the determination of Dr. J. Gwyn Jeffreys. His specimens were obtained at a spot, close to the former site, "opposite Flora Villas" (Fig. 15), which seem to be near to Avenue Road, Windmill Lane. By digging down another eighteen inches in the floor of the

FIG. 15.—SECTION OPPOSITE FLORA VILLAS.

[After T. Belt, 'Quart. Journ. Sci.,' xv.]

pit, and thus reaching a lower stratum than had been investigated before, Mr. Belt succeeded in procuring "a great number of shells, amongst which were specimens of *Unio littoralis* and *U. pictorum* [or, rather, *U. tumidus*], with the two valves united. Many of the small Cyclades also were perfect. . . . This sand is full of shells, amongst which the little *Hydrobia marginata* [Fig. 37, No. 8] is abundant." He further remarks that "the shells . . . were soft, and those of the Unios split up as they dried. . . . *Hydrobia marginata* was the most abundant." Through the kindness of Mr. A. Belt, in whose possession they are,* these shells have been examined, with the result that it was shown necessary to remove *Unio pictorum* from the list, substituting in its place *U. tumidus*, and to add *Helix concinna*, *H. hispida*, *H. caperata*, and *Sphærium rivicola*.

Certain other species are included in the table from Professor Morris and Dr. Jeffreys' lists, since though not found in the series examined there is nothing improbable in their occurrence. *Limnæa auricularia* and *L. stagnalis*, however, though cited by Morris, are left out, since, judging from other instances, these were probably errors for *L. peregra* and *L. palustris*.

Mr. J. Allen Brown has obtained specimens from almost pre-

* A set is now in the Natural History Museum.

cisely the same spot as Mr. Belt, and these were most kindly submitted for inspection. They confirmed the determinations, while adding nothing new, for the two additional names (*Paludina*, sp., and *Helix rotundata*), cited in Mr. Brown's published list (1887, p. 113) were unrepresented in the collection, and have consequently been omitted.

The examples of *Pisidium amnicum* from this locality are very fine, and remarkable for being much more inflated at the umbones than is the typical form, whilst at the same time they appear heavier and more solid.

North-East London.—Of all the localities to be dealt with this district seems to have offered more difficulties in its solution than any other, owing to various causes that need not now be considered.

FIG. 16.—SECTION IN GRAVEL-PIT, SHACKLEWELL LANE, WEST HACKNEY.

[Reprinted by kind permission of the author and of the Council of the Geol. Soc. from the 'Quart. Journ.,' Vol. xi.]

- a* Brick-earth. 2 to 3 feet.
- b* Ochreous flint-gravel, with subordinate irregular layers of ochreous and yellow sand. 6 feet.
- c* Dark-grey sandy clay, full of vegetable matter, with some bones and numerous shells. 2½ feet.
- d* Light-yellow sands and ferruginous gravel. (Depth not proved.)

So far as the shells are concerned, its history commences with Mr. Prestwich's paper in 1855, when the first list was published, the species being determined by Mr. Pickering. The section described was in Hindle's gravel-pit, Shacklewell Lane (Fig. 16), and close to the course of the Hackney Brook. The shells occurred in a layer of sandy clay, below gravel and brick-earth, at a depth of from 8ft. to 10ft. from the surface.

Mr. Pickering's list cites 23 species, amongst which *Corbicula fluminalis* is not to be found; but eight valves were presented to this Association by him in December, 1860, which are labelled

‘*Cyrena consobrina*—West Hackney gravel pits. These shells are from a bed of sand and gravel below the beds described by Mr.

FIG. 17.—SECTION IN STOKE NEWINGTON PIT.

[Reprinted by kind permission of the Council from ‘Quart. Journ. Geol. Soc.,’ Vol. xxv.]

l [Surface soil.]

k Covering bed, large flints in stiff brown clay. [Trail?] 6 to 8 feet.

j Brickearth.

i-g, e-c Finely laminated loams and clays.

f Peaty black clay.

Beds *c-j* were 30 feet thick.

Prestwich. See ‘Quart. Journ. Geol. Soc.,’ Vol. ii. p. 107.” Sir C. Lyell (‘Antiq. Man.,’ 1863, p. 161) also records finding them himself at this spot.

In 1867 Mr. George J. Smith got out of the gravel brought up from a shaft sunk near the railway-cutting, then being made, and close to the Downs Road, a number of shells referred to fifteen species, including *Corbicula fluminalis* and *Hydrobia marginata*. Unfortunately the section itself was not seen, and it cannot now be established whether these came from one stratum or from two, as in the former instance.

FIG. 18.—SECTION ACROSS THE VALLEYS OF THE HACKNEY BROOK AND THE LEA.

[‘Proc. Geol. Assoc.,’ viii, 340.]

A Ayrson Street. B Stoke Newington Common. C Stamford Hill.
a Gravels. b London Clay.

Specimens from Mr. Caleb Evans’ collection, marked as obtained in Hackney and near Hackney Downs, present the peculiarity that many of the *Corbicula fluminalis*, and the *Pisidium asturtoides* found in association with it are blue-stained, as though they had

been in contact with peaty beds, the only instance of the sort the writer is acquainted with. Mr. Tylor (1868, p. 392) speaks of the Unios as occurring in a bed of purple clay, with sands above and below them. In the same letter (p. 391) he describes a section in Highbury New Park, near Stoke Newington (afterwards alluded to by him as the Stoke Newington Pit), and gives a list of the shells therefrom determined by Mr. R. Tate. A figure of the

FIG. 19.—VERTICAL SECTIONS OF THE GRAVELS OF HACKNEY.

[‘Proc. Geol. Assoc.,’ viii, 342.]

section (Fig. 17) appeared in his succeeding paper the following year (1869, p. 95), and the list of shells, with additional species

FIG. 20.—SECTION THROUGH THE VALLEY OF THE LEA, SHOWING THE POSITION AND ELEVATION OF THE PLEISTOCENE SHELL-BEARING DEPOSITS.

[Reprinted by kind permission of the Author, W. G. Smith, F.G.S., from 'Journ. Anthropol. Inst.,' xiii.]

Horizontal scale 2 in. = 1 mile. Vertical scale 1 in. = 100 ft.
 Unshaded portions = Alluvial.
 Vertical shading = River Drift.
 Diagonal shading = London Clay.
 The thick black line indicates the "Palæolithic Floor."

determined by Mr. J. Wood-Mason, was given in the table (*lb.*, pp. 99-100). From this again *Corbicula* was absent.

FIG. 21.—SECTION BETWEEN ALKHAM ROAD AND KYVERDALE ROAD, STOKE NEWINGTON.

[Reprinted by kind permission of the Author, W. G. Smith, F.G.S., from 'Journ. Anthrop. Inst.,' xiii. See also 'Proc. Geol. Assoc.,' viii, 127.]

The lower figure is an enlargement of the portion included between dotted lines in the upper one.

- A A A } Palæolithic Floors above which is sandy loam—"Warp and trail."
- D D D }
- C Fine buff-coloured sand, often full of land and freshwater shells.
- B The 12ft. gravel with rolled bones and Palæolithic implements.

There the matter rested till Mr. Worthington G. Smith, to whom we are indebted for the elucidation of the superficial geology

of this district, followed by Mr. J. E. Greenhill, took the matter up, and extended the observations from the Hackney Brook neigh-

FIG. 22.—SECTION IN SAND-PIT EAST OF STOKE NEWINGTON COMMON.

[Reprinted by kind permission of the Author, W. G. Smith, F.G.S., from 'Journ. Anthrop. Inst.,' xiii. See also 'Proc. Geol. Assoc.,' viii, 128.]

R Humus. Q Mud of the "Trail." P Pocket of London Clay. O "Trail." C to M Sands and clays of different colours. B Buff sand, sometimes full of shells of land and freshwater mollusca. A The 12ft. gravel.

bourhood, where the sites first-named lay, to the Clapton area (Figs. 18 to 22), and though their main object was the pursuit of flint-

implements, the shells were not neglected, and three lists were published.

Of these the first was that by Mr. Smith (1882, p. 581, and 1883, p. 119), containing sixteen species only; the next of 33 species by Mr. Greenhill (1883, pp. 23-4), in which names from other lists had been incorporated; finally Mr. Smith (1884, pp. 368-70) issued a list of 45 species, which he described as "compiled from my own series, and from those published by Professor Prestwich and Dr. J. Evans." Dr. Evans, however, only cited the genera which had been quoted by Tate and Tylor in their lists.

Mr. Smith's specimens in the British Museum (some with Mr. Franks and the rest at Cromwell Road) have been gone over as well as Mr. Greenhill's own collection, and those from that of Mr. Caleb Evans already named. Mr. G. J. Smith's specimens, with Mr. Tylor's and Professor Prestwich's, are not to be traced.

The following species, the identification of which is open to doubt, are now struck out:—*Helix hispida*, *Limnæa glabra*, and *L. stagnalis*, all being given doubtfully by Mr. Pickering in Professor Prestwich's list. *Pisidium pulchellum* gives way to its synonym *P. fontinale*, and *P. obtusale* to *P. pusillum*, *Unio pictorum* being an error, undoubtedly, for *U. tumidus*, and *Planorbis carinatus* for *P. marginatus*. *Clausilia biplicata*, although it rests on Tate's determination, is far too uncertain to be included.

H. rufescens, given by Tylor on Professor Morris's authority, is doubtless an error for *H. concinna*. *Planorbis nitidus*, Müll., comprised two distinct species, and it cannot now be said which was present, though *P. lineatus*, Walker, is the commoner form. *Pupa umbilicata* is, in all probability, a slip for *P. muscorum*; whilst, as regards the *Achatina* (or, as it is now called, *Cæciliannela*) *acicula*, quoted by Mr. W. G. Smith, the only examples in his collection at the Museum are from near Brentford.

Eight species are retained on the authority of the first recorder, since there is no inherent improbability in their occurrence.

The following seven are added for the first time from the specimens in Mr. Greenhill's possession:—*Helix rotundata*, *Clausilia rolphii* (a single specimen), *Succinea elegans* (some of the specimens seeming nearer to this species than to *S. putris*), *Planorbis vortex* (from the clay beds), *Pisidium astartoides*, *Sphærium rivicola* (one fine valve—there is also a specimen marked *S. corneum* in the British Museum (Brit. Antiq. Dept.), which may prove to be a young example), and *Anodonta cygnea* (from the clay beds).

FIG. 23.—SECTION AT MR. PEARSON'S PIT, GRAYS THURROCK.

[Reprinted, by kind permission of the Author and of the Council of the Geological Society, from the 'Quart. Journ.,' Vol. xxiii.]

FIG. 24.—SECTION AT GRAYS, ESSEX.

[Reprinted, by kind permission of the Council, from 'Quart. Journ. Geol. Soc.,' Vol. xxv.]

Grays.—Although the Grays deposit was described by Professor Morris in 1836, the occurrence of shells was only briefly alluded to at the time, and the first list was published by him two years later (1838, p. 544). The next record is that given by S. V. Wood in his *Monograph on the Crag Mollusca* (1856, pp. 98-110 and 306-8). Another list was given by Professor Boyd Dawkins (1867, p. 100. Section see fig. 23), and in 1869 a revised version of Pickering's list (in Wood's *Monograph*) was issued by Mr. Tylor (1869, p. 99-100. Section see fig. 24).

Specimens from this classical locality have been examined in the British Museum, the Museum of Practical Geology, and the Geological Society's Museum; whilst Mr. Spurrell's collection, that of the late Caleb Evans, and those in Mr. W. J. L. Abbott's and in the writer's possession have helped to swell the list of authenticated specimens.

So full are the original lists, however, that only one or two species are added, and of these *Pisidium astartoides*, Sandb., was noted by S. V. Wood as the variety of *P. amnicum*, to which it had been proposed to give the name of *P. sulcatum*.

It has been considered desirable to eliminate several species from the table, viz.:—*Planorbis carinatus*, an error for *P. marginatus*; *Unio pictorum* and *Helix hortensis*, every specimen attributed to the former proving to be *U. tumidus*, and to the latter *H. nemoralis*; *Helix ruderata*, which can only have been an error of observation for *H. rotundata*; *Limax sowerbyi* [= *Amalia marginata*], since specimens under this name in the collection of the Geologists' Association are undoubtedly *L. agrestis*. *Clausilia biplicata* is far too doubtful to be admitted; whilst *Paludina vivipara*, given in one table, is probably a printer's error. *Achatina* [= *Cæcilianella*] *acicula* is given doubtfully in Tylor's list, and specimens are preserved in the Geological Society's collection; but they look so fresh that, seeing that the mollusc is a burrowing species which finds its way down to considerable depths (sometimes as much as 8ft.) from the surface, it is more likely than not to be an intruder, and therefore it is thought safer to leave it out.

Limnæa stagnalis, resting on the determination of that careful observer, Mr. Pickering, is given on his authority, as also *Hyalinia fulva*. *Planorbis nitidus*, as used by Wood, is a synonym for *P. lineatus*, and as such admitted; whilst *Vertigo substriata*, admitted on Tylor's authority, may possibly owe its appearance in his list to

the fact that *Pupa sexdentata*, quoted by Wood, is given by Forbes and Hanley as a synonym for that species as well as for *V. anti-vertigo*.

Unio littoralis is apparently very scarce at Grays, though a fine pair of united valves and two odd ones are in the British Museum (Natural History), and a few fragments in Mr. Spurrell's collection.

In addition to *Hydrobia marginata*, there are, in the British Museum series, a number of specimens ("G. 108") that must be considered a variety of *H. ventrosa*, including two extreme forms that resemble varieties of *H. ulvæ*. To the same species probably belongs the fragment of a fine example in the Museum of Practical Geology, marked "Rissoa?"

From this locality were first obtained those high-spired forms of *Vulvata piscinalis*, to which, before their identity was established, the name of *V. antiqua* was given (Morris, 1838, p. 544 and 547). According to Dollfus (1884, p. 33 note), an almost identical variety is now living in the canals of northern France.

West Thurrock.—Here, in the pit belonging to the Tunnel Cement Works Company, Mr. W. J. Lewis Abbott found some shells in loamy clay, with sandy patches, that rested on a series of sands and gravels overlying the Chalk and abutting against an escarpment of the latter.

The list is not large, and the specimens are in a very fragmentary condition, with the exception of an abnormal example of *Helix ericetorum*. This specimen* was picked off the stuff that had been thrown down from the section, and must have come from one of the sandy patches mentioned. On first inspection it appeared to belong to some other species of the *Xerophila* group, and very close to *Helix instabilis*, Ziegl.; but after a prolonged examination and guided by the presence of a colour-band, there can be little doubt as to its identity. The other shells are:—

Pupa muscorum.

Limnæa peregra.

Planorbis corneus (?).

Planorbis spirorbis.

— *marginatus*.

Bythinia tentaculata.

These are included with the Grays specimens in the table, since they come from the same series of beds.

Ilford. (Sections figs. 25 to 30.)—The Ilford deposits are

* Now in the Natural History Museum.

FIG. 25.—SECTION FROM CRAYFORD TO HANGMAN'S WOOD. Length: Nine miles along an irregular line. Prepared by Mr. S. V. Wood, F.G.S.

KEY TO GEOLOGICAL MAP OF ILFORD.

(See opposite page.)

	Alluvium.
	Brick-earth.
	Gravel.
	London Clay.
	Woolwich and Thanet Beds.
	Chalk.
	Roads.
	Railways.

[Reproduced, by kind permission of the Editor, from 'Geol. Mag.,' 1874, p. 396.]

1. The Chalk.
2. The Thanet Sand.
- a. Thames Gravel of the Highest Elevation, which covers Dartford Heath.
- b. *Corbicula* Brick-earth.
- c. Gravel (with some Brick-earth).
- Recent Alluvium.

N.B.—The *Corbicula* Brick-earth at both Grays and Crayford is partially underlain by Gravel.

FIG. 26.—GEOLOGICAL MAP OF THE DISTRICT AROUND ILFORD.
 [Reproduced, by kind permission of the Editor, from 'Geol. Mag.,' 1874, p. 397.]
 Vol. XI., No. 8.

Fig. 27.—Section (after S. V. Wood) to show the position of the Thames Valley Beds relatively to the Glacial Beds of the Middlesex and Essex Heights.

[Reprinted, by kind permission of the Editor, from 'Geol. Mag.,' 1874, p. 394.]

1. Chalk.	6. Great Chalky Clay (Glacial).
2. Thanet Sand.	x3. Gravel of the Roding Valley.
3. Woolwich Beds.	x4. " " Leas and Thame's Valleys.
4. London Clay.	x5. Alluvium.
5. Lower Bagshot.	

Fig. 28.—Section in the Uphall Brick-field, Ilford.

[Reprinted, by kind permission of the Editor, from 'Geol. Mag.,' 1874, p. 394.]

a.	Clayey brick-earth, with <i>Corbicula fluminalis</i> and other molluscan shells.
b.	Bright yellow sand, with <i>Corbicula</i> .
c.	Newer gravel.
d.	Humus, &c.

celebrated for having yielded, under the patient supervision of Sir Antonio Brady, the wonderful collection of mammalian remains that now repose in the Natural History Museum. The shell beds have unfortunately been worked out.

FIG. 29.—SECTION AT UPHALL PIT, ILFORD, SOUTH SIDE.

[Reprinted, by kind permission of the Author and of the Council of the Geol. Soc., from 'Quart. Journ.,' Vol. xxiii.]

FIG. 30.—SECTION IN THE BRICKYARD ON THE SOUTHERN SIDE OF THE HIGH ROAD, ILFORD, 1888. (J. G. GOODCHILD.)

[Reprinted from 'Geol. Surv. Mem.,' London, Vol. i., by kind permission of the Controller of H.M.'s Stationery Office.]

- a. Soil, etc.
- b. Contorted seam of coarse brown sand, with more or less loam.
- c. d. Brick-earth with *Corbicula fluminalis*, etc. Bedding obliterated above, clear and undisturbed below.

The first list of the shells was that given by Morris (1838, p. 544), when ten species were recorded. Just double that number of names were cited by Professor Dawkins in 1867 (p. 100), whilst others appear in that given by Tylor (1869, pp. 99-100) on the authority of Mr. Alfred Bell.

Concerning their occurrence, Dr. Cotton remarked (1847, p. 165):—"The two genera of shells, of which hundreds may

often be obtained at one visit, are *Helix* and *Cyrena*, but *Unio* and *Planorbis* are not uncommon, and *Ancylus*, *Succinea*, *Valvata*, *Limnæus*, *Cyclas*, and *Paludina* have been discovered. They are chiefly seen in the layers of sand upon which the brick-earth reposes, and beneath the bones, but are sometimes intermixed with them, and have been found even within their cavities; they appear to be partial in their distribution, and are not met with in the former cutting" [*i.e.*, N. side of London Road—Curtis' brickfield].

Specimens are preserved in the Natural History Museum, and in the Museum of Practical Geology, and there were a few in the collection of Mr. C. Evans. These establish twenty species, including five that have not before been mentioned as occurring in these beds:—

Helix pulchella.

Planorbis albus.

—— *fruticum*.

—— *lineatus*.

Bythinia leachii.

On the other hand, sixteen species have to be accounted for.

Unio pictorum may be dismissed at once, the species being *U. tumidus*. In the same way *H. hortensis* gives way to *H. nemoralis*, and *Planorbis carinatus* to *P. marginatus*. *Limnæa stagnalis*, there is reason to think, should have been *L. palustris*, and such was the opinion of Mr. Bell. The *Paludina vivipara* is another case of probable error, the only known example of the genus in these old gravels being the *P. contecta*, from Crayford, and it is therefore omitted from the table. *Unio littoralis*, too, though it is marked in Professor Dawkins' list, cannot be traced in any collection, and it is only copied into Mr. Tylor's list with a query, so that it has seemed best to leave it out. The other names are given for what they may be worth, on the authority of those chronicling them.

Amongst the additions, that of *Helix fruticum* (see Fig. 34, No. 7) is the most remarkable, its occurrence in the Thames Valley having hitherto been unrecorded. A single specimen was found by Mr. S. V. Wood at Stutton (1856, pp. 308-9), and the species was fairly common at Barnwell, near Cambridge.*

When the streams on which these several localities occur are traced to their sources, it will be seen that the Roding, the Stour, and the Granta (which joins the Cam just above Cambridge) all rise within a short distance of each other in N.W. Essex, so it

* 'Proc. Geol. Assoc.' (1888), p. 355.

seems a not unnatural inference that this species may have formerly had its head-quarters there, in which case the Essex Naturalists should look for it in the deposits of the Chelmer and Blackwater, which likewise rise in that area.*

Mr. W. Davies has noted† the frequent occurrence of numbers of shells of *Helix nemoralis*, etc., within the brain cavity of the skulls of oxen from this locality, and suggested that they may have found it a convenient place in which to hibernate whilst the skull still lay on the dry land. To this it may be added that the animal matter would remain longer within than without the skull, and that snails by no means despise animal diet, the flavour of which hanging about may have served as bait to attract them into what ultimately proved both trap and tomb.

In the Museum of Practical Geology are two shells of exceptional size from Ilford—an example of *Limnæa palustris*, measuring 29 mm. alt., and one of *Bythinia tentaculata*, 15 mm. high.

Crayford, Erith, and Stoneham. (Sections figs. 31 to 36.)—The deposits at Crayford and at Erith present such identical features and are so clearly, as shown by Mr. F. C. J. Spurrell, one and the same thing that no distinction need any longer be made between them. With the shells from these places may also be included the few common species found by Mr. Penning in gravels of the same age at the point where the Lewisham and Dartford loop line joins the old North Kent Railway close to Stoneham (Whitaker, 1889, p. 440).

Prof. Morris (1838, p. 544) was again the first to publish a list of species derived from Erith, whilst in the appendix to his paper (*ib.*, p. 547) appears the first identification, with a figure by Mr. G. B. Sowerby, of *Unio littoralis* as a British fossil. Morris' list contained but thirteen names, whilst there are now forty-two species definitely established for these River Drifts, of which ten are new. Prof. Dawkins (1867, p. 100. Section fig. 36) first recorded the species from Crayford and Erith separately, but of the twenty down only one was not common to both. Mr. Tylor's lists (prepared by Mr. A. Bell) brought the number up to a total of thirty for the two, whilst the relative distribution between them was by no means so level. Thirty-nine species are given in the table to their paper by Messrs. Cheadle and Woodward (1876,

* Mr. W. H. Dalton, 'Essex Nat.', 1889, p. 10, mentions some *Helices* resembling this species being found at a point 7 m. N.W. of Colchester.

† 'Cat. Pleist. Verteb. Coll., Sir A. Brady,' 1874, p. 70.

pp. 97-8). A small list was also published of species procured at Erith by Mr. G. F. Dollfus (1884, p.39).

The present record is founded firstly and mainly on specimens

FIG. 31.—SECTION OF THE CORBICULAR PIT, ERITH.

[Reprinted, by kind permission of the Council, from 'Quart. Journ. Geol. Soc.,' Vol. xxv.]

A. Chalk.

b—e. Beds of River Drift approximately as in Fig. 24.

in the possession of Mr. F. C. J. Spurrell and the writer, supplemented by some from the collection of Mr. R. Nuttall, jun.;

The arrows show the amount of dip at the spots above them.

FIG. 32.—SECTION SHOWN BY THE SOUTHERN FACE OF THE GREAT PIT AT THE ERITH BRICKYARD, 1867.

[Reprinted from 'Geol. Surv. Mem.,' London, Vol. i., by kind permission of the Controller of Her Majesty's Stationery Office.]

1. Soil and wash, lessening westward.
2. Brown brick-earth, with race, about 15 feet. Contains pebbles, and pieces of shells from the Woolwich beds.
3. Darker Brown Clay, with a little race, about 5 feet, with a little grey Brick-earth (with shells) at the bottom, passing down into the bed below.
5. Sand with shells (*Corbicula fluminalis*, etc.) and pebbles, about 4 feet; loamy at top in parts and gravelly at bottom. Thins out as the ground rises westward.
9. Brick-earth with a little pebble-gravel.

The numbers correspond with those in Fig. 33.

FIG. 33.—SECTION SHOWN BY THE NORTHERN FACE OF THE GREAT PIT AT THE CRAYFORD BRICKYARD, 1867.

[Reprinted from 'Geol. Surv. Mem.,' London, Vol. i., by kind permission of the Controller of Her Majesty's Stationery Office.]

1. Loamy soil and wash.
2. Brick-earth, about 12 feet.
3. Brown clay with race, about 3 feet.
4. Brick-earth, clayey, about 7 feet.
5. False-bedded, light-coloured sand (the shell bed), about 5 feet. *Corbicula fluminalis* very abundant.
6. Pebbly gravels, about 1 foot.
7. Brown clay, wedging out against—
8. A long lenticular bed of stiff, grey clay with race, over 4 feet.
9. Brown brick-earth, with race, 15 to 20 feet.
10. Sand and gravel false-bedded, with blocks of concretionary sandstone at top, 4 feet shown.

The numbers of the beds are the same as those in Fig. 32.

besides which the few specimens in the British Museum (Natural History),* and those in the possession of private collectors, such as Mr. Warburton, Mr. Harris, Mr. Abbott, Mr. J. Allen Brown, and others, have been examined, so that in this case the materials on which to found a satisfactory census are fortunately present in abundance. Moreover, since Mr. Spurrell's specimens are the identical ones from which the original lists were compiled, the task of eliminating errors which have been passed on from one table to another is both simplified and rendered a more certain one; though Mr. Tylor's specimens cannot unfortunately be traced.

FIG. 34.—SECTION OF THE CORBICULA BED, CRAYFORD.

[Reprinted by kind permission of the Council from 'Quart. Journ. Geol. Soc.,' Vol. xxv.]

f. Laminated brick-earth, gravel, and loam, 25 feet, passing into Corbicula sand-bed C.

e. Brick-earth and Clay, 6 feet.

d. Pebbles from Woolwich series, brick-earth and clay, 6 feet.

c. Brick-earth, 5 feet.

b. Wavy laminated brick-earth, 6 feet.

a. Sands, 4 feet.

* A complete series has now been placed there.

The following names consequently are altogether removed : *Helix rufescens* (a misidentification for *H. concinna*) ; *Planorbis carinatus* (the specimen proving to be *P. marginatus*) ; *Hydrobia marginata* (which, though quoted in some lists from both Crayford

FIG. 35.—SECTION IN CRAYFORD PIT.

[Reprinted, by kind permission of the Council, from 'Quart. Journ. Geol. Soc.,' Vol. xxv.]

Length of Section 150 feet; height 30 feet. To show variation in the pebble beds C.

- F. Covering bed [Trail ?] (without shells).
- D. False-bedded sand. Corbicula-bed from 4 to 6 feet.
- B. C. & E. Beds with shells.
- A. [Not defined].

and Erith, has never been found there, any more than has *Unio pictorum*) ; *Paludina vivipara* (the specimens being *P. contecta*) ; *Sphærium canaliculatum*, an error for *S. caliculatum* (= *S. lacustre*). *Helix cantiana* and *H. lapicida* were dead recent examples that must have been gathered up with specimens on the talus. The

following names disappear in favour of their synonyms : *Pupa marginata* (= *P. muscorum*) ; *Planorbis complanatus* (= *P. marginatus*) ; *Planorbis rotundatus* (= *P. spirorbis*) ; *Pisidium caliculatum* (= *P. fontinale*).

Zonites [= *Hyalinia*] *crystallina*, *Z. nitidula*, *Z. radiatula* and *Carychium minimum* are given on the authority of the first recorder.

FIG. 36.—SECTION AT STONEHAM'S PIT, CRAYFORD.

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The following appear for the first time :—

<i>Helix arbustorum.</i>	<i>Planorbis contortus.</i>
<i>Cochlicopa lubrica.</i>	— <i>lineatus.</i>
<i>Clausilia rugosa.</i>	<i>Hydrobia ulvæ</i> , var.
<i>Ancylus lacustris.</i>	<i>Bythinia leachii.</i>
<i>Planorbis glaber.</i>	<i>Pisidium astartoides.</i>
— <i>nautilus.</i>	

An amusing instance of the way in which errors may creep into a list is furnished by a letter from Mr. H. W. Kidd to the 'Bayswater Chronicle,' dated Oct. 25th, 1877, wherein is recorded the finding in a sample sent him from Erith by Mr. Cheadle of two small shells which were submitted to Mr. Sowerby, who recognized them as fry of *Fusus*. Mr. Cheadle, however, informs me that the sample in question was sent in a tin that had previously been used at the sea-side for collecting purposes, and amongst other gatherings had contained egg-capsules ; being in a

hurry it was not cleaned out before the Erith material was packed in it. Hence the discovery of "marine shells in the Erith Brick-earths."

The most abundant species in these deposits is *Valvata piscinalis*, though it is closely rivalled in prevalence by *Pisidium amnicum*.

Several examples of this last show a curious mended fracture down the middle from the umbo of the valve to the margin, which is consequently indented; in the pairs both valves are alike broken, and since the injury is always in the same place, it would appear evident that it was due to mechanical causes, such as pressure from without, and not, as has been suggested by a young writer, to lesion from the action of a parasite.

The two examples of *Helix nemoralis* call for special mention, inasmuch as whilst both are very fine individuals, the larger rivals the biggest specimens from southern Europe and measures 21 mm. alt. $\times$ 29 max. diam., and 25 min. diam., the mouth being 15 $\times$ 15 mm.

Other individuals of large size are an example of *Paludina contecta*, from Erith, in Mr. Warburton's possession, that has a height of 31 mm.; and an individual of *Unio littoralis*, in the same collection, measuring 55 $\times$ 78 mm.

In Mr. Spurrell's series there is a valve of *Pisidium amnicum* 9 $\times$ 11 mm., and a complete pair of *Corbicula fluminalis* 33 $\times$ 37 mm., with a thickness of 18 mm. (Fig. 34, No. 3.).

One specimen of *Bythinia leachii* measures 7 mm. alt., and at first appeared as if it must belong to another species. It was referred to Dr. Böttger, who most obligingly examined it and confirmed the determination, as he also did that of some extremely dumpy varieties of *Limnæa palustris*. To the same great authority were submitted some examples of a variety of *Sphærium corneum* from these beds, which he considers to be absolutely identical with a rare German form now living in the Main, named by Kobelt *Sphærium mænanum*.

Clausilia rugosa rests on a single specimen found by Mr. Spurrell: its state of preservation differs markedly from that of the majority of the other shells; but it came in all probability from one of the more clayey beds, whilst the mass of shells were collected from the sandy layers.

The state of preservation of the shells in the River Drift deposits.—Complete loss of all animal matter, rendering them

very friable, and absence of blue peaty staining, characterizes the shells from the River Drift. Two exceptions, however, are of interest: certain specimens of *Unio tumidus* in Mr. Greenhill's collection, that came from the very base of the series and were embedded in the washed-up London Clay, retain their periostracum in a most remarkably fresh condition; whilst the specimens from Hackney already alluded to are peat-stained.

Differences are perceptible in the specimens from the several localities. Those from Clapton and Stoke Newington are remarkably white; the Grays' specimens have a dirtier tinge, and are sometimes slightly iron-stained, whilst those from Crayford, Erith, Ilford, and Brentford are mostly iron-stained, the Ilford examples being somewhat redder in tinge. The Crayford and Erith specimens are frequently marked with dendrites, sometimes in quite pretty patterns, a feature which has not been observed in those from the other localities.

FIG. 37.—NON-MARINE MOLLUSCA FROM THE RIVER DRIFT (WITH THE EXCEPTION OF 6) EXTINCT IN BRITAIN.

1 } <i>Unio littoralis</i> , Erith.	5 <i>Pisidium astartoides</i> , Crayford.
2 } "	6 <i>Pisidium amnicum</i> , "
3 } <i>Corbicula fluminalis</i> , Crayford.	7 <i>Helix fruticum</i> , Ilford.
4 } "	8 <i>Hydrobia marginata</i> , N.E. London

(The original specimens are in the Natural History Museum.)

Notes on some of the species, etc.—Varieties when remarkable have been alluded to under the sections, whilst mere variations such as are common to all species, and which are identical with those met with in the living forms, call for no observation; they are taken for granted.

Certain main features, however, should not be passed over. Allied species which in the existing examples show passage forms are yet more difficult to separate in the fossil specimens where the approach is far closer, even if the differences be not bridged over entirely. This is the case with *Succinea putris* and *S. elegans*, and again with *Limnæa auricularia* and *L. peregra*.

Helix hortensis has not yet been definitely recognized, most of the fossil examples that used to be attributed to this species proving to be undoubtedly *H. nemoralis*, with which indeed it was at one time supposed to be identical, but this want of recognition may in part be due to the fact that when the characteristic colour-markings are absent there is at present no adequate means of distinguishing it.

Helix pomatia and *H. aspersa** are not found anywhere in pre-Roman deposits, though frequently found with Roman remains. They were probably introduced about that time. *Helix cantiana* was in all probability a still later introduction, for though everywhere most abundant nowadays, and plentiful on the Erith marshes, it nowhere occurs in any of the deposits, even the most recent.

Helix rufescens although frequently recorded from the River Drift, appears really to be typical of the Alluvium, since all specimens attributed to this species which have been examined from the former have proved to be either *H. concinna*, or sometimes *H. caperata*. *Helix concinna* is far more plentiful than *H. hispida*; and, though great doubts at present exist whether these are two species or one, still, since the extreme forms are so marked, it is found convenient to distinguish between them and to adopt the current names, though, according to Hanley the *H. concinna* of Jeffreys was the type of Linné's *H. hispida*, which type, alas, cannot now be found.

Some species, such as *Helix caperata*, seem to have been uniformly smaller in River Drift days than in the Alluvial and Recent periods.

* The single specimen recorded from the Kennet Valley is probably spurious. See 'Science Gossip,' 1883, pp. 115, 237.

On the other hand, speaking broadly, the Pleistocene molluscan fauna appears to have been finer than the existing one, as some of the dimensions quoted go to prove, and it really seems as if our non-marine mollusca had deteriorated both in size and number.

In addition to the five species extinct in Britain, there are two—*Helix lamellata* and *Succinea oblonga*—no longer found in the Thames Valley, though the latter is said by D. Cooper to have lived at one time in the Battersea marshes.* At the present day this species is very restricted, whereas formerly, judging from its occurrence in the various alluvial deposits all over the country, it must have been far more prevalent.

Planorbis glaber was likewise far commoner than now. It has been the fashion of late to try and identify this form with *P. parvus*, Say, an American species; but this is an incorrect determination. The types of both are in the United States National Museum; and Mr. W. H. Dall, when applied to, most obligingly took the trouble to examine all the specimens very carefully. He writes: "*Planorbis glaber*, Jeffreys, in my opinion is distinct from *P. parvus*. The latter is flatter and less deeply umbilicated, and shows much more of the whorls within the outer one. It is also distinctly less polished in the average specimen." An examination of the specimens he was so good as to send at the same time confirms this opinion.

Planorbis carinatus is another species which has been recorded from the River Drift, but which appears to be confined to the Alluvium. It was generally in early days put down instead of *P. marginatus*, which was mistaken for it.

Neritina fluviatilis may be called the characteristic shell of the Alluvium, being extremely common, not to say abundant, therein; whilst not a single example occurs in the older beds, in which *Corbicula fluminalis* is correspondingly plentiful. The two nowhere occur together.

Unio littoralis (Fig. 37, Nos. 1, 2) is curiously erratic in its occurrence. No specimen has been found in N.E. London, and though once recorded from Ilford, it was probably through a misprint.

Unio pictorum is, as Wood observes, very rare as a fossil. Two localities are cited by him—Grays and Crophorne. Now the specimens from the former locality, in the British Museum, and those named by Pickering, in the collection of the Geologists'

* 'Mag. Nat. Hist.,' n.s., ii (1838), p. 478.

Association, are all *U. tumidus**; the Cropthorne specimen, a single valve, is preserved in the Geological Society's Museum, and though the determination is correct, the specimen is in such a completely different state of preservation to that of the other shells from the locality as to warrant the conclusion that it got in from a higher and far more recent layer than that which contained the other shells.

U. pictorum does occur at Barnwell, and in the Upper Fresh-water beds at West Runton; nevertheless, so far as the Thames Valley is concerned, it must at present be held to be a late Alluvial species.

Corbicula fluminalis, when a number of specimens are examined from each of the localities, shows features characteristic for each.† Those from N.E. London are nearly exactly as broad as high, the average specimen measuring 18 mm. each way. The Grays' specimens are nearly all 2 mm. wider than broad, and much smaller in appearance, the average example being 14×16 mm. The largest specimen from this locality is one in the Natural History Museum: 19×22 mm. From Ilford they vary more, but average $1\frac{1}{2}$ mm. broader than high, or 15×15.5 mm. Specimens from Crayford and Erith (Fig. 34, No. 3), again, like those from Grays, are broader than high, usually by about from 2 to 3 mm., but being larger the proportional difference is less, 19×21 mm. being about the rule. The form shown in Fig. 37, No. 4, is exceptional here.

What led to the extinction of this interesting species, that once had a wide range over Northern Europe and Asia, remains to be explained. That it bred in this country is certain, the shells of the fry being found, as well as individuals of all sizes.

Pisidium amnicum (Fig. 37, No. 6), again, shows variation with locality. Those from Crayford exhibit the lines of growth but faintly, whereas specimens from Grays or Clapton are very strongly marked. Specimens from Brentford and the Loop cutting, Crayford, are alike in being more swollen and having more prominent umbones than the average specimens.

Pisidium astartoides (Fig. 37, No. 5) was first observed by Sir C. Lyell in the fresh-water beds at Runton, and figured by

* There is a specimen in the Museum of Practical Geology (Cotton Coll. No. 2367) that bears a strong resemblance to *U. pictorum*. Unfortunately the interior is not visible, so that it is impossible to pronounce definitely what it is.

† *Conf.* Dollfus, 1884.

him in 1840 * as "*Cyclas (Pisidium) annica*, var. ?" Dr. S. P. Woodward appears to have at one time certainly considered it a separate species, for a box in his collection, marked "*Pisidium sulcatum*, Grays," contained undoubted examples of *P. astartoides*, mixed with extremely sulcate varieties of *P. annicum*, some of which can scarce be separated from the former. The existence of these passage forms, if such they be, from Grays, is the only possible cause of hesitation in adopting the species, for in other cases, such as those from Crayford, no such intermediate examples can be found. Moreover, the form in question is not met with except in the River Drift, and in association with *Corbicula fluminalis*, no example being quoted from the Alluvium or known living, though *Pisidium annicum* is quite as common as ever. As a rule it is so readily separable from its congener that the two have quite as much right to be distinguished as have *Succinea putris* and *S. elegans*, or *Limnæa auricularia* and *L. peregra*.

Pisidium astartoides (Fig. 37, No. 5) is less elliptical than *P. annicum* (Fig. 37, No. 6), and usually may be easily recognized by observing the lines of growth, which are equidistant throughout, whereas in *P. annicum* they are, save in exceptional instances, fainter, and placed closer together at the umbo than towards the margin.

Summary.—On reckoning up the total number of species in each column of the table it will be seen that there are 135 living and seven extinct forms recorded as British, and that 111 of the former are noted as living in the area drained by the Thames and its tributaries. Omitting from the calculation the 12 species of slugs and *Vitrina pellucida*, the remains of whose small and delicate shells are scarcely ever met with, and counting in *Helix lamellata* and *Succinea oblonga*, which, though British, do not now occur in the area under discussion, there are exactly a round 100 species whose shells might be looked for in the Thames Valley deposits, so that the total number of occurrences in succeeding columns of the alluvial beds shows also the exact percentage of forms met with.

Of the seven forms met with in the British Pleistocenes, but not now living in Britain, five (Fig. 37) have been found in the Thames Valley River Drift, and when it is borne in mind that some forms which occur here now were in all probability not British subjects at that time, it seems fair to consider that the totals of

* 'Lond. and Ed. Phil. Mag.,' xvi, p. 364.

those columns also fairly represent the percentages. So that, even under favourable conditions, the number of species of a given non-marine molluscan fauna that may be looked for in the alluvial beds of such a river as ours does appear to exceed 50 per cent.

In the Essex alluvials possibly the average will, when worked out, prove to be somewhat higher, but then the streams there are far smaller.

In some cases the occurrences are most irregular, owing mainly, of course, to imperfect knowledge; thus six living forms—*Limax agrestis*, *Helix aculeata*, *H. ericetorum*, *Clausilia rolpheii*, *Succinea oblonga*, and *Paludina contecta*—are only recorded from the River Drift.

On the other hand there are twelve species which are only found in the Alluvium, and of these some certainly were not inhabitants of Britain before that period; whilst no less than twenty-eight species, now living in the area, are not found in any of the alluvial deposits.

In attempting to deduce from the mollusca any conclusions respecting the age of the beds in which they occur, or the nature of the physical conditions under which these were formed, the greatest caution is of course necessary.

In the case of the Alluvium, any difference in age is, geologically speaking, unimportant, and all that need be said is that the Fulham, Whitefriars, Blackfriars, and Lea Valley peaty beds are newer than the sands with shells below the layer of peat at Westminster, which may be held to correspond with the lower beds at Crossness. (See Figs. 6 and 8).

When treating of the river drift series, however, there seems a little more to go upon, and hence the order in which the localities are cited in the table.

Omitting for the moment the Brentford and Ilford beds, which show the smallest returns, and looking at the critical species, we find that at Crayford the typical shell *Corbicula* is at its finest, whilst at Grays the average size is far less, and in N.E. London, though not quite so small, it is confined to quite the base of the series. This points to its gradual diminution and extinction. With it goes *Pisidium astartoides*. The shells from N.E. London and from Grays resemble each other in state of preservation, and specimens of *Corbicula* from both show faint traces of coloration; in both, too, we find *Hydrobia marginata* and *Unio pictorum*, forms which are not yet met with at Crayford,

fairly abundant, and may, therefore, be judged to be coming in for the Crayford beds have been far too well worked to allow of their having escaped notice had they been present. From these facts it seems fair to infer that, if anything, the chronological order is as given. At Brentford, though *Unio littoralis* and *Hydrobia marginata* have been found, no trace whatever has been discovered of *Corbicula*. *Sphærium rivicola* occurs there and in N.E. London, where it makes its first appearance; accordingly, Brentford is set down as being the latest of the river drift series, although the evidence is admittedly not all that could be desired.

Ilford remains to be considered, and here the shells in their state of preservation much more closely resemble those from Crayford than from any of the other brickearths. The *Corbiculæ* are in size nearest to those from Crayford, and while *Unio tumidus* has made its appearance, *Hydrobia marginata* is still wanting, as at Crayford; so that it seems not unnatural to place these beds between those of Grays and Crayford.

For purposes of comparison Mr. E. T. Newton has been good enough to draw up a table of the mammalian remains from Grays, Ilford, Crayford, and Erith (v. p. 388), and to these localities has been added N.E. London, from Mr. J. E. Greenhill's list (1883, pp. 22-3, sep. paper, p. 2), omitting *Alces machlis*, which the printer was probably responsible for.

The mammalian remains, as previously pointed out, cannot, of course, be relied on to the same extent as the molluscan, nor, taken alone, would they prove much in the present instance; still it is a curious circumstance that, granted the order of the beds to be that here urged, then there are certain forms present in the upper ones which are absent in the lower; and though in most cases these have been found in yet older deposits elsewhere, it does look as if the Thames Valley at one time knew them not.

When the test of relative levels is applied from approximate figures furnished for this purpose through the kindness of Mr. Spurrell, who intends shortly to publish them in detail, the foregoing arrangement of these various patches of brickearth by no means adjusts itself to the law; for whilst the Crayford beds rise from O.D. to 100ft., the Ilford and Grays, starting at the same point, go up to only 40ft. and 45ft. respectively; whilst the N.E. London series begins at the 50ft. contour and rises to nearly 100ft. above O.D.

The two lines of evidence thus stated are at variance, and the

question arises as to whether the palæontological or the orological one be the more correct in this instance.

To discuss this question adequately would require more space than can be conceded here ; but a brief statement of what are considered the most probable conclusions may be permitted. These are :—

1st. That while the relative levels of the terraces in a river valley are a fair test of their ages under the ordinary conditions of an unimpeded flow, such is not the case when the waters have been dammed back so as to cause them to slowly rise up the sides of the valley till a lake-like expansion of the river ensues.

2nd. The relative ages of the deposits formed under these conditions at the different levels during the rise of the waters will be just the reverse of those thrown down under the normal state of affairs, *i.e.*, the highest will be the newest.—Both series may be present in a valley.

3rd. Such phenomena are of actual occurrence, the process being repeated time and again where the collection of the water is caused by the formation of a barrier through the accumulation of water-logged trees and decaying vegetation.

4th. That some such a cause must be held to have had its share in the formation of the brickearths of the Thames Valley. How else are those of Crayford, 100ft. thick, to be accounted for ?

5th. The Crayford beds probably represent the complete series ; the Ilford and Grays the more or less denuded remains of other patches ; whilst the N.E. London deposits represent the high-water mark, and the Brentford beds the final position when the waters had again sunk to their old level.

6th. The mode of occurrence and condition of the shells certainly suggest quiet water deposition along the margins of a lake-like expansion of the river rather than the products of ever-recurring times of flood ; and the variations observable in the examples of *Corbicula* from the several places under discussion—the proximity of which is such as to preclude the idea that differences of environment can alone be held accountable for them—indicate a lapse of time by no means inconsiderable.

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APPENDIX.

Table showing the distribution of Pleistocene Mammalia in the various River Drift deposits of the London area. By E. T. Newton, F.G.S., etc. With the addition of those from N.E. London.

	N.E. Lond.	Grays.	Ilford.	Crayford.	Erith.
PRIMATES.					
<i>Homo</i>	x	..	...	x	...
<i>Macacus pliocenus</i> , Owen	...	x	...	...	...
CARNIVORA.					
<i>Canis lupus</i> , Linn.	x	x	x	x	x
„ <i>vulpes</i> , Linn.	x	x	x	...	...
<i>Felis leo</i> , Linn.	x	x	x	x	x
„ <i>catus</i> , Linn.	...	x	...	...	...
<i>Hyæna crocuta</i> , Erxl., var. <i>spelæa</i>	...	x	...	x	...
<i>Lutra vulgaris</i> , Erxl.	...	x	...	...	...
<i>Ursus arctos</i> , Linn.	x	x	x	x	...
„ <i>horribilis</i> , Ord.	x	x	x	x	...
UNGULATA.					
<i>Bison bonasus</i> , Linn., var. <i>priscus</i> , Boj.	x	x	x	x	...
<i>Bos taurus</i> , Linn., var. <i>primigenius</i> , Boj.	x	x	x	x	x
<i>Capreolus caprea</i> , Gray	x	x	x	...	...
<i>Cervus elaphus</i> , Linn.	x	x	x	x	x
„ <i>giganteus</i> , Blum. (= <i>Megaceros hibernicus</i> , Owen)	x	x	x	x	x
<i>Elephas antiquus</i> , Falconer	x	x	x	x	x
„ <i>primigenius</i> , Blum.	x	x	x	x	x
<i>Equus caballus</i> , Linn. (= <i>E. fossilis</i> , Meyer)	x	x	x	x	x
<i>Hippopotamus amphibius</i> , Linn. (= <i>H. major</i> , Owen)	x	x	x	...	...
<i>Ovibos moschatus</i> , Zimm.	...	...	...	x	...
<i>Rhinoceros antiquitatis</i> , Blum.	x	...	x	x	x
„ <i>leptorhinus</i> , Owen	x	x	x	x	x
„ <i>megarhinus</i> , Christol	x	x	x	x	...
<i>Sus scrofa</i> , Linn.	x	x	...	...	...
RODENTIA.					
<i>Microtus amphibius</i> , Linn.	x	x	x	x	...
„ <i>ratticeps</i> , K. & B.	...	...	...	x	...
<i>Castor fiber</i> , Linn. (= <i>C. europæus</i> , Owen)	x	x	x	...	...
<i>Spermophilus erythrogenoides</i> , Falconer	...	...	...	...	x
„ sp.	...	...	...	x	x
INSECTIVORA.					
<i>Sorex</i> sp.	...	x	...	...	...