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IS THE LOESS OF AQUEOUS ORIGIN?

BY B. SHIMEK.

Organic remains furnish the best criterion for the measure of conditions which prevailed during any given age of the earth's geological history, provided, of course, that their relation to the deposit can be clearly shown.

To such an extent is this true of the older rock formations, that the modern geologist has generally accepted without question the conclusions long ago reached by the paleontologist, and has turned his attention to the physical, rather than the biological, phenomena presented by the various horizons.

In every case the paleontologist reached these conclusions in the main by comparisons with modern forms of life. The more remote the age, the greater the gap between its fauna and the fauna of the present day. Ordinal, family, and at best generic characters and relationships alone furnish a clue to the then existing conditions. Yet these have been considered sufficient. How much easier then is the task, and how much more satisfactory the deductions, if in the investigation of a much more modern horizon, we find the similarity of faunas extending to the species, and if for purposes of study we may place by the side of its fossils representatives of the same species which exist abundantly to-day under conditions which may easily be studied.

This is the advantage presented by the fauna of the loess. This fauna is in the main molluscan. A few remains of the vertebrates have been found, but the characteristic, most abundant and most widely distributed species are molluscs, and to these we must turn for the chief paleontological explanation of loess conditions.

The majority of the geologists who have given attention to

the loess of the Mississippi valley have ascribed its deposition to water in lakes or sluggish streams *

Some have also contended that this occurred in a glacial climate, or at least in a climate much colder than that of to-day in the same region. †

That fresh water has been regarded as the agent of deposition is due in no small degree to the belief that a very considerable portion of the species and individuals found in the deposit consists of aquatic or semi-aquatic forms, although the fact has long been recognized that terrestrial species prevail. There is, however, absolutely nothing in the loess fauna to indicate that the loess land-surfaces were more moist, or to any extent more widely or more deeply covered with waters, than are the surfaces of Iowa and Nebraska to-day,—the evidence, if it suggests any difference, indicating rather less moisture than is found in eastern Iowa at the present time. This statement, which cannot be too strongly emphasized, is based upon the study of the modern molluscs of Iowa and Nebraska, and their fossil prototypes, extending over a period of nearly twenty years.

Every species of molluscs which has thus been reported from Iowa, Nebraska, ‡ and Missouri is living to-day, § and with three or four exceptions all are found living within the territory covered by the loess. The conditions which are offered for comparison are therefore exceedingly favorable.

The following account of the species of *Mollusca* which are found in the loess is given with special reference to the habits of the modern forms. Table I at the close of the

*The following are among the chief references: G. C. Swallow, Geol. Sur., Missouri, Vols. I and II, p. 74; W. H. Pratt, Proc. Dav. Acad. Sci., Vol. I, p. 97; C. A. White, Geol. Sur., Iowa, Vol. 1, pp. 113 and 115; Sir Chas. Lyell, Prin. of Geol., Vol. I, p. 481; W. J. McGee, Proc. Am. A. A. S., Vol. XXVII, p. 32; Archibald Geikie, Text-book of Geol., p. 384 (he adds, however, that the loess shades off into rain-wash and æolian formation); S. Aughey, Sketches of Phys. Geog. and Geol. of Neb., p. 273, *et seq.*; R. D. Salisbury, Ark. Geol. Sur., Vol. II., pp. 225-230; McGee, Rep. U. S. Geol. Sur., Vol. XI, p. 574, etc. More recently Prof. Calvin shows in the Rep. Iowa Geol. Sur., Vol. VII, p. 89, that the loess materials are derived from the drift, but says that the nature of the agents "is not so clear." He adds that the piling of loess around the margin of the drift is better explained by currents.

†Some of the references are as follows, J. E. Todd, Proc. Am. A. A. S., Vol. XXVII p. 6; W. J. McGee, Proc. A. A. A. S., Vol. XXVII, pp. 31-2; W. J. McGee and R. E. Oall, On the loess and Associated Deposits of Des Moines, pp. 22-3; R. D. Salisbury, Rep. Ark. Geol. Sur., Vol. II, p. 229; W. J. McGee, U. S. Geol. Sur., Vol. XI, p. 574, etc.

‡No account is here taken of Professor Aughey's long list of southern forms from the Nebraska loess, its unreliable character having already been pointed out by the author in Bull. Lab. Nat. Hist. State Univ. of Iowa, Vol. II, p. 95.

§*Zonites Shimekii* Pilsbry, the only species thus far accredited to the loess alone, is undoubtedly the widely distributed terrestrial *Zonites nitidus*.

paper contains the names of the species which have been authentically reported from the loess, or which are in the author's private collection. The numbers opposite the names show the number of cleaned specimens in the collection which are available for immediate study. Only those from the loess of Iowa and Nebraska are there included, and they are divided into two groups,—those from the eastern loess (the territory including the counties of Des Moines, Muscatine, Scott, Dubuque, Bremer, Johnson, Iowa, Polk and Warren in Iowa), and those from the western loess (from the counties of Fremont, Pottawattamie and Woodbury in Iowa, and Otoe, Sarpy, Cass, Douglass, Lancaster, Saunders and Cumming in Nebraska). The numbers are given for the purpose of showing the relative number of specimens of the various species which have accumulated in the collection in nearly a score of years, and which form the basis for this paper. Of course this does not represent the entire number collected, for many have been sent out in exchange. Neither does the table show the exact ratio of the fossils in the loess, for of the common terrestrial forms many were observed but not collected, whereas of the rarer forms and of the *Limnææ* nearly all which were observed were taken, and few or none were sent out in exchange. The fossils were compared with many thousands of modern specimens.

1. *Aquatic or semi-aquatic Mollusca.*

The forms which may properly be included under this head are the species of *Limnæa Physa*, *Bulinus*, *Planorbis* and *Segmentina*, all of which are, however, pulmonates—and *Valvata*, *Pisidium* and *Unio*, which are branchiate, strictly aquatic species.* Special stress has been placed upon these forms as proving the presence of large bodies of water during the deposition of the loess. The weight of their testimony is here considered in detail.

Limnæa.—It will be observed in Table I that there are at present in the author's collection 771 fresh water specimens, of which 750 belong to the pulmonate genus *Limnæa*. Of the latter number over 300 specimens were collected near Iowa City in a "pocket," the exposed cross-section of which does not exceed four square feet in area. The remaining specimens were also found in restricted areas (as though deposited at the edge of a pool or pond),—never being so generally diffused

*Swallow's *Amnteola lapidaria* from Missouri (see Table D) is *Pomatopsis lapidaria* a terrestrial species.

through the fossiliferous loess as are some of the Succineas and other terrestrial forms. Considering them rare in the loess the author collected a number out of all proportion to the ratio which actually exists between them and the terrestrial forms.

The great majority of the specimens are *L. humilis* Say. Mingled with this species, and not always distinguishable from it and from each other, are *L. desidiosa* Say, and *L. caperata* Say. All these species are rather small compact *Limnææ*, such as chiefly characterize our pond air-breathing molluscan fauna of to-day. The first two species may be found creeping about, in and near springs, streamlets, and small ponds, in all the region covered by the loess, and *L. humilis* especially is quite as frequently found out of the water as in it. Both are abundantly developed in ponds and streams which are dry during the greater part of the summer. *L. caperata* is also a common species to-day, and like the two preceding species is often found in ponds which are dry during most of the year. Near Lincoln, Neb., this species is common in prairie-ponds which usually contain water for but a few weeks in the spring, and last summer the author found it abundant upon the Sioux Quartzite exposure in northwestern Iowa in a pool which contained scarcely a gallon of water. It is noticeable that these recent prairie specimens are of the small "depauperate" type which occurs in the loess. Neither the habits of these species nor their distribution in the loess indicate the presence of any large bodies of water. They could be much more abundant and yet could not form as conspicuous a part of the fauna of the loess as the same species do of the fauna of our comparatively dry weather prairies to-day.

The larger *L. reflexa* and *L. palustris* mentioned in the table, while locally common in larger ponds and prairie swamps to-day, have not been found in the loess of Iowa and Nebraska. They, too, are air-breathers, and never occur in deep waters.

Physa.—Two specimens are in the collection, one from Iowa City, and one from Lincoln, Neb. Both are young and the species cannot be satisfactorily determined. Two species have been reported from Missouri by Swallow (*l. c.* p 215), but representatives of this genus are evidently very rare. The habits of all are essentially the same as those of the *Limnææ*.

Bulinus.—One species, *B. hypnorum*, has been reported from Missouri by Swallow (*l. c.*). It has not been found in the loess of Iowa and Nebraska. The species is found now in prairie

ponds in Iowa and Nebraska, and seeks the habitats which are agreeable to *Limnæa palustris*.

Planorbis.—Two species have been recorded from the loess. *P. trivolvis* has twice been reported (see Table I), but in each case with doubt. *P. parvus* (it may be *P. dilatatus*) is rare in the western loess, five specimens only being in the collection. In habits these species of *Planorbis* are all, like the species of *Limnæa* and *Physa*, inhabitants of shallow water borders.

Segmentina.—One species, *S. armigera* has been reported from Missouri by Swallow. It is evidently extremely rare. The species is now locally common, especially in prairie ponds, and in habits is similar to *Planorbis*.

All of the foregoing species are air-breathing, and all are found living abundantly in Iowa and Nebraska to-day. Their presence not only does not prove that there was an excess of moisture, but their scarcity actually suggest that there was less water than may now be found over the same areas.

Valvata. One species, *V. tricarinata*, has been reported from Missouri (see Table I). This and *Campylom i subsolidum* are the only branchiate aquatic Gasteropods reported from the loess.*

It is now locally common in ponds and sluggish streams, often being found in ponds which become dry in summer. Its total absence from the loess of Iowa and Nebraska, and its scarcity in Missouri, make the species of little value in determining prevailing conditions in loess times.

Pisidium.—Two valves only, of a species which has not been satisfactorily identified†, were found at Iowa City, associated with *Limnæa* in the little pocket to which reference has already been made. The species of *Pisidium* are small bivalves (hence gill-bearing and aquatic), which are locally common in all our fresh waters. They also frequently occur in ponds and streamlets which become dry during the summer. For two reasons the author collected numerous specimens of a species much like our fossils (probably the same) near Lincoln, Neb., in a streamlet which during both years was dry all summer.

The presence therefore, of aquatic forms of the foregoing types does not indicate that large bodies of water, whether in lakes or rivers, existed,—indeed it does not show that, even in the particular localities where they were developed, water was found during all the year. No doubt there was water. There

**Pomatitopsis lapidaris* and *Helicina occulta*, both gill-bearing, but terrestrial in habit are considered with the terrestrial forms.

†For *Cyclas* from Missouri see Table I.

were rain and snow,—there were pools, and springs, and streams,—and it would be strange indeed if some evidence of water action, water-presence was not found. But the character of these fresh water fossils, and their comparative scarcity, indicate either that there were very few bodies of water, or that the loess was deposited chiefly where there was no water. Of the fresh water forms there remain to be considered the species of *Unio* and *Cunpe'loma*. These may be discussed together for both genera are chiefly fluviatile, and are usually associated in our streams, while the record of their occurrence in true loess is about equally established. From two localities, only, have specimens of loess *Unioni'dæ* been reported.* Professor Witter reports† three species of *Unio* and one species of *Margaritina* from the loess of Muscatine.‡ All are recorded as “rare and local.”

Mr. H. Foster Bain, of the geological survey, furnished the three species of *Unio*, represented by twelve valves, which are reported in Table I, from Sioux City. The author does not know whether any doubt exists concerning the correctness of the reference of these forms to unmodified loess.§

But granting that no such doubt does exist the evidence furnished by them that the loess was deposited under fluviatile conditions, is by no means conclusive. They are extremely rare in proportion to other molluscs, and the occurrence of such scanty material may be accounted for otherwise. The author has a number of times found shells of Unios at a considerable altitude above high water mark. The bluffs along the Iowa river above Iowa City have furnished several examples. Whether they were carried to their lodging places by bird or beast could not be determined, but some of the shells bore marks as of the teeth of a mammal. That there were streams in loess times is evident from present river courses and river valleys. That Unios occurred in these waters is quite probable. That some of these should have been carried to altitudes greater than those at which they were developed is

*To these should be added a third locality. McGee, in U. S. Geol. Sur., Vol. XI, p. 460, reports “fragile bits of shells of *Unio* or *Anodonta*” from Stone City, Iowa.

†Rep. U. S. Geol. Sur., Vol. XI, p. 471.

‡For list of species see footnote (15) under Table I.

§Since this paper was written Mr. Bain has submitted additional numerous valves of *Unio* from near the mouth of the Broken Kettle, Plymouth county, Iowa. A list of the species is given in Table III. With the Unios were associated a few shells of *Succinea lineata* and one specimen of *Helicodiscus lineatus*, both being of the ordinary loess type. The Unios were clustered in small heaps or pockets. Mr. Bain pronounces the deposit in which these shells, as well as those previously collected at Sioux City were found, to be a terrace of modified loess.

possible. But it is extremely strange, if the loess was deposited either in rivers or in lakes, that these remains of mussel shells are not more abundant. It has been suggested that the waters were too cold for the best development of the *Unionidæ*, but species of *Anodonta* of this family are common in lakes and sluggish streams far to the north, and over most of the northwestern territory, and, if such conditions prevailed, at least fragments of these should be found if the delicate eggshells of a small snail (see Table I) were permitted to come down to us entirely uninjured. If the waters had been too cold for the *Unionidæ*, the land would likewise have been too cold for the land snails.

Moreover, the evidence of these four shells, while worthy of attention, should scarcely be permitted to outweigh that of the thousands of terrestrial forms so widely distributed in the deposits.

2. *Terrestrial molluscs*.—Of fossil terrestrial molluscs there are 4,816 specimens in the collection. Some of the forms here classified as terrestrial have frequently been incorrectly reported as aquatic or semi-aquatic. This is especially true of *Helicina*,* *Pomatiopsis*†, and *Succinea*‡. *Helicina occulta* Say, though gill-bearing, is strictly terrestrial. At Iowa City, where it was discovered by the author many years ago, and in Hardin county, where it is not rare, it is always found on steep hillsides high above high-water mark.

Pomatiopsis lapidaria Say is likewise wholly terrestrial. Call (*l. c.*) repeatedly refers to it as a fresh-water form, and, when we consider that a conchologist of such wide experience makes this error, it is not surprising that others repeat it. At Iowa City, Belle Plaine, Eldora, and other points where this species is common at the present time, it is usually associated with *Patula striatella* and *Succinea obliqua*, both likewise terrestrial forms, and is in no sense aquatic.

Succinea.—Two types of this genus appear. That represented by *S. ovalis* has a very large body-whorl and a short spire. These forms are mostly found in swampy places creeping about on semi-aquatic plants, or on mud, but not living in water. Of this type three specimens are in the collection.

*J. E. Todd, Proc. Am. A. A. Sci., Vol. XXVII, p. 6; F. M. Witter, "Notes on the Loess;" W. J. McGee, Rep. U. S. Geol. Sur., Vol. XI, p. 461

†R. E. Call, Rep. Ark. Geol. Sur., Vol. II, pp. 166, 167, and 178.

‡Lyell, Prin. of Geol., Vol. I, p. 460; J. E. Todd, Proc. Am. A. A. S., Vol. XXVII, p. 6; F. M. Witter, Notes on the Loess; R. E. Call, On the Loess and Associated Deposits of Des Moines, p. 16.

The other type with smaller body-whorl, more exerted spire, and more convex whorls, is represented by *S. avara*, *S. lineata*, and *S. obliqua*. These are not only not semi-aquatic, but are often found in high, very dry situations. This is especially true of the small form of *S. avara*, and of *S. lineata*, both of which are very common in the loess. Of this type there were 1,714 fossil specimens in the collection, and even if the three specimens of *S. ovalis* be accepted as "semi-aquatic," their importance is far outweighed by these strictly terrestrial forms.

Remaining forms.—Of all the remaining forms in the list it may be said that they are wholly terrestrial in habit. While they require a certain amount of moisture, that which is retained under a stick or leaf is sufficient. Most of the species are abundant to-day in both Iowa and eastern Nebraska, and several prefer a decidedly dry region.*

Their presence, therefore, does not prove a moist climate, but rather suggests less moisture †

In all discussions of loess conditions it should be borne in mind that the forms of molluscs which are everywhere present, and which are truly characteristic of the loess, are all terrestrial and none require much moisture.

So far as evidences of a glacial climate are concerned, this much may be briefly said: The climate was of necessity such as to permit the development of abundant plant-food for the terrestrial molluscs, for they are almost without exception herbivorous. The fresh water pulmonate fauna of the loess, instead of being of the large, comparatively thin-shelled type which prevails northward, is more nearly like that of our comparatively dry prairies to-day, as has been stated

Great stress has been placed upon the depauperate condition of the shells of the loess †

With the exception of the extremely variable *Patula strigosa cooperi* the author has found every species occurring in the loess exhibiting modern mature forms which do not exceed, and in many cases are smaller than the fossils. The conditions which produce the depauperation exist to-day in the loess covered

*This is especially true of *Patula strigosa cooperi*, *Pupa alticola* and *Succinea lineata*.

†It may be added, parenthetically, that the larger shells, such as *Mesodon multilineata*, *M. profunda* and *Patula alternata*, often have their apices broken in exactly the same manner which may often be observed in fresh shells from which birds (blue jays, etc.) have extracted the animals.

‡J. E. Todd, Proc. Am. A. S., Vol. XXVII, p. 6; McGee and Cali, On the Loess and Associated Deposits of Des Moines, pp. 21-2, and plate; Ohas. R. Keyes, Bull. Essex Ins., Vol. XX, p. 5; W. J. McGee, Rep. U. S. Geol. Sur., Vol. XI, pp. 300-1, 435 and 448. See also author's paper in Bull. Lab. Nat. Hist. State Univ. of Iowa, Vol. II, pp. 93-4.

region, and their presence is no proof of a glacial climate, but may suggest a drier climate.*

3. *Mammals*.—The evidence furnished by the mammals is unsatisfactory, since in some cases, at least, there is doubt that the remains came from unmodified loess. Several species have been reported† all of them herbivorous and rare.

The scarcity of material, however, does not necessarily show that these forms were very rare (thus suggesting limited land areas), for we have quite the same difficulty in finding the bones of more modern mammals. The bones of the bison, deer, bear, etc., are seldom found, yet the species were once common. The rabbit and squirrel leave but few traces of their existence, yet they are common even now.

The presence of the fossil mammals, so far as it has any value in the present discussion, indicates plenty of plant-food, a possibility of extensive land areas over which these forms roamed.

Certain other questions, bearing largely on physical geography, are suggested to the student of the fauna of the loess. The fact that the loess caps the hills has long been known. If the material was deposited in water, there must have been a body of the latter sufficiently large to cover these hills, for it is recognized that the general topography of this region was determined before the loess was deposited.‡ If there was such a large body of water, where are the evidences of its shore lines? It has been suggested§ that the waters were contained within walls of ice, but that hypothesis calls for climatic conditions which would make impossible the development of the life of which we find evidences.

Where, too, were the land areas upon which the molluscs and mammals flourished? It might seem plausible at first

* This was suggested by the author in Bull. Lab. Nat. Hist., State Univ. of Iowa, Vol. II, p. 91, but was not sufficiently emphasized.

† The following have come to the author's attention:

Bootherium cavifrons Ledy, G. Hambach, Bull. I. Geol. Sur. Missouri, p. 82.

Caster fiber Ow. G. C. Swallow, Geol. Sur. Mo., Vols. I and II, p. 215; Hambach, l. c., p. 82.

Cervus muscatinensis Lidy, F. M. Witter, Notes on the Loess; Rep. U. S. Geol. Sur., Vol. XI, p. 471.

Elephas prtmgentius Blume, Swallow, l. c. p. 215; W. H. Pratt, Proc. Dav. Acad. Sci., Vol. I, p. 98; Hambach, l. c. p. 82; W. J. McGee, Rep. U. S. Geol. Sur., Vol. XI, p. 471 (quoted from Pratt, l. c.).

Mastodon giganteus Cur., Swallow, l. c., p. 215; Hambach, l. c. p. 82.

‡ To this Prof. S. Calvin again recently calls attention in Geol. Sur. Iowa, Vol. V p. 69.

§ McGee and Call,—On the Loess and Associated Deposits of Des Moines, pp. 22-3; McGee,—Rep. U. S. Geol. Sur., Vol. XI, p. 574.

thought that the remains now fossil drifted in from very remote regions. Land shells are imbedded to-day in fine alluvium along our streams,* but these are seldom carried to a distance, but are rather covered *in situ* by the fine silt of the stream. The above assumed conditions, however, would call for the transportation of the materials from great distances, and the larger shells would be precipitated long before the fine silt had reached its destination, or if floating, would be thrown ashore in bands. Any observer who collects shells in river drift and then traces the rarer species of more restricted distribution to their source, can ascertain that these shells are not carried far. Dredging in "sloughs," ponds, and sluggish streams also shows that land shells are seldom washed into them.

Moreover the molluscan loess-fauna of any region is on the whole like the modern fauna of the same region. For example, Binney reports a number of species from the "post-pleiocene" (evidently the loess) of the lower Mississippi valley, of which eleven† are southerly species, and all now live in the same region. Call reports‡ fifteen species from the loess of Arkansas, three of them included in the southerly list in Table II, and all belong to the modern molluscan fauna of that state. The same is true of the faunas of Iowa and Nebraska as has been stated.

This does not indicate transportation from a great distance. It is interesting and noticeable that for the most part the species of the loess are common over the same region now. There are some exceptions, for there have been changes no doubt, but these changes, as indicated by the distribution of the shells, are no greater than may now be observed in any limited region in the course of a few years. Species are sometimes disposed to appear, disappear, and reappear in a surprising manner in a given locality, and, if we may judge from the vertical distribution of the fossil shells, the same was true during the deposition of the loess.

The horizontal distribution of the fossils is likewise such that it suggests at once that they were deposited *in situ*.§

As there are surface areas to-day which have no molluscs, lying in close proximity to those on which molluscs are abun-

*For author's account of an example see Bull. Lab. Nat. Hist., State Univ. of Iowa, Vol. II, pp. 169-174.

†See Table II.

‡Geol. Sur. Ark., Vol. II, pp. 49, 165, and 166.

§For a further discussion of this point by the author see Bull. Lab. Nat. Hist. State Univ. of Iowa, Vol. III, pp. 95-96.

dant, so there are deposits of loess without fossils, adjacent to those which are fossiliferous. As the lands, high or low, lying adjacent to larger streams have greater numbers of molluscs to-day than the outlying prairies, so the loess bordering these streams is usually much more fossiliferous than that which covers more remote areas,—but the distribution of the fossils is not in bands, as if drifted, but is similar to that of the modern specimens at the surface. Summing up the evidence of the fossils we may assert that it points to conditions not unlike those which exist to-day, and that geologists, in seeking for the cause and manner of the deposition of the loess must give up the assumption of widely submerged areas over which fossiliferous loess now occurs, and of a cold climate.

* * * * *

That the loess is not everywhere uniform in composition is recognized.* Especially marked is the difference between the loess in the counties in Iowa designed as eastern, and those in Iowa and Nebraska referred to as western, the former being finer and washing readily, while the latter is more silicious and persists in vertical sections for a much longer time. These differences may possibly suggest a difference in mode of deposition, but so far as evidence is furnished by the molluscs, the climatic and surface conditions in both regions were essentially the same,—that is, they did not differ more than at present. A comparison of the species and number of specimens of each from the eastern and western loess, as given in Table I, shows that but few are not common to both, and these are mostly the rarer species. There are now equivalent differences between the faunas of the two regions, but the great majority of fossils as well as of recent forms is the same in both. The differences which exist between the two deposits are probably due to the different sources of material rather than to different agencies of deposition.

It seems evident that the loess materials originated largely or wholly in drift,* and as the comparatively recent investigations by members of the Iowa geological survey have demonstrated the presence of several drift sheets in this state, and as Nebraska has at least two such sheets, an interesting problem is suggested to geologists, namely: the determination of the relation which the various deposits of loess bear to those drift

*W. J. McGee.—Rep. U. S. Geol. Sur., Vol. XI, pp. 202 and 205, etc.

*R. D. Salisbury,—Ark. Geol. Sur., Vol. II, pp. 235-6; S. Calvin,—Iowa Geol. Sur., Vol VII, p. 89.

sheets which during the deposition of the loess were found at the surface of adjacent regions. This would involve a careful comparison of the finer materials in the drift with the loess, and the consideration of the probable or possible direction and means of transportation to the present location of the loess.

TABLE I.

LIST OF LOESS FOSSILS (*Mollusca*).

TERRESTRIAL FORMS	Eastern Loess.	Western Loess.	Total.
<i>Zonites radiatulus</i> Alder.....	2	9	11
<i>Zonites arboreus</i> (Say) Binn.....		10	10
<i>Zonites minusculus</i> (Binn.) F. & C.....	3	3	6
<i>Zonites shimckii</i> Pils. (<i>nitidus</i>).....	98	74	172
<i>Zonites fulvus</i> (Drap.) Binn.....	140	28	168
<i>Zonites binneyanus</i> (Morse) Binn. reported (1).....			
<i>Zonites indentatus</i> (Say) Binn. reported (2).....			
<i>Helicodiscus lineatus</i> (Say) Morse.....	13	10	23
<i>Patula strigosa cooperi</i> W. G. B.....	85		85
<i>Patula striatella</i> (Anth.) Morse.....	288	206	494
<i>Patula striatella</i> eggs (3).....	6	14	20
<i>Patula alternata</i> (Say) Binn.....	61	54	115
<i>Patula perspectiva</i> (Say) Binn. Reported (1).....			
<i>Macrocyclis concava</i> (Say) Morse. Reported (2).....			
<i>Stenotrema leaii</i> (Ward) Binn. (<i>monodon</i>).....		24	24
<i>Stenotrema hirsutum</i> (Say) Fry.....		3	3
<i>Mesodon multilineata</i> (Say) Fry.....	103	42	145
<i>Mesodon albolabris</i> (Say) Morse.....		2	2
<i>Mesodon profunda</i> (Say) Binn.....	61	3	64
<i>Mesodon thyroides</i> (Say) Fry. Reported (2).....			
<i>Mesodon clausa</i> (Say) Fry.....	1		1
<i>Mesodon divesta</i> (Gld.) Fry. Reported (1).....			
<i>Vallonia pulchella</i> (Muell.) Binn.....	66	190	256
<i>Strobila labyrinthica</i> (Say) Morse.....		2	2
<i>Fernesacia subcylindrica</i> (L.) Binn.....	12	16	28
<i>Pupa holzingeri</i> Sterki.....		3	3
<i>Pupa armifera</i> Say.....	14	11	25
<i>Pupa muscorum</i> L.....	72	183	255
<i>Pupa contracta</i> Say.....		1	1
<i>Pupa alticola</i> Inger. (<i>simplex</i>).....	247	50	297
<i>Pupa fallax</i> Say.....		12	12
<i>Pupa corticaria</i> Say. Reported (4).....			
Other <i>Pupidae</i> (5).....	378	160	538
<i>Succinea ovalis</i> Gld.....		3	3
Other <i>Succineae</i> (6).....	1,200	514	1,714
<i>Carychium exiguum</i> (Say) Gld.....	9		9
<i>Helicina occulta</i> Say.....	180	150	330
<i>Pomatiopsis lapidaria</i> Say (7).....			
Total terrestrial forms.....	3,039	1,777	4,816

AQUATIC OR SUB-AQUATIC FORMS.

<i>Limnæa reflexa</i> Say. Reported (2).....			
<i>Limnæa palustris</i> Mull. Reported (2).....			
Other <i>Limnæa</i> (8).....	567	183	750
<i>Physa gyrina</i> Say (9).....	1	1	2
<i>Physa heterostropha</i> Say (9).....			
<i>Bulinus hypnorum</i> (L) Binn. Reported (10).....			
<i>Planorbis parvus</i> Say.....		5	5
<i>Planorbis trivolvis</i> Say. Reported (11).....			
<i>Segmentina armigera</i> (Say) H. & A. Ad. Reported (12)			
<i>Valvato tricarinata</i> Say. Reported (2).....			
<i>Campeloma subsolidum</i> Anth Reported (13).....			
<i>Pisidium</i> ——— — sp. (14).....	2		2
<i>Unio undulatus</i> Barnes.....		6	6
<i>Unio rubiginosus</i> Lea.....		5	5
<i>Unio pustulosus</i> Lea (15).....		1	1
Total aquatic forms.....	570	201	771

TABLE II.

List of fossil molluscs from the "Post-pleiocene deposits" ¹⁶.

Zonites fuliginosus (Griff.) Binn

Zonites intertextus Binn.

Zonites inornatus (Say) Biun.

Zonites gularis (Say) Binn.

Patula solitaria (Say) Binn. ¹⁷.

Stenotrema stenotrema (Fér.) Try.

Triodopsis palliata (Say) Binn.

Triodopsis obstricta (Say) Binn.

Triodopsis inflecta (Say) Binn.

Mesodon elevata (Say) Binn.

Mesodon exoleta (Binn.) Try.

Helicina orbiculata Say ¹⁸.

TABLE III.

List of *Unios* from modified Loess submitted by Mr. Bain.

These are all from near the mouth of the Broken Kettle, Plymouth county, Iowa.

Unio anoxontrides Lea.

Unio donaciformis Lea.

Unio elegans Lea.

Unio pustulosus Lea.

Unio rubiginosus Lea.

Unio undulatus Barnes.

1. J. E. Todd, Proc. Am. A. S., Vol. XXVII, p. 6, from southwestern Iowa.
2. G. C. Swallow, Geol. Sur. of Mo., Vols. I and II, p. 215, from Missouri.
3. The eggs vary slightly in size. The smaller agree exactly with eggs of modern *P. striatella*. The larger may belong to another species.
4. R. E. Call, On the Loess and Assorted Deposits of Des Moines, pp. 14 and 17; from Des Moines Iowa. F. M. Witter, Rep. U. S. Geol. Sur. Vol. XI, p. 47.
5. These lots include *Pupa pentodon*, *Vertigo ovata*, etc., the greater part consisting

of the first species. All are represented in our Iowa molluscan fauna, and all are terrestrial, hence the general result is the same. They are not all reported in the collection, hence are not separately listed. A critical review of these and other forms will appear in a monograph of the loess *Mollusca*, which the author is preparing.

6. These include *S. obliqua*, *S. lineata* and *S. avara*. All belong to a division of the genus *Succinea* the species of which are terrestrial in habit, and occur living in abundance in Iowa and Nebraska to-day.

The remarks on *Pupidae* in the preceding foot-note apply equally well to these *Succinea*.

7. This is Swallow's (*l. c.*) *Amnicola lapidaria* from Missouri. Todd (*l. c.*, p. 7) also reports it doubtfully from southern Iowa.

8. These include *L. caperata*, *L. humilis* and probably *L. desidiosa*. As many, especially young specimens, cannot readily be referred to their respective species, all are here grouped together. A more complete discussion of these forms will appear later. (See foot-note 5.)

9. *Physa gyrina* and *P. heterostrophis* have both been reported from Missouri by Swallow (*l. c.*) Our specimens are very young, but probably belong to *P. gyrina*.

10. Reported as *Physa elongata* by Swallow (*l. c.*) from Missouri.

11. Doubtfully reported by Todd (*l. c.*, p. 7) from southern Iowa, and by Witter (in notes on the Loess) from East Des Moines.

12. Reported as *Planorbis armigerus* from Missouri by Swallow (*l. c.*).

13. Reported as "rare and local" by Professor Witter, U. S. Geol. Sur., Vol. XI, p. 471. It may be from modified loess.

14. Swallow (*l. c.*) also reports a *Cyclas* from Missouri. This name was formerly applied to both *Pistidium* and *Sphaertum*. Hambach (Bull. No. 1, Geol. Sur. of Mo., p. 82), who practically reproduces Swallow's list, omits this entirely.

15. In the U. S. Geol. Sur., Vol. XI, p. 471, McGee reports the following species on authority of Professor Witter:

Unto ebenus Lea.

Unto ligamentinus Lam.

Unto rectus Lam.

Margaritana confragosa Say.

16. From Binney's Terrestrial Air-breathing Mollusks, Vol. V (except the last species). In most cases these are simply reported as "post-pleiocene," but several are specifically reported from Natchez Bluff. Most of the species belong wholly to the southern fauna, and all are terrestrial.

Only such "post-pleiocene" species as are not given in Table I are included in Table II.

17. It is possible that this is *P. strigosa cooperi* as given in Table I. Mr. Binney, the veteran conchologist, at first pronounced our loess specimens *P. solitaria*, but upon a closer examination of Iowa specimens declared his inability to decide between that species and *P. strigosa cooperi*.

18. Reported from the "post-pleiocene" by Binney in Land and Fresh-water Shells of N. Am., part 3, p. 108. The species is strictly terrestrial and is now common in the southern states.