# XV.—*On a Fossil Fox found at Œningen near Constance; with an Account of the Deposit in which it was imbedded.*

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[Read January 18th, 1830.]

THE remarkable fossil quadruped which has given rise to this memoir was found in the quarries of Œningen near Constance, in the autumn of 1828, immediately before my first visit to them. The novel occurrence of an entire carnivorous quadruped regularly imbedded in stone led me to put together a few observations on the deposit which contained it; but I deferred the publication of them until the specific character of the animal should have been correctly ascertained. This point has now been accomplished through the scientific labours of Mr. Mantell, and I have since re-examined the locality accompanied by Professor Sedgwick.

It may be well to preface the following observations by a short sketch of what other naturalists have written on the same subject.

The quarries of Œningen are known to have been worked as early as the year 1680; and when their contents were first described and figured by Scheuchzer in his *Herbarium Diluvianum**, so great an interest was excited, that numerous collections were rapidly formed by Gessner, Lavater, Ammann, and other naturalists of the neighbourhood†.

Up to the beginning of this century various authors have written on the deposit of Œningen, or some of its contents; amongst whom may be specified Andræa, Gessner‡, de Saussure§, Razoumofsky||, and Blumenbach¶. Of these works the relation of Razoumofsky is the most detailed. He was followed by Karg of Constance, who in the year 1800 published a clear and faithful section of the quarries, with a very copious list of all the animal and

* Published 1700.

† The most complete collection was that made by Professor Pfeiffers, under the patronage of the Bishop of Constance, in the year 1784, and placed in the palace of Mersburg, from whence it has passed to the Grand Ducal museum of Carlsruhe.

‡ *Lettres sur la Suisse.*

§ *Voyage dans les Alpes*, vol. iii. p. 331.

|| *Mémoires de l'Académie de Lausanne*, vol. iii.

¶ *Manuel, und Gotha Magazin.*

vegetable remains*. The variety of this list would astonish any geologist unacquainted with the wonderful fertility of these quarries; for in it are mentioned several quadrupeds and birds, a vast number of fishes, reptiles, insects, and innumerable plants, all of which were by him, as well as by Razoumofsky and other cotemporary writers, identified with existing species†.

At that period, however, fossil zoology had not the fixed character which it has since assumed through the labours of the illustrious Cuvier, who has clearly shown that several of the organic remains of Œningen have in fact no exact types in living nature, and that the celebrated *Homo diluvii testis* of Scheuchzer was in reality an aquatic salamander‡. Much however remained to be examined; for it was still left in doubt whether amidst the fishes, insects, shells, and plants, many might not yet prove to be of existing species. Cuvier satisfactorily established, that all the mammalia discovered in this deposit up to the time of the publication of his work were Rodentia, and that no *carnivorous* quadruped had been hitherto found in it.

Previous to the appearance of the *Ossemens Fossiles* M. Brongniart had

* *Denkschriften der Vaterländischen Gesellschaft der aerzte und Naturforscher Schwabens*, vol. i. p. 1. Tubingen, 1805.

† In the memoirs of Scheuchzer, Razoumofsky, and Karg, will be found the three principal theories by which it has been attempted to explain the nature of the Œningen formation.

1st. Scheuchzer referred the whole to the Mosaic deluge, bringing forward, as a proof of it, his *Homo diluvii testis*, an animal which subsequent German authorities considered to be a skeleton of a large fish, but the true nature of which was only established by Cuvier, who has clearly shown that it was an "aquatic salamander."

2ndly. The hypothesis of Razoumofsky (*Annales des Sciences de Lausanne*, vol. iii.) was, that the sea in retiring had left a vast freshwater lake which extended fifty-nine leagues in length, covering all the country between the lakes of Geneva and Constance. In support of his theory this author identified the fossil species of this lacustrine deposit with those of the lignite beds near Vevay, where it is now well known that a few land and fluviatile shells, differing entirely from those of Œningen, are mixed up with marine remains. He further imagined that volcanic subterranean agencies had indurated, altered and bituminized the marls, calcined the shells, and carbonized the plants. It is remarkable that this author seems to have been unacquainted with the existence of the adjoining volcanic group of Hohentwiel, which might have served to confirm his views as to the igneous consolidation of the deposit. (See a description of the volcanic rocks of Hohentwiel. *Denkschriften der Naturforscher Schwabens*, vol. i. p. 204.)

3rdly. Karg and others imagined that the strata were formed in tanks or fish-ponds within the period of history. This singular notion was adopted under the false supposition, that as all the animals and plants were of existing species, they most probably inhabited ancient fish-ponds which the legends of the adjoining convents asserted to have formerly existed in this neighbourhood.

‡ *Ossemens Fossiles*, vol. v. part 2. p. 431.

visited Œningen, of which he has given a section and description*, and in which differing from Karg, who had not only asserted that the deposit was superposed to all other formations of the neighbourhood, but had even been accumulated within the historic period, he endeavours to prove that it is subordinate to the adjoining molasse, and of about the same geological age as the Palæotherian strata of the Paris basin. My observations, however, whether derived from actual sections, or from a consideration of the organic contents of the quarries, have induced me to come to different conclusions from both these authors, and to think that the Œningen formation is exclusively of ancient, lacustrine origin, yet entirely posterior to the molasse of Switzerland†. To prove this position I shall offer,

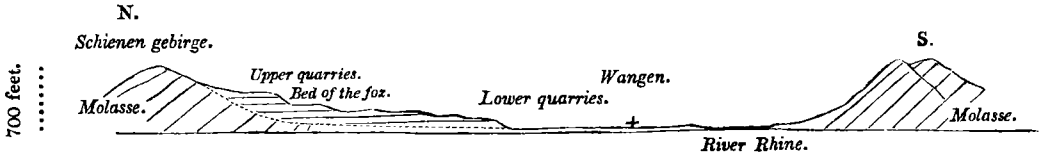
1st, A description of the deposit and its relations to the surrounding country, with actual sections of the quarries.

2ndly, A sketch of their contents, including a special account of the carnivorous quadruped by Mr. Mantell, and a synopsis of other organic remains formerly and recently discovered.

3rdly, Conclusions drawn from the previous details.

The Rhine, in its course from Constance to Schaffhausen, flows for many miles in a depression of the tertiary marine formation known by the name of Molasse, which being cut through transversely, is exposed in hills on both banks, at heights varying from seven to nine hundred feet. These hills, consisting of micaceous sandstone and conglomerate, form the western prolongation of that great range of tertiary deposits which extends along the flanks of the Austrian and Bavarian Alps, and has been described by Professor Sedgwick and myself. The marls and limestone of Œningen are recumbent on this molasse, and are seen in various patches on the sides of the hills, and are worked in two quarries at different elevations overlooking the Rhine.

*Section across the Valley of the Rhine, showing the Relations of the Lacustrine Formation of Œningen to the Inferior Marine Molasse.*




* *Environs de Paris*, p. 307.

† In justice to M. Brongniart it is right to state, that the quarries had not been worked for some years previous to the period of his visit, and were probably then too much encumbered with rubbish to admit of his making a satisfactory section. (See his observations, *Env. de Paris*, p. 308.)

The quarries seen in the accompanying wood-cut are situated on the right bank of the Rhine, just where the river re-issues from the Zeller-See or lesser lake of Constance, about two miles distant from the village of Œningen, and three miles west of the town of Stein. The lowest of these is near the village of Wangen, about two hundred feet above the level of the river; the highest is nearly one mile further distant from the Rhine, and about six hundred feet above its level. In both the upper and lower quarries are found an abundance of freshwater and terrestrial remains, to the entire exclusion of anything marine; and in both cases the marl beds rest upon molasse, which rock thus forming the bottom of the basin, is exposed beneath the lower quarries in the denudation of the Rhine, and rises behind them into the woody hills of Schienen. It would therefore appear from the configuration of this district, that the valley in which the Rhine now flows was, at a remote period, deeply excavated in the molasse, and that subsequently, a lake was formed in one of the broader parts of this valley, in which marls and limestone were gradually deposited: indeed the arrangement and shape of the strata scarcely allow of any other hypothesis; for the beds though nearly horizontal, thicken slightly towards the centre of the basin, whilst the nature of the organic remains, and their deposition in successive layers, not only prove the long period of time which must have elapsed during their accumulation, but also demonstrate the lacustrine origin of the deposit*.

*Lower Quarries.*

The lower quarries have never been extensively worked on account of the incoherent nature of the stone, nor have they afforded the same quantity of organic remains as the upper quarries; they are however at present exposed to the depth of about twenty-five feet. The principal beds are cream-coloured marlstones, with a blue, internal fracture, and have in parts a considerable proportion of sand and some mica, which seem to have been derived from the detritus of the formation of molasse on which they rest. These strong beds are separated from each other by thin way-boards of unctuous, argillaceous marl. Plants chiefly dicotyledonous, fishes, and shells, are distributed throughout the finer bands of marlstone, which separate the coarser beds from each other. Amongst the plants I here found that remarkable impression of a leaf described in the sequel as *Populus cordifolia*, several small fishes, a few shells of Anodonta, &c.

* In corroboration of these views, see Karg's Memoir, cited, p. 278.

*Upper Quarries.*

These were ascertained by the barometrical observations of de Saussure to be six hundred feet above the town of Stein; but Karg, who examined the formation thirteen years later, places them at only five hundred feet. This discrepancy is easily reconciled; for in fact numerous quarries of freshwater limestone have at distant periods been opened on the sides of the Schienengebirge at very different elevations: hence it follows that the sections made by geologists who may visit this locality at different times will seldom precisely correspond*. It will be found however, on comparison, that Karg's section, made in the year 1800, accords very nearly with my own. The present quarries consist of two sets of works at slightly different levels, and separated from each other by about one hundred paces. The carnivorous quadruped was found in the lowest of these, and overlaid by upwards of twenty feet of marl, limestone, and building stone, the beds being arranged in the following descending order.

| | Ft. | In. |
|---|---|---|
| 1. Superficial covering of brown, stiff, argillaceous, marly earth ..... | 5 to 6 | 0 |
| 2. Crumbling and incoherent, calcareous marls, with broken vegetable remains and shells, &c. ..... | 5 to 7 | 0 |
| 3. Fissile, fetid marlstone, splitting into thin slabs, containing many impressions of leaves and stems of plants in the laminæ of division, a few flattened shells of Planorbes, and a small Limnea ..... | 2 | 0 |
| 4. Thin wayboard of dark-coloured marl ..... | 0 | 2 |
| 5. Strong bed of cream-coloured, fine-grained, hard and fetid limestone of dull fracture, earthy texture, high specific gravity, with here and there a minute scale of mica, and an occasional transverse vein of carbonate of lime. Fishes are sometimes found in the lines of separation ..... | 4 | 0 |
| 6. Very finely laminated, white marlstone, the surface spotted over with innumerable, blackish stems of plants and carbonized vegetables. Insects abundant in the finest and most paper-like laminæ. Fishes, crustacea (Cypris) and shells (Planorbis) also occur in these thin layers ..... | 1 | 2 |
| 7 Darker coloured, thin layer of marlstone, in which was found this year (1829) a magnificent specimen of a *fossil tortoise*, probably the largest ever seen. It is about three feet in length. Three of the pats, the head, the neck, and tail, being well preserved and adherent to the body† ..... | 0 | 4 |
| | 20 | 8 |

* In the time of Karg the quarries were much larger than at present.

† This splendid fossil tortoise may possibly still find its way into an English museum: in the mean time I would remark that the only existing species that has reminded me of the fossil, is a large *Testudo Indica* which I recently saw in the museum at Leyden.—Jan. 1831.

| | Ft. | In. |
|---|---|---|
| Brought forward.... | 20 | 8 |
| 8. Thin band of highly fetid, finely laminated, whitish grey marlstone. This bed contained the *fossil fox*. The fissile nature of this stone has occasioned it to split into two slabs with such uneven surfaces, that characteristic portions of the bones or impressions of them are seen in each. The slab containing the more perfect portion of the animal has been selected by Mr. Mantell for his operations of clearing away the surrounding rock. It is worthy of remark, that the fox and the great tortoise present themselves in their fossil state in such an undisturbed position, that we may suppose them to have scarcely moved after they sunk down amidst the fine silt and mud of the ancient lake, with which their bones have since become partially mineralized. In this layer also occur other organic remains, among which are fishes of great size, one of which in a very perfect state had just been found previous to my first visit, and resembled a large pike ..... | 0 | 5 |
| 9. Two or three fine layers of marlstone, differing very little from Nos. 7. and 8. and containing leaves..... | 0 | 10 |
| 10. Great building stone of granular texture; it resembles somewhat No. 4. but is harder, and is considered the best building stone of the quarry. In its less adherent parts shells of *Anodonta Lavateri* are disseminated, with their "nacre" well preserved; and fishes are also found between the laminæ of division ..... | 4 | 6 |
| 11. Finely laminated, white, slaty marlstones, resembling Nos. 7. 8. and 9. in slabs of three to six inches each, and containing fishes, plants, Anodonta, &c.. | 2 | 0 |
| | 28 | 5 |

Here the work was stopped by water, in the autumns of 1828 and 1829, owing to the wetness of those seasons; but in dry weather several inferior, slaty layers are to be seen, and beneath them the micaceous sandstone or molasse.

The adjoining quarry, which is to the north-west of the preceding, consists of beds of rather a more arenaceous texture, and of a darker colour than those just described. These beds contain plants and fishes, and a great number of *Anodonta Lavateri*, but none of the insects which characterize the more finely laminated layers of the middle and lower beds.

All the strata are nearly horizontal, having only a very slight inclination of two or three degrees to the south; and hence it may be inferred, that the

upper beds, which are about one mile from the river, were originally continuous over those of the lower quarries, which are about half a mile distant, and nearer to the Rhine*. This conclusion is further borne out by the differences of mineral character, and by the absence in the lower quarry of many of those organic remains which characterize the upper.

Several distinguished naturalists have examined and described the organic remains which I collected; and to their observations I beg to add a short synopsis of some other Œningen fossils which have come under my notice, and which are now scattered through the principal museums of Europe, in the hope that such a list, however imperfect, may stimulate other inquirers to complete the identification of a vast number of objects which are yet undescribed, or which in former times have been inaccurately named. To commence, however, with the carnivorous quadruped. The following account of it is given by Mr. Mantell in a letter to myself†.

"In compliance with your request, I beg to offer a few remarks on the osteological characters of the extraordinary fossil discovered by you in the Œningen limestone; a fossil which far surpasses in interest any of the wonderful remains which had been found in that deposit.

"When you first submitted this matchless specimen to my chisel, you expressed your conviction that it would prove to be a species of fox; and as I proceeded in the interesting task of removing the stone from the skeleton, I found myself warranted in agreeing with you in that opinion. When the specimen was entirely exposed, I procured a recent fox, and dissected the skull, extremities, &c., and upon comparing them with the fossil could detect no essential difference. Through the kindness of Mr. Clift I have since been able to examine the skeletons of several varieties and species of the genus Vulpes in the museum of the College of Surgeons; namely, five or six individuals of the *Vulpes communis;* the black fox, the cross fox, and the Isatis, or white fox. The skull of the last-mentioned species is more obtuse than that of the fossil; but the skulls of the common fox and its varieties do not differ more from the fossil than from each other; in fact there was not a greater difference observable than between the skulls and teeth of individuals of the recent animal, of various ages and countries. In making this observation I would, however, particularly remark, that the skull of the fossil is unfortunately so much broken and defaced, that the true form of the frontal bone, post-orbital apophyses, &c., cannot be correctly determined, and that these alone might be expected to afford essential, specific characters.

"In the other parts of the skeleton, the only differences I noticed were the

* See Wood-cut, p. 279. † Plates XXXIII. and XXXIV. fig. 1, 2 & 3.

following; viz. the spinous process of the *dentatus* appeared to be more expanded; the *radius* more cylindrical and elegant near its brachial extremity; and the *fibulæ* larger, and more rounded, than the corresponding parts of the skeletons of the *Vulpes communis,* which I had an opportunity of examining. I do not, however, think that these slight variations in osteological structure are alone sufficient to establish a variety, much less a species. Near the angle of the lower jaw of the fossil, there is a process of bone so like the *styloid* in form, and occupying the situation which it might be supposed to occupy, if these animals possessed such a process, that its appearance was at first very puzzling: upon minute examination I am inclined to believe that it is a spiculum of bone, displaced by the fracture and compression which the skull has sustained, and that its situation is accidental; it is, however, too remarkable an appearance to be passed by without comment.

"I very much regret that from my limited means of observation I cannot offer more satisfactory results: the remark of Baron Cuvier on the bones of the animals of this genus found in caverns, 'that they may with almost equal propriety be assumed to belong to one recent species as to another*,' will apply also to the splendid specimen before us. If the skull were perfect, more rigid conclusions might be obtained; but as this is not the case, I beg to submit that the only inferences we are warranted in deducing are the following:

"1st. That the fossil animal belonged to the genus Vulpes.

"2ndly. That it bears a closer analogy to the *V. communis* than to any other with which it has been compared.

"Lastly, that notwithstanding its resemblance to the recent, it may possibly belong to an extinct species, since specific differences cannot always be detected in the skeleton."

In addition to what Mr. Mantell has said of this animal, I have to observe, that the occurrence of a portion of black-coloured matter in the place of the abdomen, immediately beneath the lumbar vertebræ, induced me, under the supposition of its being the fossil fæces of the animal, to submit a portion to the examination of Dr. Prout, who, after analysis, has pronounced it to be of the same nature as the balls of *Album Græcum,* and coprolites of Dr. Buckland. This is the first instance in which this fossil substance has been found in the body of a land quadruped, although Dr. Buckland had observed that it occurred in the abdominal regions of saurians. In this case, however, it is not the coprolite alone which contains phosphate of lime; for by other experiments of Dr. Prout it appears that the entire block of the surrounding marlstone is also impregnated with the same mineral. There seems therefore to

* *Ossemens Fossiles,* tom. iv. p. 465.

be every reason to conclude, that the bituminization of this mass of rock* is due, in a great measure, to the destruction of the large quantity of animal matter contained in it; for the coprolite itself only differs from the surrounding matrix in containing a greater proportion of phosphate of lime.

All the other mammalia hitherto found at Œningen are Rodentia; and for an account of several of them I refer to the works of Baron Cuvier†. One specimen of these, which is in the British Museum, has subsequently been figured, and named by Mr. König *Anoœma Œningensis*‡.

Another animal of this order was brought from the quarries this year by Professor Sedgwick, which M. Laurillard of the Jardin du Roi, Paris, refers to Lagomys.

*Birds.*

These are considered by Blumenbach and Karg to be chiefly aquatic, and according to the former they consist principally of Grallæ. The latter author enumerates birds of other classes, as well as detached specimens of beaks and feathers§.

*Reptiles.*

Of these the most curious is the large aquatic Salamander, described by Cuvier, and of which there are several individuals; one of which, in admirable preservation, is in the British Museum. In the Carlsruhe Museum I observed specimens of Rana and of Testudo. Besides the splendid individual mentioned, p. 281. in the section of the quarries, the *Testudo orbicularis?* is said to have occurred‖.

*Fishes.*

The fishes of Œningen have not yet been fully described, although Andræa, Lavater, Knorr and Scheuchzer, published and figured many genera and species, comprehending lamprey, trout, pike, seventeen species of carp, &c. Cuvier and Blainville doubt the accuracy of many of these identifications, although they both allow they have not as yet seen a sufficient number of specimens for comparison, and the former distinctly reserves his opinions for a

* See similar conclusions as to the cause of the bituminization of the rock at Seefeld in the Tyrol containing fossil fish, in a memoir by myself read before the Geological Society, and published in the Philosophical Magazine and Annals of Philosophy, July 1829.

† *Ossemens Fossiles*, tome v. Partie 1. p. 61—64.

‡ *Icones Fossilium Sectiles*, inedited.

§ Karg's list of organic remains is not given, because many of his specifications cannot be depended upon. Of the specimens alluded to by him the greater number are now in the Carlsruhe Museum; others are in the British Museum, and a few are at Paris and Vienna.

‖ Karg's Memoir.

subsequent work on Ichthyolites. Blainville, however, recognizes the *Esox lucius** to be a true pike, but is not quite decided that it is of the common species. *Cyprinus jeses* and *C. bipunctatus* are also identified by him, but with a slight doubt†.

*Insects.*

These are found in abundance when the quarries are in activity, but being disregarded by the workmen are usually thrown away with the refuse: I could therefore collect only a few specimens, one of which is referred by Mr. Curtis to the family of Formicidæ, and another to the Hymenopteræ?. Amongst the Œningen insects in the British Museum‡, Mr. Samouelle has noticed the larvæ of two species of Libellula; Anthrax two species, Coccinella one, Cimex one, Cerambyx one, Blatta one, Nepa one. Now it is highly interesting to remark that several of these insects, such as Anthrax, Cerambyx, &c., are in living nature found upon such marshy plants as they are here associated with in a fossil state, so that we can have little difficulty in supposing that they dropped into this ancient lake from the vegetation which surrounded it. Again, the larvæ of Libellula above mentioned, exactly resemble our common English species *Libellula depressa,* which is aquatic, the perfect insect frequenting lakes and stagnant waters; whilst the Nepa is a well known inhabitant of the bottom of muddy pools.

Mr. Stokes has obligingly granted me the use of some nearly perfect insects from Œningen, three of which have been kindly drawn for me by Mr. Swainson, and described by Mr. Curtis in these words:

"Plate XXXIV. fig. 4. A young larva of an Œshna (Libellula Linn.) perhaps *Œ. grandis.*
——————— fig. 5. The underside of a pupa of the same insect, showing the curious mask, the insertion of the legs, and the spiraculæ.
——————— fig. 6. An Agrion, perhaps *A. sanguineum.* The stigmata of the wings not being visible is what might be expected, because even in recent specimens, soon after their exclusion from the chrysalis, those parts are of so pale a colour as not to be apparent, and must consequently be injected by fluid to colour them, which by pressure or absorption would disappear from the stigmata as well as the nervures."

In examining these bodies the entomologist can neither assert nor deny the identity of the greater number of them with existing species§. We may safely state, however, that although they are very unlike those of the gypseous ter-

* See Knorr, *t.* 1. *tab.* 26. and Scheuchzer, *Pisc. Quer. tab.* 1.

† In the British Museum there are many fine specimens of Œningen fishes yet undescribed.

‡ Ammann and Lavater's original collections.

§ It is very much to be desired that some able entomologist may soon examine the splendid collection of these insects, now placed in the grand Ducal Museum at Carlsruhe.

tiary formation of Aix in Provence*, yet both there and at Œningen the forms and generic characters of the fossils, with few exceptions, accord with those of the insects now living in each district.

*Crustacea.*

A species resembling *Cancer fluviatilis* (Potamophilus of Latreille), is cited by M. Brongniart†; and crabs are figured by Karg from the Lavater and Gessner collections. Other specimens of Crustacea are to be seen in the museum at Carlsruhe. Cypris resembling *C. faba*, occurs abundantly, as has been noticed in the sections of the quarries.

*Conchifera.*

*Anodonta Lavateri*‡ is the only bivalve which I have observed; but it is very abundant.

*Mollusca.*

Limnea resembling *L. ovum*§; and a very small, much flattened, Planorbis of a species not yet determined‖.

*Plants.*

A very long catalogue is to be seen in Karg's memoir, wherein he mentions many species of modern European forest trees, shrubs, flowers, ferns, &c., for some of which he refers to the figures in Scheuchzer and Knorr. M. Gmelin, Professor of Botany at Carlsruhe, has also assured me that many of the fossil vegetables of Œningen in the museum of that place were not distinguishable from existing species¶. If these identifications have been pushed too far, the specimens in this country, which have been closely examined by eminent botanists, prove that most of the Œningen leaves in the British Museum belong to dicotyledonous plants, and that they all have a modern character. A pentapetalous flower in this collection has been recently figured by Mr. König, and named by him *Viburnum Œningense***.

Mr. R. Brown has discovered that among these plants, one is almost undis-

* Described by Mr. Curtis in a Memoir by Mr. Lyell and myself; Edinb. Phil. Journal. No. XIV. p. 287—298. See also by M. Marcel de Serres.

† Cuvier and Brongniart, *Env. de Paris*, p. 309. ‡ Ibid. § Ibid.

‖ *Patella* (*Ancylus*) *lacustris?* and other shells are cited by Karg.

¶ Amongst these he enumerates *Populus tremula*, *Betula Alnus*, *Salix caprea*, *S. alba*, *S. viminalis*, *S. Helix* (*purpurea*), *Acer pseudo-platanus*, *Fraxinus excelsior*, *Sparganium erectum*, *Potamogeton natans*, *P. pusillum*, Confervæ, &c.

** *Icones Fossilium Sectiles*, ined.

tinguishable in the leaf, from the *Acer villosum,* a species of maple brought from Nepaul by Dr. Wallich.

The specimens which I collected have been referred to Mr. Lindley, who has favoured me with the following report. "I have again examined your Œningen fossil vegetables, but with as little success as before. That some of the leaves may have belonged to plants still existing is highly probable; but the evidence about many of them is not perfect enough to enable a botanist to speak positively. I retain the opinion which I expressed to you last year, that one of them is the lateral pinna of *Fraxinus rotundifolia;* and I see no reason to change my belief that the lobed ones have belonged to some kind or kinds of Acer. If they all belonged to one kind, it must have been a species more variable in the foliage than any at present existing; but it is possible that two kinds may have been intermixed. Some of the impressions, particularly a beautifully perfect one, are not to be distinguished by comparison from the young leaves of *Acer opulifolium,* a species still existing in Dauphiny and Piedmont; others are extremely like *Acer pseudo-platanus* (the common Sycamore), but I cannot assert that they are the same; indeed I incline more to consider them different. The fact is, that these forest trees vary so much in the outline of their leaves, that it frequently is difficult to determine them even from *fresh* specimens.

"Among the fossils is however one in so good a state of preservation, that I am able to say with confidence that it is not of any species at present native of Europe, and I think unknown elsewhere. It is a large cordate roundish leaf with the remains of a petiole, a coarsely toothed margin, and a distinct impression of two elevated glands, at the point where the leaf joins the petiole. Now there are no European trees in which these glands exist, that need be compared with the fossil, except the poplar tribe; and there is no known poplar which bears leaves that do not essentially differ in character from this: I have therefore named it *Populus cordifolia. Populus nigra,* and all its varieties, have smaller leaves, which are truncate, never deeply cordate at the base, and their glands are both smaller and differently formed. *Populus canescens,* in which the leaves are cordate in an equal degree, and as large, has no glands, and its outline is more ovate. *Populus græca* has leaves with two glands placed as in the fossil, but the leaves are much less cordate, and without toothing at the margin.

"Upon the whole I should say the fossils may be considered to consist of one or two species of Acer, possibly referable to existing European species, but probably extinct;—A plant that is not distinguishable from *Fraxinus rotundifolia;*—An extinct species of Poplar; and some other plants bearing a

great general resemblance to the leaves of existing trees, but not in such a state as to be satisfactorily identified."

In addition to these observations I may remark, that the greater number of the leaves of forest trees have their petioles still adherent, as if they had fallen off spontaneously, and in their due season.

In conclusion it may be observed,

1st. From the nature of its organic remains, that the deposit of Œningen is of unmixed lacustrine origin ; and, from the fine lamination and structure of the beds, that they could only have been formed during a long period of time.

2nd. This deposit of marl rock having taken place in a basin of the molasse, that formation must have been deeply excavated prior to the existence of the lake in which the marly strata were accumulated.

3rd. From the intermixture of species undistinguishable from those now existing, with others decidedly extinct, this deposit may be considered an important link in the history of the earth's structure, indicating an intimate connection between the ancient state of nature and that which now prevails.

4th. The deposit differs essentially in its organic remains from any other freshwater formation at a distance from it with which we have hitherto been made acquainted, either in France, or in the adjacent regions of Germany*; thus satisfactorily affording proof of the independence and isolation of these lake formations, amongst which, this of Œningen, both from its contents and superposition to the molasse, must be considered one of the most recent.

5th. Yet recent as must have been the epoch of this formation, the basin in which it was deposited has subsequently been re-excavated to a considerable depth ; the proof of which is, that horizontal beds still present escarpments several hundred feet above the Rhine, without any barrier between them and that river.

Lastly. However long the epoch of this accumulation must have preceded the period when the Rhine attained its present level, we are taught by

* The freshwater limestone of Ulm is deposited in Jura limestone, and contains the *Helix morognesi*, the *Limnea ovata*, and other shells, which peculiarly characterize the lacustrine formations of the Limagne d'Auvergne, and a striated Planorbis, like that of the Isle of Wight.

At Steinheim near Heidenheim the freshwater strata are also deposited on Jura limestone, and contain the *Limnea ventricosa* (Brongn.) of the Paris basin, and a shell (*Paludina variabilis* of Bronn) which M. Deshayes refers to " Ampullacère," a genus of New Holland, &c.

At Bouxweiller near Strasbourg, the lacustrine limestone rests upon a rock of about the age of the great oolite of England, and some of its fossils are identical with those of the freshwater formations of the Isle of Wight. These and several other analogous formations in Swabia, &c. were visited by Professor Sedgwick and myself, on our return from the Austrian Alps, in the autumn of 1829.

lumbar (G. G.), three sacral (H H H), and nineteen or twenty caudal vertebræ (K. K.). The spinous process of the *dentatus* (L) seems to be rather larger than in the fox, but this appearance may perhaps arise from compression.

*Ribs.*—Almost all the ribs are seen, although in some instances they are displaced, and lie in confusion; those of the left side are marked (M. M.), those of the right (N. N.).

*Sternum.*—The greater part of the sternum remains (O. O. O.).

*Scapulæ.*—P. the left, and Q. the right scapula. The head of the left scapula is seen at (*m.*), the body of the same (*n.*) is displaced and lies above the dorsal vertebræ. The right scapula is not broken, and extends under the vertebræ and displaced portion of the left.

*Humerus.*—R. the left, and S. the right humerus; the heads of the bones lie in contact with the glenoid cavity of the scapulæ.

*Ulna.*—T. the left, and V. the right ulna.

*Radius.*—U. the left, and W. the right radius. It has already been mentioned that the head of this bone appeared to be more cylindrical, and the shaft more rounded, than in the common fox with which it was compared. In conjunction with other osteological differences this might have been important.

*Pelvis.*—X. The pelvis is unfortunately in a very mutilated and indistinct state: the ischium is seen at (*o*).

*Femur.*—Y. the left, and Z. the right femur.

*Patella.*—&. Probably one of the patellæ.

*Tibia.*—A″·· The left, and B″·· the right tibia.

*Fibula.*—C″·· The left, and D″·· the right fibula.

*Carpus.*—The bones of the left carpus are seen at E″··, those of the right at F″··; the phalanges are marked 1. 2. 3, the ungueal 4.

*Tarsus.*—G″. The left os calcis or calcaneum, and H″. the right.

I″. The right astragalus, and K″. the left.

L″. Other bones of the tarsus.

The phalanges are numbered like those of the carpus. Several of the sesamoid bones remain; two are seen almost *in situ* at 5. 5.

## PLATES XXXIII. & XXXIV.

Illustrate Mr. Murchison's paper on the Fossil Fox found at Œningen.

### PLATE XXXIII.

The Fossil Fox.

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### PLATE XXXIV.

Outline of the Fossil Fox. (See Mr. Mantell's anatomical description, p. 291.)

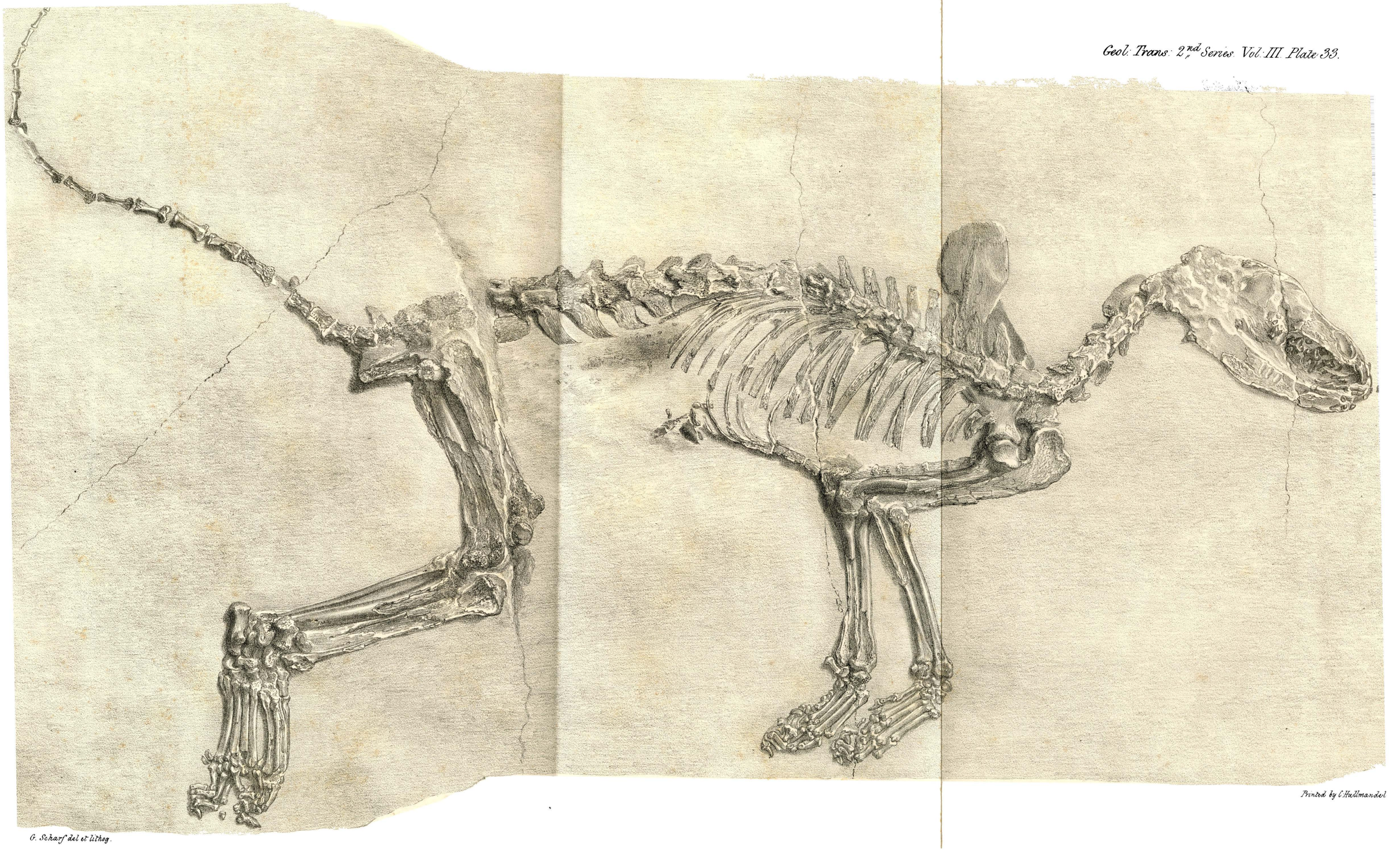

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Fig. 2.

Fig. 4.

Fig. 5.

Fig. 6.

W. B. Swainson

Fig. 1.

Fig. 3.

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