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MEDEDEELINGEN
VAN DE
RIKSOPSPORING VAN DELFSTOFFEN
No. 6

MITTEILUNGEN DER STAATLICHEN BOHRVERWALTUNG
IN DEN NIEDERLANDEN

MÉMOIRES DU SERVICE DES EXPLORATIONS MINIÈRES
DE L'ÉTAT DES PAYS-BAS

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EXPLORATION OF THE NETHERLANDS

UITGEGEVEN OP LAST VAN
HET MINISTERIE VAN LANDBOUW, NIJVERHEID EN HANDEL
's-GRAVENHAGE 1915

THE PLIOCENE FLORAS
OF THE
DUTCH-PRUSSIAN
BORDER

BY

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AND

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's- GRAVENHAGE
MARTINUS NIJHOFF
1915'

Eu.

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Pocket
at end.

INTRODUCTION.

A few words are needed to explain how it happens that in the following pages we are describing the Pliocene floras of Limburg and the Prussian border, instead of keeping to our own country, where so much remains to be done. And it will be well to explain also why we treat the subject less from the point of view of the describer of extinct plants than from that of the plant-geographer and the field-naturalist.

For many years we have worked in the Pleistocene and Pliocene deposits of Britain, in the hope of obtaining some approximate measure of geological time, some idea of the succession of climatic changes, and some insight into the origins and migrations of successive faunas and floras. We found, however, as others have found, that it is necessary to use two parallel chronologies, the one founded on the changes amongst the inhabitants of the lands and rivers, the other on the inhabitants of the sea. Not only are the changes in the two sets of fossils not contemporaneous; but even the climatic conditions may be quite different for seas and lands closely adjoining. The bridge which helps the migration of the land flora and fauna is the barrier which prevents the mingling of the faunas of two closely adjoining seas; the strait which connects two seas is the barrier which stops the spread of the fauna and flora of the land.

The fossil fauna of the sea is fairly well known, and its Tertiary history is now nearly continuous. But the land-animals and plants are comparatively little studied, and their geological record is full of gaps; still it is on the land that we live, and it is the climate and past history of the land-areas which are of the greatest interest to us.

The natural history of the land-areas is therefore our special study; but in enquiries of this sort the field is so vast that before venturing to generalize it is necessary first to specialize on some particular group. The group selected must be one which responds readily to changes of climate and physical conditions, and is found in all latitudes and at all altitudes.

Mammals, or any warm-blooded animals, are unsafe guides; for they have great power of resisting and adapting themselves to climatic changes. Closely allied species may inhabit arctic and tropical regions, and we cannot learn from any living mammal under what conditions an extinct ally may have lived. The elephant and the rhinoceros are now tropical; extinct elephants and rhinoceroses, clothed with thick fur, are found frozen up in the soil of Siberia, and were evidently adapted to an arctic climate.

The land and freshwater mollusca have proved of less use than was expected. The coleoptera probably would be a very valuable group for this study, were their fossil

remains less fragmentary and less difficult to collect and preserve. There remain the flowering plants and cryptogams, both of which are extremely useful; of these we have undertaken specially the flowering plants.

During recent years we have therefore devoted all our available time to the study of the living and newer Tertiary floras, employing methods not in general use for collecting the fossils. We found that the usual method, the study mainly of the fossil deciduous leaves, did not yield altogether satisfactory results, either for the determination of the species, or for the size of the fossil floras. In our research, the evidence being cumulative, we must have a large number of species, and we found it advisable to work chiefly with fruits and seeds, which are also more readily collected, and preserved in a determinable state, than leaves.

It is evident that a collection of fossil leaves, mainly deciduous, will contain quite a different assemblage from that found in a collection of fossil fruits and seeds; for the latter is not only more varied, but contains also the herbaceous genera, usually absent in palaeobotanical collections. If we desire to study the changes in the flora during successive periods, we must work as far as possible with fossils deposited under similar conditions and collected by the same methods. It is almost impossible yet to make a satisfactory comparison between the flora of a deposit yielding only leaves, and one containing seeds.

Systematic washing of the seed-bearing deposits in Britain has yielded most interesting results. We have now a good sequence of small floras, commencing with Roman deposits, and going back through Celtic, Neolithic, Glacial, Interglacial, and Early Glacial strata to the latest Pliocene stage, shown in the Cromer Forest-bed. But at this point there is in Britain a break in the succession of land and freshwater strata, the earlier Pliocene deposits being marine and containing no plants. When we again find plant-beds it is so far back, in the earliest Miocene or latest Oligocene, that comparison is impossible.

Thus we were forced to look abroad for the continuation of the history of the Pliocene flora of north-western Europe, and when we heard of the discovery of a Pliocene flora in Limburg we immediately arranged to examine it. The study, about seven years ago, of the Upper Pliocene flora of Tegelen yielded results so unexpected as to necessitate a reconsideration of the whole question of the origin of the Palaearctic flora. When therefore Dr. W. J. JONGMANS asked us to undertake the examination of material obtained from deposits probably of somewhat earlier date, we willingly consented. Perhaps we should not have consented so willingly had we known beforehand how many months of work would be required, or what an enormous mass of material would be sent to us.

The work of collecting the fossiliferous material in Limburg and in the clay-pits just over the German border was done by Dr. JONGMANS and Dr. TESCH. In the Herbarium at Leiden the various gatherings of lignitic material were boiled down with soda, so as to remove the inorganic sediment, and also the decayed humus. Some of the

residue after boiling was examined at Leiden by DR. JONGMANS, who picked out the fruits and seeds. But the bulk of the washed residue was sent either in water, or wet, for us to examine. Even with Dr. JONGMANS' assistance so much of the preliminary picking over remained to be done, that besides undertaking a great deal ourselves, we were glad to enlist the services of friends. For this work our kind friend Mr. A. H. LYELL volunteered, and his extensive experience in examining archaeological material was very valuable. Miss HYLDIA BRUCE both helped with this work, and also assisted in the careful waxing and preservation of the specimens, without which they would probably crumble away and disappear entirely in the course of a few years. Miss BRUCE was also able to help us in the development and printing of the photographs, the whole of the photography being done by ourselves.

All the specimens figured in this Memoir will be placed in the palaeobotanical collection of the "Rijksopsporing van Delfstoffen" and to this collection we have given the figured specimens from Tegelen, published in 1907, 1908, 1910.

So large a proportion of the Pliocene plants belong to genera previously unknown in the fossil state, or only known from leaves, that comparison with fossil plants was almost impossible. We have been obliged therefore to rely on the herbaria for material for comparison, our own collection till lately being mainly European. The work would have been extremely difficult, without the great assistance freely rendered by the Director and officers of the Royal Gardens at Kew, who allowed the examination and dissection of numerous fruits and seeds in the Herbarium, or supplied fresh material from the Gardens, where such was available. To them our thanks are principally due. We have to thank also several botanists who happened to be working at Kew, for valuable suggestions, especially Mr. H. N. RIDLEY (formerly of the Singapore Botanical Gardens), and Mr. S. T. DUNN (formerly of Hong Kong). Dr. A. B. RENDLE (of the British Museum) has also helped us.

As many of the fossils belong to warmer countries than ours, it has been necessary to apply for specimens or advice to botanists in other lands. Amongst those who have helped we may specially mention Professor SARGENT and Mr. E. H. WILSON (of the Arnold Arboretum), Dr. TOKUTARO ITO (of Tokyo, Japan), and Dr. ALWIN BERGER (Curator of La Mortola Garden).

The miscellaneous objects found in sorting the material were not many. The few mosses have been examined by Mr. H. N. DIXON; some galls were sent to Professor J. W. H. TRAIL; and the curious diseased fruits of *Meliosma* have been reported on by Mr. G. MASSEE, of KEW, who has devoted special attention to the fungi. The notes of these gentlemen who have so kindly assisted us have been incorporated in the text.

GEOLOGY.

At the point where Rhine and Maas leave the hill-country and enter the plain their ancient high-level terraces combine, spread out into a wide somewhat undulating plateau, and occupy the whole area now separating the two rivers. This high plateau is the head of an ancient delta, most of which has been destroyed by the action of river or sea; so that the edges of the plateau now form steep scarps, either facing the Rhine or overlooking the plain of the Netherlands.

The deposits of this delta consist mainly of current-bedded sand and sandy gravel, partly derived from the basin of the Rhine, partly brought down by the Maas. They contain, however, subordinate beds of freshwater clay and lignite, on at least two different horizons. These masses of clay, which vary from 1 to about 5 metres in thickness, were laid down in abandoned river-channels, or shallow lakes, and were probably never continuous over long distances. After their deposition, as the level of the delta rose, they were covered by sheets of sand and gravel, like those below; and in this process there was a certain amount of breaking up and destruction of the clay-beds, for large pebbles of fossiliferous clay are often found in the gravel — indeed in some cases clay-pebbles with plant-remains are the sole relic of a once-continuous clay-bed.

The total thickness of the delta-deposits is still unknown. It is probably at least 100 metres; but the complete sequence has not been proved at any one spot. Tectonic disturbances have affected the delta, and were probably in progress whilst the delta was being formed; it is therefore impossible to estimate the thickness of the delta-deposits by measuring from the maximum height of the gravel plateau to the maximum depth to which the gravels descend beneath the level of the sea.

We must not make the mistake of estimating the importance of the ancient delta by the small remains now preserved between the Dutch lowlands and the Rhine. At the period of its maximum extension the fan stretched right across the North Sea, and gravels evidently derived from the Rhine and Maas are found abundantly in the so-called "Cromer Forest-bed" of the Norfolk coast. We do not yet know whether any part of the high-plateau between the Rhine and Maas belongs to this maximum extension; but the Cromerian fauna and flora should be searched for on the highest parts of the plateau. Only rivers flowing at that high level could form a gravelly delta as far away as the coast of England — unless the relative levels have since greatly altered.

It is probable that when the surface of the high plateau is more thoroughly examined, even more recent deposits may be found on it, and if care is not taken

these may be confused with the ancient delta-deposits. Though the plateau is now so dry that rain immediately sinks into the ground, and does not form surface streams, it must not be forgotten that when the climate was arctic, conditions were entirely altered. Then the gravel must have been frozen to a considerable depth and rendered impervious, either for the whole year or until late in the spring. Under such circumstances the spring thaw and spring rains would cover the plateau with irregular water-channels and pools, and in the deposits of these pools we may expect to find Arctic plants, or the bones of mammoth, *Rhinoceros antiquitatis*, and lemming, just as they are found in Germany and England. The discovery of such fossils in the surface layers must not be taken as proving that the formation of the plateau itself was of Pleistocene date.

There has been much discussion as to the age of the gravels of the high terraces and high plateaus, and on the ground that these gravels were thought to be earlier than the first advance of the Alpine glaciers, they have been referred to the Diluvial or Pleistocene period. The question of Alpine glaciations is however of very little importance in the lowlands. The extension of the Alpine glaciers depends mainly on two factors which do not here concern us. The first factor is the varying elevation of the Alps at different periods, and this at present we have no satisfactory means of estimating. The delta-deposits show no sign of tectonic disturbance in England; in Limburg and Prussia they show numerous faults; probably in the Alps far greater movements took place. The second, and probably the more important, factor is the rainfall. The glaciation of a mountain chain depends entirely on the accumulation of snow, and this may be quite unconnected with the climate of the plain a hundred kilometres away. The advance of glaciers may be due to a general climatic change; but it depends much more on the angle at which the moist winds impinge on the mountain slopes. The snow-line may be found at quite different levels on the two sides of a mountain-chain. In the Himalaya it is far lower (about 1000 metres), and the glaciers are much larger on the moist-warm south side than on the dry-cold north side.

A dry-cold period, with a sub-arctic fauna like that of the loess, will be considered in the Alps, if the strata are unfossiliferous, to be interglacial, not glacial, for the glaciers retreated. But a much warmer moist period, provided the moist winds reached the Alps, will there be considered as glacial, instead of interglacial, for the glaciers advanced. The discussion of the extension of the Alpine glaciers may therefore be left out of the question, and we must judge of the age of the deposits of the plain from their internal evidence, and from their correlation with other strata of known date in the basin of the North Sea.

Our classification of the Tertiary deposits is founded mainly on the percentage of extinct mollusca contained in the marine deposits. This, owing to the continuity of the oceans, and the variety, good preservation, and great ease with which the mollusca can be determined, gives a means of correlation far more satisfactory than that yielded by local climatic conditions, or by the examination of the fauna and flora of isolated land-areas. In the case of isolated lacustrine deposits it may be necessary to adopt

provisionally an independent classification; but wherever possible it is better to use for all strata the same standard, and the one having the widest possible application.

The greater part of the delta-deposits of the high plateau are unfossiliferous; but as already mentioned thin clays have been found on at least two different levels, and there may be others above or below. The principal clay-deposits are exposed at the foot of, or low down in, the steep scarp overlooking the Maas. Towards the northern end of the high plateau, at Wylerberg, near Nijmegen, there is however a clay-pit high up on the plateau. But the clay-beds are nearly vertical, and may have been driven up from a lower level by the thrust of the ice-sheet, which here was stopped by the scarp. The locality happens to be exactly at the limit of the ice, and in England, where for long distances the ice impinged against the rising land, such upthrusts of low-lying strata are common. Messrs. FLIEGEL and STOLLER have published a list of plants from this locality. We have not examined the specimens, but the presence of *Vitis* and *Pterocarya* suggests that the clays may be of the same age as those of Tegelen.

Owing to the position of the main clay-beds, which lie some distance down in the delta sands, they are usually only to be seen near the foot of the scarp overlooking the plain of Dutch Limburg. Thus the fossiliferous strata from which most of the plants are obtained, though lying partly on the Netherland and partly on the Prussian side of the frontier, are only readily accessible from the Netherland side, and the clays there dug are made into bricks in the neighbouring Dutch villages. Whether they are found on the Netherland or Prussian side the clay-seams are continuous, and cannot be treated of separately. Thanks to the courtesy of the Prussian Geological Survey we are enabled to deal with them in this Memoir independantly of the political boundary.

Much has been written about the gravels of the high plateaus of the Maas and Rhine, and they have been accepted by most writers as Pleistocene; though some geologists have recognised that they may include strata of older date. The discovery of various fossiliferous masses of clay and lignite has now taught us that the deposits are composite, and belong to more than one stage, some extending back at least as early as Middle Pliocene. Much remains to be done before the geology of this ancient delta is thoroughly understood; for at present we only know the fossils of two of its stages in this region, and of a third stage in England alone.

In this Memoir we will not attempt to deal with the whole of the delta deposits; it will be better to confine our attention to those parts we have more particularly studied. But before passing on to the local evidence, a word of caution is needed to those who attempt to correlate the gravels with terraces higher up the valleys. We are dealing with a river under somewhat abnormal conditions. When geologists examine ancient river-deposits they almost invariably assume that the highest terrace is the oldest; and such is usually the case in a river-valley in a mountainous country, and under normal conditions. But in the case we are now considering the conditions were not normal. A delta-fan was being accumulated to a great thickness, and its further edge was being gradually pushed forward, till it reached the Norfolk coast, 300 kilometres away. How

much further north the mouth of the river lay we do not know, for in Norfolk the delta-deposits consist largely of coarse gravel, and beyond we might expect a wide expanse of muddy alluvium. The necessary results of this advance of the delta must be taken into account. The addition of 600 kilometres to the course of the Rhine, and the consequent rise of the river-bed, must affect the flow for long distances above the head of the delta, and far above the sea-level.

Before the delta began to form, the Rhine and Maas poured their waters, perhaps independently, into the Pliocene sea, and the erosion of the Rhine and Maas valleys near the sea reached its maximum depth, leaving successively lower and lower terraces. But then, as the gravelly delta advanced over the marine Pliocene deposits and obstructed the flow, the water was ponded back, the level of the delta rose, and new high-level terraces may have been formed. The newest of these high-level terraces, corresponding with the maximum extension of the gravel-delta into Norfolk in Cromerian times, may in the upper Rhine Valley coincide in level with some far more ancient terrace, perhaps of Lower Pliocene or even of Miocene date.

The fluctuations of the position of the mouths of the Maas, Rhine, and Elbe, which flowed into the intermittently subsiding area of the North Sea, were very complicated, and we are not yet in a position to write the complete history of these fluctuations. At certain periods the rivers entered the sea directly they left the hills, at others, as already observed, their combined deltas extended hundreds of kilometres further. We know of at least three periods of great extension. The earliest was in Cromerian, or latest Pliocene times, when coarse Rhine-gravels were carried as far as the coast of England, where they yield peculiar mammals, of which *Elephas meridionalis*, *Rhinoceros etruscus*, *Equus stenonis*, and *Cervus verticornis* are perhaps the most abundant. A second extension seems to be represented by the Pleistocene mammalian fauna of the Dogger Bank, where in former years were dredged many bones, of which the most abundant were the mammoth (*Elephas primigenius*), *Rhinoceros antiquitatis*, *Bison priscus*, *Equus caballus*, *Cervus tarandus*, and walrus (*Trichechus rosmarus*).

Recently a third extension of the delta has been recognised, in the peat trawled from the submerged plateau of the Dogger Bank. This extension, from the character of its temperate flora, seems to be of Early Neolithic date, and equivalent to the lowest "submerged-forests" or submerged peat-beds of England and the Netherlands.

These two later extensions of the delta, however, do not concern us here. They probably did not much affect the surface of the high plateau, for the deposits of the Dogger Bank lie at a considerable depth below the sea (20 metres and more). The equivalents of these strata may be looked for in the Maas and Rhine valleys in the low terraces, for the outlet of the rivers, though far away, was not blocked, as it must have been in Cromerian times, when coarse Rhine-gravels were deposited in Norfolk to a height of 5 or 10 metres above the present sea-level.

The problem of the tectonic movements in the delta and in the North Sea basin is a most difficult one, and brings in additional complications. Intermittent movements

seem still to be in progress, and an important subsidence over wide areas appears to have taken place as recently as Neolithic times, probably about 3500 years ago. We here, however, need only deal with the Pliocene delta, which probably began to form as soon as the Diestian, or Lower Pliocene, sea became shoal. Unfortunately however, it has not yet been possible to prove by vertical superposition the exact relation of the delta-gravels to the marine Pliocene strata of Limburg. They occupy slightly different areas; but the underground structure suggests that the oldest delta-gravels are either contemporaneous with, or somewhat newer than, the marine Scaldisian. The gravels commonly rest directly on Miocene strata; but some boring or mine-shaft may at any time prove an extension of the Pliocene marine strata into the area with which we are now dealing.

It being at present impossible to prove the age of the Pliocene delta-deposits by direct superposition, we must fall back on the evidence yielded by the included fossils and the climatic conditions they indicate. Provisionally we must still use two parallel classifications, the one for the marine the other for the freshwater strata. This is the more necessary owing to the exceptional character of the Pliocene floras of the high plateau. We have no similar floras elsewhere in Europe to compare with them, and the older of the two fossiliferous horizons yields nothing but plants, and a few freshwater mollusca not yet determined. Fortunately the upper or Teglian clays yield, in addition to the plants, certain mammalian remains, and these show a striking resemblance in part to the Norwich Crag, in part to the Cromer Forest-bed. The position of these two divisions is perfectly well known, for in both cases they yield marine mollusca of Upper Pliocene date. We may safely say that the Teglian is newer than the upper marine strata, or Amstelian, and probably represents the Norwich Crag of England — a stage not yet recognised among the marine strata of Belgium and the Netherlands. The Teglian fauna and flora both suggest a date somewhat earlier than Cromerian, but not older than the Norwich Crag.

With regard to the earlier stage, represented at Reuver, Swalmen, and Brunssum, this contains a flora of older type, though many of the plants are common to the Teglian. They show a somewhat warmer climate and indicate a distinct stage, which we call Reuverian. Their most probable position seems to be Middle Pliocene. They may fill the gap which occurs between the warm-sea deposits of the Scaldisian and the colder sea Amstelian, though no fluviatile deposits have yet been discovered between these two marine divisions of the Dutch and Belgian plain. Provisionally, however, we can only class the Reuverian as Middle Pliocene, leaving its exact equivalent for future determination.

We must admit the great difficulty of comparing marine faunas with land floras. Even in the same region the temperatures of land and sea do not correspond, and in the case of the ancient deposits of the North Sea basin we are confronted with a special difficulty, as was pointed out when we described the Pliocene deposits of Norfolk. The same deposit may yield contemporaneous subarctic marine mollusca, southern freshwater mollusca, and plants still living in the same latitudes.

The cause of this singular discrepancy has been dealt with elsewhere; it probably arose in the main through the exceptional physiography of the North Sea basin in Middle and Newer Pliocene times. Throughout these periods the North Sea formed a basin open to the north only, so that only cold currents could enter, and only pelagic larvae from the north could drift in, to replace such southern forms as were locally exterminated by exceptional winters. Thus without much real change of average temperature the marine fauna became more and more arctic as time passed. Britain, on the other hand, was attached to the continent of Europe on the south only, and had no land-connexion northward. Its eastern part was also traversed by rivers rising many degrees to the south, in Central France and the Alps. Britain therefore could only receive southern land and freshwater species, and the discordance between the marine and the freshwater species, as indicators of climate, would become more and more marked as long as the Strait of Dover still remained closed.

Thus it happens that we now find, mingled in the same Upper Pliocene estuarine deposits in Britain, a southern land-fauna and a sub-arctic marine fauna, whereas the climate, as shown by the plants, was little different from that now existing. Plants, which give the best indications of the real climatic conditions, unfortunately have not yet been found in any of the British Pliocene deposits older than the Cromerian stage.

It will be understood from the foregoing remarks that there still remains much uncertainty as to the exact correlation of the strata; but we may tentatively place the two plant-bearing deposits now to be described in approximately the positions shown in the subjoined table: —

PLIOCENE DEPOSITS OF THE NORTH SEA BASIN.

	ENGLAND.	NETHERLANDS AND BELGIUM.
Pleistocene (base)	{ Glacial and Interglacial beds Arctic Plant-bed Leda-myalis bed	Diluvium ? ?
Upper Pliocene	{ Cromerian Weybourn Crag Chillesford Crag Norwich Crag Red Crag of Butley	} not yet recognised
Middle Pliocene	{ ? Walton Crag (unconformity)	
Lower Pliocene	{ Coralline Crag and Lenham Beds	Teglian Amstelian Reuverian Scaldisian
	{ "Box-stones" with derivative Early Pliocene or Miocene fossils	Diestian
		Miocene

Fig. 1

We need not attempt more fully to describe the deposits of the high plateau; its geology is evidently more difficult and complicated than had been thought, and until accurate large-scale geological surveys have been made, we shall not know exactly what strata are represented, and how they are affected by the tectonic movements. This Memoir deals mainly with the fossil floras contained in the clay-deposits worked in the scarp facing the Netherland plain; we will therefore now confine our attention to the four localities from which these plants were obtained.

South of Nijmegen and Wyler we leave the glaciated area, and the deposits are undisturbed by the Baltic glacier; but they are sometimes affected by faults. These faults make the stratigraphical relations somewhat difficult to follow, for as far as we yet know there are no lithological differences between the gravels above, between, or below the clay-beds. The various clay-beds, though differing somewhat in character and colour, are not sufficiently different for us to use these variations for stratigraphical purposes. Some of the variations are almost certainly due to geographical position; for though the northern localities belong to the combined basin of the Rhine and Maas, the one furthest to the south belongs to the Maas alone, and the clays therefore will not be lithologically the same, even if the beds are contemporaneous.

The Teglian, or Upper Pliocene, flora has been obtained entirely from a single large pit, at Tegelen, near Venloo, worked by Messrs. CANOY, HERFKENS, and SMULDERS for bricks and tiles. This pit has been described by Professor EUG. DUBOIS, who obtained there certain plants and large mammals, which he spoke of as interglacial. The clays were subsequently examined by us, and we obtained from the lower layers a much larger flora, of very striking character, clearly older than that of the Cromer Forest-bed, and in many respects resembling that of Eastern Asia. In washing these clays we found also various small bones, which have been determined by Mr. E. T. NEWTON. Three other species of mammals were subsequently found by Dr. TESCH and determined by Mr. NEWTON. The vertebrate remains are important, as helping to fix the Newer Pliocene date of the Teglian, we therefore give the list in full, those marked * having been determined by Professor DUBOIS.

PISCES.

Abramis brama Linn.
Anguilla vulgaris Linn.
Esox lucius Linn.
Gasterosteus aculeatus Linn.
Leuciscus cephalus Linn.?
 „ *erythrophthalmus* Linn.
Lucioperca sandra Cuv.?
Perca fluviatilis Linn.
Tinca vulgaris Cuv.
 Cyprinoid teeth (not determined)
 Minute curved spines (unknown)

AMPHIBIA.

Rana sp.

MAMMALIA.

Castor europaeus Linn.

* *Cervus dicranus* Nesti

* „ *rhenanus* Dubois

* „ *teguliensis* Dubois

* *Equus stenonis* Cocchi

* *Hippopotamus amphibius* Linn.

Hyaena crocuta Zimmerm.

Microtus (*Mimomys*) *pliocenicus* Major

„ „ *intermedius* Newton

Myogale sp.

* *Rhinoceros etruscus* Falc.

Talpa europaea Linn.?

* *Trogontherium cuvieri* Owen

Ursus etruscus Cuv.

A revised list of the Teglian plants, with some additional species lately obtained, is given in our table (p. 38).

The brick-clay of Tegelen is a well-bedded grey or brown sandy loam. It is worked to a depth of 6 metres, and borings made by Professor DUBOIS prove that its thickness reaches 8 metres. Below this is found coarse white sand and gravel with much mica, and then another clay-bed, which may perhaps be the Reuverian; but this lower deposit lies below the water-level and its fossils have not been examined. The Teglian clay passes beneath a thick mass of sandy gravel of the Rhine-Maas delta; but no fossils have yet been found in this neighbourhood in the high plateau and the geological date of these overlying strata is still unknown.

A short distance south of Tegelen, faults cut the scarp, bringing up a clay-bed which is probably the lower bed of Tegelen, there only reached by boring. This clay seems to form a continuous bed with a northward dip. It is worked in a series of large pits about half-way up the scarp between Reuver and Swalmen; above and below it lie current-bedded Rhine-Maas gravels. Unfortunately no representative of the Teglian clay has yet been found in the scarp or plateau immediately above, or at any point south of the faults; we must therefore fix the relative age of these two deposits by other evidence. This evidence is provided by borings, which show that the Miocene floor on which the Pliocene deposits rest is raised considerably on the south side of the faults. The lithological character of the Reuverian clay differs also from that of

Tegelen, though the localities are only a short distance apart. And when we compare the floras of the two deposits, the difference is even more striking, as will be shown when we discuss the botanical evidence. There seems no doubt that the nearly continuous series of clay-pits above Reuver and Swalmen are in a single bed, which represents a stage below the water-level and inaccessible further north, unless it be represented by the disturbed deposits of Wylerberg.

The Reuver pits show a thick bed of grey loam, with leaves in the lower part; above this come carbonaceous strata with more lignite and numerous seeds. It is from this upper part, which is rejected by the brick-makers as too carbonaceous, that our collections have been made. Thick roots penetrate the loam and pass down into the underlying sand, proving that some at least of the trees grew on the spot. A great deal of the lignite and many of the seeds may however have drifted for a considerable distance, for the upper part of the deposit seems to have been brought by floods. The leaf-bearing clays below yield also a few badly-preserved freshwater mollusca, including *Anodon*, but no vertebrate remains have yet been found. This part of the deposit seems to have been formed in an abandoned channel or backwater, with little or no current; for though the sediment is so fine, the beds are curiously irregular.

Still further south, but forming an almost continuous series with those of Reuver, are the Swalmen pits. In these the clay is comparatively thin; but shows a similar succession, with grey leaf-bearing loams below and more carbonaceous seed-bearing clays above. Here also the loams and underlying sands are penetrated by vertical roots.

The fourth locality from which collections have been made is Brunssum, near Heerlen, a long distance south of the other pits. Here some small pits in the middle of the heath show 1 to 1.5 metres of very carbonaceous clay, full of lignite, fruits, seeds, and badly preserved leaf-fragments. The whole deposit is penetrated by small vertical roots, which have tended to injure the fossils. These carbonaceous clays rest immediately on the pure white Miocene sand, and in some road-cuttings near the coal-mine have been seen to be faulted against the Miocene strata. The Miocene is also of freshwater origin, and contains masses of lignite, which were penetrated in sinking the neighbouring coal-shaft. This Miocene lignite however is quite unlike the Pliocene. It is hard, compact, and forms a true brown coal. The seeds found in it are all unknown in the overlying Pliocene strata. Below these Miocene lignites are found marine Middle Oligocene strata, so the exact date of the Miocene lignite is still unknown.

Brunssum lies a long way south of the other plant-bearing localities, and its flora differs somewhat from that of Swalmen and Reuver, though the deposits are probably contemporaneous. This difference can perhaps be correlated with the lithological change in the gravels. The gravels of Reuver and Swalmen are mixed gravels of the Rhine and Maas, and the plants there found may have floated down either river. Brunssum, however, lies above the old junction of the rivers, and its flora should therefore be that of the Maas basin alone. This geographical difference seems sufficient to account for the differences in the floras, for though it is possible that the clays may be of slightly

different date, there is nothing to suggest which flora is the older. Many of the differences which at first seemed to be striking have now proved to be due merely to the comparative rarity of certain plants at one or other of the localities. The plants peculiar to Brunssum are now comparatively few.

All these localities lie between latitudes $50^{\circ} 50'$ and $51^{\circ} 20'$; so that their floras are strictly comparable. The Cromerian localities are somewhat further north, in latitude $52^{\circ} 30'$; but being nearer to the Atlantic, Cromer would probably lie on the same isothermal line.

THE REUVERIAN FLORA.

As soon as we attempted to identify the Reuverian plants, we found before us a flora whose elements were almost unknown, though they suggested an even closer affinity to the flora of eastern Asia than the plants from Tegelen, already described by us. The few European and Chinese forms we could recognise led us to think that we must search the whole palaeartic region for the remainder. Finding our own carpological collections quite inadequate, we examined as many palaeartic species as we could in the Kew Herbarium. Through the courtesy of the authorities we were enabled to make working drawings of a very great number of fruits, endocarps, and seeds belonging to palaeartic genera. In this way preliminary determinations were made which we checked afterwards by microscopic examination, and comparison side by side with the recent specimens. For enabling us to carry out this part of the work we must thank the Director and staff at Kew, who provided us with specimens for comparison, dissection, and photography.

As the work proceeded it became evident that our search must extend beyond the palaeartic boundary, and we carried it into certain American, Malayan and Australian genera, if we had reason to think that our fossils had relationship with them. Unfortunately time and opportunity would not serve to carry out this part of the research fully, and it is quite possible that some of our unknown forms may have this wider range. We think it more probable however that their alliance is with Chinese species to us unknown, though some may belong to extinct genera.

The Reuverian flora already includes nearly 300 species. Of these we have been able to suggest the botanical position of about 230 with some degree of certainty, and of a lesser number, rather more than half the known flora, with considerable certainty. Various causes have militated against the specific determination of many of the species — lack of material, fossil or recent, for dissection, the fragmentary state of some of the fossils, or more often the fact that they belong to immense orders or genera, or to those with very minute seeds. Among such we may count *Umbelliferae*, *Labiatae*, *Carex*, and *Hypericum*. The labour involved in the determination of such forms is prohibitive, except where access can be had to a world-wide carpological collection, arranged for convenience of microscopic study. Unfortunately in England we have as yet no such collection; consequently material has to be laboriously searched for and prepared from the sheets of herbarium specimens.

Though our specific determinations only represent a part of the Reuverian flora, they yet prove some remarkable facts. On examining the list of trees and shrubs, which form the most peculiar and striking element in this flora, we find a surprising resem-

blance to the living flora of the mountains of western China, and to its more or less allied geographical provinces — Japan, the Himalaya, Eastern Tibet, and the Malay Peninsula. A less close relationship exists with the flora of Europe, the Caucasus, and the Mediterranean; a still remoter with the flora of North America.

This close relationship with the mountain flora of western China is marked by the presence in Limburg of various species which, though now extinct in Europe, cannot be separated from living Chinese plants. The most noticeable of these are *Gnetum scandens*, *Stewartia Pseudo-camellia*, *Magnolia Kobus*, *Zelcowa Keaki*, *Pyrularia edulis*, *Prunus Maximoviczii*. Besides these, others occur which, belonging to genera now extinct in Europe, are still represented in China by species closely allied to our fossils. Of these perhaps the most interesting is *Meliosma europaea*, which we at first thought might be referred to the living *Meliosma Veitchiorum* of the mountains bordering China and Tibet. *Actinidia faveolata* is another conspicuous example.

Not only is the alliance marked by the number of species belonging to Chinese and Japanese genera which are not represented in Europe, but by the curious fact, that when the genus lives in both Europe and China, it is often the Chinese or Japanese species that most resembles the Reuverian plant. Thus in the genus *Pterocarya*, *P. limburgensis* is more closely allied to *P. hupehensis* than to *P. caucasica*. In *Styrax* the alliance is with *S. japonica* and *S. Obassia*. In the genus *Betula* we have *B. digitata*, an ally of the Chinese *B. ulmifolia* and belonging to a section of the genus no longer found in Europe. In *Cornus* we have either *C. controversa* or a closely allied species. The only *Clematis* is the Chinese *C. grata*, not the nearly related European *C. Vitalba*. But perhaps the most remarkable of these cases is in the genus *Eupatorium*; for not only is the alliance of the Reuverian plant closer to *E. japonicum*, but it is closest to an unnamed variety of *E. japonicum*, collected by Père Faurie from a single mountain in Japan.

It is necessary to bear in mind that not only is the Chinese alliance strongly marked, but it is actually more strongly marked than that with the existing flora of the Mediterranean basin. And this is so even though the Reuverian flora suggests a mean temperature not greatly differing from that found in southern France at the present day.

The Chinese alliance is a very peculiar one. It is not a resemblance, such as we should expect, between the Reuverian flora and the existing lowland flora of certain latitudes of China, which now have a mean temperature similar to that which held in Limburg in Pliocene times. The alliance is shown almost entirely by species whose northernmost geographical range now lies much further south than Limburg; but they are mountain plants in China, and are not now found anywhere on the plains. In other words, though living in southern latitudes they are temperate forms, and belong to the moist and temperate forest-belt found only on the Chinese mountains*, and in the

* An excellent description of this mountain region of Western China and its flora will be found in Mr. E. H. WILSON's recently published book "A Naturalist in Western China" 2 vols. 1913. Mr. WILSON spent several years collecting in this region, and the discovery of a great part of the species is due to him, following after Dr. AUGUSTINE HENRY.

similar moist regions of the Himalaya and Japan. Whether their absence over the Chinese plains may not be due in part to the thorough cultivation of these plains through thousands of years, and to the removal of the trees and shrubs for fuel, we do not yet know. In all probability however they had disappeared over the dry plains long before cultivation could affect them.

We find however, that certain Reuverian species are either still living in Europe, or are more nearly allied to living European forms than to those of China, and it is noticeable that many of these are large-seeded. Among these we may instance *Picea excelsa*, *Quercus Robur*, *Carpinus Betulus*, *Corylus Avellana*, *Prunus spinosa*, *Ilex Aquifolium*, *Vitis vinifera*, and a *Fagus* allied to *F. silvatica*. With the exception of the vine, the northernmost range of all these plants now lies very considerably to the north of Limburg. That is to say, they are all plants which by moving somewhat further south, perhaps to the south of France or the Caucasus, could survive the cold of the Glacial Period without being obliged to cross the mountains. We speak more particularly of these large-seeded trees, for little difficulty would occur with small-seeded plants; these latter can easily be carried across mountains, and as we shall see, it is among the trees and shrubs (mostly large-seeded) that the greatest extermination has taken place. The ease with which small-seeded species can be transported great distances across barriers is well seen by the figures given in HOOKER's "Outlines of the Distribution of Arctic Plants". Here he shows that 75 per cent. of the species of Arctic Europe cross the Alps, and 20 per cent. cross the Mediterranean. But, with the exception of about 10 species out of the 450 so transported, all are small-seeded forms.

It is necessary to make clear these facts of the present-day relationships of the Reuverian flora, also of the character of the seeds of plants which have been preserved, and which have been exterminated; they have an important bearing on the causes of geographical distribution in the present and past, and on the preservation or extinction of genera and species in different parts of the world.

Other facts emerge, which throw light on the same questions. It has already been mentioned in passing that the nearest congeners of the Reuverian plants now inhabiting southern China, are nearly all mountain plants. The same is true of nearly all congeners which inhabit southern latitudes, in whatever part of the Northern Hemisphere they occur. Thus *Pterocarya hupehensis*, *Meliosma Veitchiorum* and *M. Beaniana*, *Stewartia Pseudo-camellia*, *Diospyros Lotus*, *Camptotheca acuminata*, and the nearest living species of *Actinidia*, all inhabit the temperate belt of the Chinese mountains. *Zelcowa Keaki*, *Orixa japonica*, *Phellodendron japonicum* inhabit the mountains of Japan. *Helwingia himalayaca*, *Bucklandia populnea*, and *Pyrularia edulis* inhabit the Himalaya, the last of these three having been found also in Western China by Dr. AUGUSTINE HENRY, though till lately the specimen was overlooked. The different species of *Corylopsis* are natives of the Himalaya and the mountains of China and Japan. *Liquidambar orientale* belongs to the mountains of Asia Minor. *Vitis vinifera* is found in the Caucasus, the mountains of Greece and the Orient. *AEsculus Hippocastanum* has a similar range, but extends also

into the Himalaya. *Sequoia* and *Carya* inhabit the uplands of west and east North America respectively.

Still other noteworthy facts that have appeared are: — That the number of trees and shrubs in the Reuverian flora was probably much greater, both absolutely and proportionally, than it is in the Central European flora of today; and that the flora was probably much richer in species. The actual number of species obtained is very great, as compared with other Pliocene strata; and the deposits are by no means exhausted, for each fresh consignment of material added a number of new forms. The flora too must have been very varied, for numbers of the species are represented by but one specimen. Taking these facts into consideration, together with the correlative fact that it is but a very small fraction of any flora that can be preserved through long ages in a state of fossilization, we realize what an enormous flora the Reuverian must have been. It was possibly in some degree comparable in variety, in the number of its species, and in the abundance of its trees and shrubs, with the present-day flora of Western China. It is here worth noticing that the proportion of trees and shrubs obtained in three similar deposits, belonging to three successive periods, the Reuverian, the Teglian, and the Cromerian, falls from 50 per cent. of the whole determined flora in the Reuverian, to 24 per cent. in the Teglian, and 15 per cent. in the Cromerian. Bearing in mind also that as a general rule trees and shrubs are large-fruited and large-seeded, and herbaceous plants small-seeded, we see that it is among the large-seeded plants that the greatest proportional (we do not say numerical) extermination took place.

We must now consider what these facts imply. It can hardly be doubted that the alliances shown by the Reuverian fossils, and the known connexion between the Chinese and North American floras (ASA GRAY, WILSON, SARGENT), indicate three great streams of migration, radiating from some common centre in the north, and directed towards warmer climates. Two of these streams of migrants effected (more or less completely) their escape to congenial latitudes. The American found its way directly open to the tropics. The East Asian, by way of the coastal plains of China, and the great valley systems of that country, ultimately reached warm temperate and sub-tropical regions. Hence one cause of the great wealth of species in these countries at the present day. For this migration was not a series of isolated episodes; it was rather, a continuous movement of successively cooler floras, following one another southward, till the direction of the migration was reversed by the reversal of the climatic conditions, during the first Interglacial Period. But every wave of this migration brought its quota of species to enrich the flora of China, and in the earlier periods, of North America also.

It would appear that the third stream of migrants, that which entered Europe, the existence of which is proved by the Reuverian fossils, was less fortunate. Driven southward by the ever-advancing cold, by no route could it unimpeded reach climates more genial than were offered by the Caucasus, and the south of France. Throughout the whole length of Europe and Asia, till the coastal plains of China were reached, the retreat to the south was cut off by one unbroken barrier of seas, deserts, and moun-

tains through which no rivers opened a way to the south. The want of relationship between the Reuverian and the living flora of Europe would seem to imply that, as wave after wave of migration broke against this barrier, the species it brought must have perished, cut off by the cold of the north behind and of the mountains in front. It was at this barrier that the connexion between the present European and the Chinese floras was destroyed; so that now, except in deposits such as the Reuverian, and in a lesser degree the Teglial, very little trace of it is to be found. From time to time seeds were undoubtedly carried across the mountains; but it is interesting to note that the plants thus transported were nearly always small-seeded species, such as could be dispersed by birds. A few of the hardiest plants, as we have already shown, managed to survive north of the mountains — such forms as *Quercus Robur*, *Corylus Avellana*, and *Picea excelsa* — and here it is interesting to note that many of these cool-temperate survivors are large-seeded forms.

Even those plants that crossed the Alps were not however secure. They had migrated into a region warm enough, but too dry for them, as are the lowlands of China; where, as WILSON shows, the mountain flora is quite unable to live. Present day conditions in the Mediterranean Region are unsuited to the Reuverian flora, though the mean temperature probably does not differ greatly from that of Limburg in Middle Pliocene times. This unsuitability of South Europe to act as a refuge for the Reuverian plants was brought home to us in a curious way. The botanic gardens of La Mortola, in the Italian Riviera, have an enormous collection of Warm Temperate plants, and the authorities are very liberal in helping botanists. We therefore wrote to ask whether they could let us have fruits of any of the peculiar mountain plants of West China. Dr. ALWIN BERGER, though he was able to send us many Mediterranean species, only one of which occurred also in the Reuverian flora, was obliged to answer our special request thus: "Unfortunately I have never cared much for the Chinese and Japanese Flora for our garden, as most of those plants do not like our dry and hot climate, as do the plants from Australia, the Cape, Mexico, etc." In a later letter he endorsed our suggestion that this unsuitability of the climate was probably one cause of the absence of many of our fossil species in the Mediterranean Region.

By the advent of the first Glacial Period almost all the warmer elements of the temperate flora of Northern and Central Europe and Asia must have been swept away; so that when milder conditions prevailed, these regions had to be re-colonized. But colonization into a region of rising temperature could only take place from the south, probably by slow migration of the small-seeded plants northward across the mountains, and from the Iberian Peninsula northward along the coast, in the direction of the prevalent wind. We have an interesting example of such colonization going on in the southwest of England and Ireland at the present day. Here many Lusitanian plants, all of them small-seeded, are slowly establishing themselves near the sea, and in some instances (*Erica vagans*, etc.) gradually pushing their way inland and northward. But such a process is very slow, and it is not surprising that, both in Interglacial times and the present, the flora of cool-temperate latitudes in Europe should be a poor one.

We have endeavoured to explain how it was that the species brought by this wave of migration, having entered Europe, were there destroyed, so as to leave few living representatives at the present day. It remains to explain why in China and in North America they survived. In whatever country they occur, *these congeners of the Reuverian species which now inhabit warmer latitudes, are there almost invariably mountain plants*. It was the mountains of China and North America that saved them.

Geology, Palaeobotany and Palaeontology prove that during later Tertiary times the climate of the Northern Hemisphere became progressively cooler. This fall of temperature persisted till it reached a minimum about which it oscillated somewhat rapidly, giving rise to a succession (how many we need not here discuss) of Glacial and Interglacial Periods. We ourselves are now living in a warmer period succeeding arctic cold.

The problem therefore is, to explain not only how a flora managed to survive in a slowly but continuously cooling Hemisphere, but how it also managed to survive a succession of somewhat rapid oscillations from cold to comparative warmth. With this survival, as exemplified in the Yangtse Valley, we will now deal, for it is in the mountain flora of this valley that the greatest assemblage of descendants from the parent stock of the Reuverian is found. The history of the survival of these plants will serve as a typical example to explain the survivals in other mountainous countries.

The fact that so much of the Tertiary flora has survived in the Yangtse Valley, would by itself suggest that this valley is very ancient. In the Pliocene Period the valley-floor must have been much higher than at present, and there would be free access for a migrant flora to the upper reaches beyond Ichang, now to a great extent cut off from the lower Yangtse Valley by a series of mountain ranges, of comparatively low elevation, through which the river has cut its way, giving rise to the world-renowned gorges. In fact the Yangtse Valley must have formed in one direction a continuation southward of the coastal plain. Into the great area of country thus open, the stream of migration poured, some members occupying, by gradual spreading, the alluvial flats, others passing along the ridges. As the temperature fell, the warm-temperate species occupying the valley-floor, and the less adaptable species, were successively destroyed; the warmest species to survive being therefore those which occupied the valley-floor during the glaciation of the north. With returning warmth the valley-floor became too warm for these species and they were forced to climb the mountain slopes, only to return to the valley-bottom when the temperature again fell.

In the way just described it is possible for a flora in a mountainous country to survive changes of climate which, in a level country where free movement north and south is barred, would exterminate it. For, by changing its altitudinal zone, it can, within the range of a few hundred metres, find the change of climate necessary for its survival — provided that the climate never becomes colder than it was when this flora entered the valley. If this happens, the warmer elements must succumb.

But not only will the vegetation of the valley-floor be saved. If the mountains

are high enough to rise above the snow-line, the whole range of the flora, from the foot of the mountains to the snow-line can survive. This probably is one of the main causes which accounts for the greater richness of the Chinese flora, as contrasted with that of eastern North America (see SARGENT): the Chinese mountains around the Yangtse Valley are enormously higher than those of the eastern United States.

Reference to MR. E. H. WILSON's zonal tables of the Chinese flora (*op. cit.* vol. II, pp. 5—9), and to the records of herbarium specimens, especially to the great collections of DR. AUGUSTINE HENRY, in which habitat is so carefully given, shows that the congeners of the Reuverian are mostly inhabitants of the temperate zone of the mountains of Western China, and to a smaller degree of the cool-temperate zone of higher altitudes. A few are warm temperate or even sub-tropical forms of the valley floor; but the general facies is decidedly temperate.

The fall of temperature in Limburg from the Reuverian to the Glacial Period corresponds approximately with the temperature gradient from the valley-floor up to the temperate mountain zone, still inhabited by the Reuverian representatives in the Yangtse district today. We take this to imply that during the Glacial Period the Reuverian element of the Chinese flora occupied the valley-bottom, but as the climate grew warmer this flora was driven up the mountains to 1500 or 2000 metres, leaving the valley-bottom to some extent depopulated. With each return of glacial or interglacial conditions the same process would be repeated. Remembering that we ourselves are now living in a genial climate, following a rigorous one; conditions which, we suggest, would in a flat country or valley-floor correspond with a poor flora, it is interesting to note what Mr. WILSON says of the flora of the comparatively low-lying Red Basin of Szechuan (*op. cit.* vol. 1, p. 65).... "the flora, in contradistinction to that of the contiguous regions, is relatively poor, and the species largely common to the entire basin. Further, the majority of these species are widely spread throughout the warmer low-level regions in China, some indeed ranging to the extreme eastern limits of the country." If we are right in thinking that this warm-temperate and sub-tropical flora has had to be re-introduced since the last Glacial Period, this is exactly what we should expect. The valley-floor of the Szechuan basin is only now being re-peopled from the south by way of the coastal plain, after having been deserted by the flora which occupied it during the Glacial Period.

With regard to the relationship between the Reuverian, the living Chinese, and the American floras, before leaving the subject we may again refer to MR. WILSON, one of the greatest living authorities on the flora of China. He writes (*op. cit.* vol. II, pp. 11, 12): —

"At first sight it would very naturally be supposed that the Chinese flora was most closely allied if not to that of Europe at least to that of the Asiatic continent generally. Yet this is not so. The real affinity is with that of the Atlantic side of the United States of America!

"This remarkable fact was first demonstrated by the late DR. ASA GREY when

investigating the early collections made in Japan. Modern work in China, and especially central China, has given overwhelming evidence and established beyond question ASA GRAY's conclusions. There are many instances in which only two species of a genus are known — one in the eastern United States and the other in China. Noteworthy examples are the Tulip tree, Kentucky Coffee tree, the Sassafras, and the Lotus Lily (*Nelumbium*). A considerable number of families are common to both countries, and in most instances China is the dominant partner. Usually the U. S. A. have one and China several species of the same genus, but here and there the opposite obtains. Magnolias afford a good illustration of this affinity. This genus, absent from Europe and western North America, is represented by 7 species on the Atlantic side of the North American continent, and by 19 species in China and Japan."

Then follows a list of 15 genera common to China, Japan, and the Atlantic side of the United States, but not now living in Europe. Of the 15 genera 4 have already been found in the Reuverian, viz. *Magnolia*, *Stewartia*, *Berchemia*, and *Nyssa*, as also 2 of the 4 previously mentioned, the Tulip tree (*Liriodendron*) and *Nelumbium*.

Comparison has been made between the Reuverian flora and the flora of the Yangtse Valley, because the latter is more closely allied to the Reuverian than is any other, and also because it serves particularly well to illustrate the effect of high mountains upon the preservation of a flora under an oscillating climate. A reference to the distribution of species shows, however, that there is also a considerable alliance between the Reuverian flora and the flora of the Himalaya. A close relationship has been proved to exist between the flora of Western China and the Himalaya (DR. AUGUSTINE HENRY and others); but the distribution of species in these regions is as yet only partially worked out, and until more is known of the living floras, we shall not be in a position to solve this problem. Still, we may suggest three factors which singly or combined may account for the relationship between the Reuverian, the Himalayan, and the Chinese floras.

(1) It has been suggested (WILSON) that the Himalayan flora is an extension westward of the Chinese. If this is so the extension would date back to a time, probably Pliocene, anterior to the cutting of the great gorges. In that case the flora must have entered these regions as an upland flora, and, as the climate cooled, it must have descended.

(2) It is both possible and likely that in part the Himalayan flora may be a return wave from that part of the migrating flora which passed coastwise into the Malay Peninsula, when the other stream entered the Yangtse Valley. Whether the great alternations of climate in the north extended into tropical latitudes we do not know; but it is possible, for there are clear signs of a former great extension of the Himalayan glaciers. An interval of interglacial warmth might therefore cause a return migration to cooler regions, the path being open, by way of the Mekong, Salwen, Irawadi, Brahmaputra, etc.

(3) Yet a third suggestion may help to account for the resemblance between these floras. The immense area of high land in Central Asia, including Tibet, the

Himalaya, and Western China, may have acted as a second centre for the origin and dispersal of temperate species, which radiated from these uplands when the climate became colder, just as they radiated from the shores of the Arctic Sea. If such a dispersal as this took place it must have been in Miocene or Pliocene times, when the northern hemisphere was cooling.

The truth of a theory can only be tested by its ability to explain facts. Let us, in recapitulation, consider how this theory, that the direction, survival, or destruction of the different streams of migrants depended on the direction of the valleys, plains, and mountain ranges, and the height of the mountains, is capable of explaining the facts.

It accounts, in the first place, for the great richness of the Pliocene flora of Limburg and Prussia, which reached thus far on its southward and westward journey unchecked, and possibly with the loss of but few elements. By the influence of the east and west mountain chains it accounts for the destruction of this rich flora of trees and shrubs, which in Europe has left so few living traces of its existence. For the comparative poverty of the living North European and North Asian floras, of which the members are but the survivors from the destruction during the glaciation, together with return migrants from the south. For the great floral wealth of the Chinese mountains, and the poverty of the Szechuan Basin. For the wealth of the North American flora, which, as with the Chinese, entered the country unimpeded, and in a lesser degree was saved by its north and south running mountain chains. Finally, it accounts for the curious fact that the trees and shrubs which were lowland plants in Pliocene Limburg, are now found (they or their nearest living congeners) as mountain plants in such far-removed countries as China, Japan, North America, the Himalaya, and the Caucasus, at the present day.

It is of much interest to note that DARWIN, in the first edition of his *Origin of Species*, anticipated in a general way this explanation of the reason why the living rain-belt flora of China, and the corresponding flora of North America, are, partially at any rate, relics of the early Pliocene floras of more northern latitudes. But in DARWIN's time the flora of Western China being unknown, he could reason only from the living floras of Europe and North America, and the little-known extinct Tertiary floras. He founded his conclusions upon the study of the living flora of the Arctic regions and its distribution southward in isolated mountain chains. Following EDWARD FORBES, he explained this distribution as the result of a mild period following a gradually cooling one. By the cold the flora was driven south; by the returning warmth it was driven back northward, and, in mountainous regions, up the mountain heights. Then by an extension of his argument DARWIN goes on to show that the same reasoning will explain "the relationship with very little identity between the productions of North America and Europe" and "the singular fact..... that the productions of Europe and America during the later tertiary stages were more closely related to each other than they are at the present time." He infers that during some warmer period "such as the Older Pliocene period, a large number of the same plants and animals inhabited the

almost continuous circumpolar land; and that these plants and animals, both in the Old and New Worlds, began slowly to migrate southwards as the climate became less warm, long before the commencement of the Glacial period." By the cooling during later Pliocene times, he explains, these species became isolated and modified, so that "when we compare the now living productions of the temperate regions of the New and Old Worlds, we find very few identical species (though ASA GRAY has shown that more plants are identical than was formerly supposed), but we find a host of closely allied representative forms."

THE TEGLIAN FLORA.

If the Dutch and English Pliocene be studied together — and they may fairly be compared, for the localities are now all on the same isothermal line — we can carry our researches still further. We find not only that an exotic flora with Chinese affinities once flourished in this part of Europe, but further, that this flora was displaced by one of more cool-temperate character, bearing a close resemblance to the European flora of the present day. Thus, if from the Reuverian we pass to the Teglian, we find in the first place, that all plants with Malayan or Australian affinity, *Hakea*, *Jongmansia*, *Epipremnum*, *Mimusops* — such forms as were probably lingerers from a more remote and warmer Miocene Period — have entirely disappeared. The North American forms have dwindled down to *Dulichium vespiforme* (and probably *D. spathaceum*, for that species has been recorded as living in Europe in interglacial times). Yet a considerable number of very distinctive Chinese and Japanese species still remain, for we find *Magnolia Kobus*, *Euryale* (also interglacial in Russia), *Prunus Maximoviczii*, *Rubus* cf. *pungens*, *Actinidia faveolata*, *Pterocarya limburgensis*, *Crataegus cuneata*, and *Cryptotaenia*. The last two have not yet been found in the Reuverian; but doubtless belong to that stream of migration.

The few very striking plants above mentioned give perhaps a more Oriental aspect to the Teglian flora than is justified by the general facies. If it be examined critically, its closest alliance is seen to be with the existing flora of Central Europe. Further, if the Cromerian flora be examined in the same connexion, the European facies will be found to be fully established, the peculiar Chinese element having disappeared, except for such species as still live in Europe. It must not be forgotten however, that many of our most common living European plants probably did not originate in Europe, but were Pliocene immigrants, which finding suitable stations in Europe have established themselves here. Till the Miocene flora of the European uplands and of the Arctic Regions is more thoroughly known, we cannot distinguish these immigrants.

The question now arises WHERE did this new flora, which replaced the old Reuverian, come from? A close study of the present-day distribution of the Teglian and Cromerian species would appear to indicate two sources. We find in modern Europe two marked areas of distribution for these plants, an approximately circumpolar area, and the area comprising Central Europe and Central Asia, from the Himalaya to the Mediterranean and Atlantic. Bearing in mind that the period from the Reuverian to the Cromerian was one of continual cooling, and that therefore the movement of species

was necessarily from northern latitudes to southern, and from higher altitudes to lower, we see that the distribution of these plants points to two directions of migration. The one migration is from the north southward, a continuation of the great southward movement, of which the Reuverian formed a part; but not like that characterized by the present-day isolation of its several branches. In this later movement, the flora, being of a more cool-temperate type, was able in a much greater degree to survive throughout the temperate regions of Europe and Asia. The second stream of migration appears almost certainly to have originated in the mountainous parts of Europe and Asia, and to have radiated outwards. It is noticeable that this second line of migration is much more pronounced in the Cromerian than in the Tegliian.

In conclusion, we would add one note of caution. It must not be assumed that because in Pliocene times — and for that matter even at the present day — we see clear evidence of a connexion between the floras of Western Europe, China, and North America, that therefore there was necessarily land connexion between these countries in comparatively recent times. Far from it! The time needed for a large flora, such as the temperate Chinese and North American, and probably also the Reuverian, to spread from its original home in the remote North to the southern latitudes where it lives now, or did live in the past, must have been great. And it is probable, that long before the last stream of migrants had reached our latitudes, the connexion had been broken behind, by cold, desert, or by sea. The date when the Reuverian flora flourished as a polar flora, or one inhabiting the high plateau, the “roof of the world”, of Tibet, may well have been far back in Tertiary times.

TABLE OF THE REUVERIAN FLORA,

SHOWING DISTRIBUTION IN TIME AND SPACE.

When the identification is doubtful, the fossil is entered in the appropriate place, but the distribution is marked by queries; when a relationship is merely suggested, no distribution is given.

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Pinnatella</i> sp. nov.?	-	+	-	-	-	+	-	-	-	-	-	+	+	-	§ <i>Urocladium</i> of genus <i>Pinnatella</i> .
<i>Mnium antiquorum</i> Card. et Dixon	+	-	-	-	-	+	-	-	-	-	-	+	-	-	§ <i>Trachycystis</i> of genus <i>Mnium</i> .
<i>Equisetum</i> sp.	+														
<i>Araucaria</i> ?	-	+	-	-	-	?									
<i>Picea excelsa</i> Link.	+	+	+	-	+	-	+	+							
<i>Larix europaea</i> DC.?	+	-	-	-	-	-	+	+							
<i>Pinus</i> sp.	+	?													
<i>Sequoia</i>	+	-	-	-	-	+	-	-	-	-	-	-	-	+	S. gigantea, and S. sempervirens.
<i>Gnetum scandens</i> Roxb. var. robustum var. nov.	+	-	-	-	-	-	-	-	-	-	-	+	+		
<i>Sparganium</i> cf. ramosum Huds.	+	+	-	?	?	?	+	+	+	-	-	+	-	+	
„ cf. minimum Fries.	+	-	-	-	-	?	+	+	+						
„ noduliferum sp. nov.	+	+	+	-	-	+									
<i>Potamogeton</i> sp. 1	-	-	+												
„ sp. 2	-	-	+												
„ sp. 3	-	-	+												
„ sp. 4	+	-	+												
„ sp. 5	-	-	+												
„ sp. 6	-	+													

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Potamogeton sp. 7	+														
„ sp. 8	+														
„ sp. 9	—	+													
„ sp. 10	+														
Najas marina Linn.	+	+	—	+	+	—	+	+	+	—	+	+	+	+	
„ aspera sp. nov.	—	—	+	—	—	+									
„ lanceolata sp. nov.	+	—	—	—	—	+									
„ fusiformis sp. nov.	+	—	—	—	—	+									
Zannichellia?	+	—	—	—	—	?									
Sagittaria sagittifolia Linn.. . . .	+	—	—	+	+	—	+	+	+	+	+				
Alisma Plantago Linn.	+	+	—	+	+	—	+	+	+	+	+	+	+	+	
Gramineae	+	+	+	+	+										
Scirpus cf. carinatus A. Gray. . . .	+	+	—	—	—	?	—	—	—	—	—	—	—	+	
„ lacustris Linn. var.	+	—	—	—	—	?	+	+	+	+	+	+	—	+	
„ mucronatus Linn.?	+	—	—	—	—	—	+	+	+	—	+	—	+		
„ Tabernaemontani Gmel.? . . .	—	+	—	+	+	—	+	—	+						
„ sp.	—	—	+												
Cladium Mariscus R.Br.	+	—	—	—	—	—	+	—	+	—	—	+	+		
Dulichium spathaceum Rich	+	+	—	—	—	—	—	—	—	—	—	—	—	+	
„ „ var. marginatum var. nov.	+	—	—	—	—	+	—	—	—	—	—	—	—	+	
„ „ var. ellipticum var. nov.	—	+	—	—	—	+	—	—	—	—	—	—	—	+	
„ vespiforme Reid var. trian- gulare var. nov.	+	—	+	—	—	+	—	—	—	—	—	—	—	+	D. spathaceum.

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Dulichium urceolatum sp. nov. . . .	—	+	—	—	—	+	—	—	—	—	—	—	—	+	D. spathaceum.
" " " " var. . .	+	+	—	—	—	+	—	—	—	—	—	—	—	+	" "
" ? sp. nov.	+	—	—	—	—	?									
Carex flagellatus sp. nov.	+	+	+	—	—	+									
" sp. 2.	+	—	—	—	—	?									
" sp. 3.	—	+	—	—	—	?									
" sp. 4.	—	—	+	—	—	?									
Palmae, Genus?	+	+	+	—	—	+									
Epipremnum crassum sp. nov. . . .	+	+	—	—	—	+	—	—	—	—	—	+	+	—	genus Epipremnum.
" sp.	+	—	—	—	—	+	—	—	—	—	—	+	+	—	" "
Pterocarya limburgensis sp. nov. . .	+	+	+	+	—	+	—	—	—	—	—	+	—	—	P. hupehensis.
Carya angulata sp. nov.	+	—	—	—	—	+	—	—	—	—	—	—	—	+	C. alba.
Carpinus Betulus Linn.. . . .	+	+	+	+	+	—	+	+	+	+					
Corylus Avellana Linn.	+	+	+	—	+	—	+	+	+	+					
Betula digitata sp. nov..	—	+	—	—	—	+	—	—	—	—	—	+	—	—	B. ulmifolia.
" sp.	+	?													
" sp.	+														
Alnus sp. 1	+														
" sp. 2	+	+													
" sp. 3	+														
" sp. 4	+														
Fagus decurrens sp. nov.	+	+	+	—	—	+	+	+	—	+	—	—	—	—	F. silvatica.
" ? sp.	—	—	+	—	—	+									
Quercus Robur Linn.	+	+	+	—	+	—	+	+	+	+					

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Zelkowa Keaki <i>Linn.</i>	-	+	+	-	-	-	-	-	-	-	-	+			
Morus?	+	-	-	-	-	?									
Urtica dioica <i>Linn.</i> ?	+	-	-	+	+	-	+	+	+	+	+	+			
„ <i>urens Linn.</i> ?	-	+	-	+	+	-	+	+	+	+	-	+			
„ <i>sp. 3.</i>	+	+	-	-	-	?									
Urticaceae (<i>Girardinia</i> ?) <i>sp. 4</i>	-	+	-	-	-	?									
„ „ <i>sp. 5</i>	+	-	-	-	-	?									
„ ?	+														
„ ?	-	+													
Hakea angulata <i>sp. nov.</i>	-	-	+	-	-	+	-	-	-	-	-	-	+	-	<i>genus Hakea.</i>
Pyrularia edulis <i>A.DC.</i>	+	-	-	-	-	-	-	-	-	-	+	+			
Asarum?	+														
Polygonum <i>sp. 1.</i>	+														
„ <i>sp. 2.</i>	+														
„ <i>sp. 3.</i>	+														
Chenopodiaceae (<i>Atriplex</i> ?)	+	-	-	-	-	?									
Aphanisma?	-	+	-	-	-	?	-	-	-	-	-	-	-	?	<i>genus Aphanisma.</i>
Nyctaginaceae?	+														
Caryophyllaceae	+														
Nelumbium minimum <i>sp. nov.</i>	-	+	-	-	-	+	-	-	-	-	-	+	-	+	<i>genus Nelumbium.</i>
Brasenia peltata <i>Pursh</i>	-	-	+	-	-	-	-	-	-	-	+	+	+	+	
„ <i>tuberculata sp. nov.</i>	-	-	+	-	-	+	-	-	-	-	+	+	+	+	<i>B. peltata.</i>
Nuphar canaliculatum <i>sp. nov.</i>	+	+	-	-	-	+	+	+	+	+	-	-	-	-	<i>N. luteum.</i>
„ <i>sp.</i>	+	-	-	-	-	+									

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA.	
<i>Euryale nodulosa</i> sp. nov.	+	—	—	—	—	+	—	—	—	—	+	+	—	—	<i>E. ferox.</i>
„ <i>lissa</i> sp. nov.	—	—	+	—	—	+	—	—	—	—	+	+	—	—	„ „
<i>Ceratophyllum?</i> sp. nov.	+	—	—	—	—	?									
<i>Anemone</i> sp. 1	+														
„ sp. 2	—	—	+												
„ sp. 3	—	—	+												
„ sp. 4	+														
„ sp. 5	+														
<i>Clematis grata</i> Wallich	+	+	—	—	—	—	—	—	—	—	+	+			
<i>Ranunculus brutius</i> Tenore	—	—	+	—	—	—	—	—	+	+	—	+			
„ <i>lateriflorus</i> DC.	+	+	—	—	—	—	—	—	+						
„ <i>nemorosus</i> DC.	+	+	—	—	+	—	—	+	+	+					
„ sp.	+														
<i>Thalictrum Bauhini</i> Crantz	—	—	+	+	—	—	—	+	+						
„ <i>simplex</i> var. <i>galioides</i> Nest.	—	—	+	—	—	—	—	+							
<i>Magnolia Kobus</i> DC.	+	+	—	+	—	—	—	—	—	—	—	+			
<i>Liriodendron aptera</i> sp. nov.	+	—	—	—	—	+	—	—	—	—	—	+	—	+	genus <i>Liriodendron</i> .
„ <i>tulipifera</i> Linn.	+	+	+	—	—	—	—	—	—	—	—	—	—	+	
<i>Illicium?</i>	+	—	—	—	—	?	—	—	—	—	—	?	—	—	genus <i>Illicium</i> .
<i>Jongmansia cypreaeformis</i> sp. nov.	+	+	—	—	—	+									
<i>Cinnamomum</i> sp. 1	—	+	—	—	—	?	—	—	—	—	—	—	?	—	<i>C. lampongum.</i>
„ sp. 2	+	—	—	—	—	?	—	—	—	—	—	—	—	—	<i>C. nitidum. India.</i>
„ sp. 3	+	—	—	—	—	—	—	—	—	—	—	+	—	—	<i>unnamed sp. coll. Dr. Henry.</i>
<i>Bucklandia striata</i> sp. nov.	+	—	?	—	—	+	—	—	—	—	+	+	+	—	genus <i>Bucklandia</i> .

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	REUVER	SWALMEN	BRUNSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Liquidambar orientale</i> Miller var.?	+	+	-	-	-	?	-	-	-	-	-	-	-	-	<i>Asia Minor.</i>
<i>Corylopsis limburgensis</i> sp. nov.	-	-	+	-	-	+	-	-	-	-	-	+	-	-	<i>genus Corylopsis.</i>
Hamamelidaceae, Genus?	-	-	+												
Eucommiaceae?	-	-	+	+	-	?	-	-	-	-	-	?	-	-	<i>genus Eucommia.</i>
<i>Cotoneaster acuticarpa</i> sp. nov.	+	+	+	-	-	+	-	-	+	+	-	-	-	-	<i>C. pyracantha.</i>
<i>Pirus Malus</i> Linn. var.	-	-	+	-	-	?	+	+	+	+	+				
„ cf. <i>Malus</i> Linn.	+	-	-	-	-	?	+	+	+	+	+				
<i>Mespilus monogyna</i> Jacq.	+	-	-	-	+	-	+	+	+	+	+	+	-	-	<i>Crataegus auctorum.</i>
„ sp. 2.	-	-	+												
<i>Rubus</i> cf. <i>Fruticosi</i> (sp. 2)	+	-	?	-	-	?									
„ cf. <i>pungens</i> Cambess (sp. 3)	+	-	-	+	-	?	-	-	-	-	-	+	-	-	<i>section Pungentes.</i>
„ sp. 1	-	-	+	-	-	?									
„ sp. 4	+	-	-	-	-	?	-	-	-	-	-	-	-	-	<i>section Saxatiles?</i>
<i>Prunus Maximoviczii</i> Ruprecht	+	-	+	+	-	-	-	-	-	-	-	+			
„ spinosa Linn.	-	+	?	+	+	-	+	+	+	+					
„ cf. spinosa Linn.	+	-	-	-	-	?	+	+	+	+					
„ „ „	+	-	-	-	-	?	+	+	+	+					
„ spinulosa Sieb. et Zucc.	+	-	-	-	-	-	-	-	-	-	-	+			
„ stipitata sp. nov.	+	-	-	-	-	+									
„ tenuiputamenta sp. nov.	+	-	-	-	-	+									
„ sp. 4	+	-	-	-	-	?	-	-	-	-	-	-	-	?	<i>P. Ramburii.</i>
„ sp. 8	+														
<i>Wistaria</i> ?	-	+	-	-	-	-	-	-	-	-	-	?	-	-	<i>genus Wistaria.</i>
<i>Biebersteinia</i> sp. nov.	+	-	-	-	-	+	-	-	+	-	+	+	-	-	<i>genus Biebersteinia.</i>

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	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
Nitraria?	—	—	+	—	—	?	—	—	—	—	—	—	—	—	genus Orixia.
Orixia reticulata <i>sp. nov.</i>	—	—	+	—	—	+	—	—	—	—	—	+	—	—	
Ruta <i>sp.</i>	+	—	—	—	—	?	—	—	—	—	—	—	—	—	
„ <i>sp.</i>	—	—	+	—	—	—	—	—	—	—	—	—	—	—	P. japonicum.
Phellodendron elegans (<i>Reid</i>)	+	+	—	+	—	+	—	—	—	—	—	+	—	—	
„ tessellatum <i>sp. nov.</i>	+	—	—	—	—	+	—	—	—	—	—	+	—	—	
Simarubaceae?	+	—	—	—	—	—	—	—	—	—	—	—	—	—	T. pubescens, and T. villosa.
Turraea?	—	—	+	—	—	?	—	—	—	—	—	?	?	—	
Euphorbia <i>sp.</i>	—	—	+	—	—	—	—	—	—	—	—	—	—	—	
Coriariaceae?	—	+	—	—	—	?	—	—	?	—	—	?	?	—	genus Coriaria.
Pistacia acuminata <i>sp. nov.</i>	+	+	—	—	—	+	—	—	+	+	+	+	—	—	genus Pistacia.
Teschia crassicaarpa <i>sp. nov.</i>	?	+	—	—	—	+	—	—	—	—	—	—	—	—	A. carpinifolium, and A. pictum.
Ilex Aquifolium <i>Linn.</i>	+	—	—	—	—	—	+	+	+	+	—	—	—	—	
Staphylea <i>sp.</i>	—	—	+	—	—	?	—	—	—	—	—	—	—	—	
Acer <i>cf.</i> Lobelii <i>Pax.</i>	—	+	—	—	—	?	—	—	—	+	—	+	—	—	A. carpinifolium, and A. pictum.
„ striatum <i>sp. nov.</i>	+	+	—	—	—	+	—	—	—	—	—	+	—	—	
„ <i>sp.</i> 3.	+	—	—	—	—	?	—	—	—	—	—	—	—	—	
AEsculus spinosissima <i>sp. nov.</i>	+	+	—	—	—	+	—	—	+	+	+	—	—	—	AE. Hippocastanum.
Sapindaceae, Genus?	+	—	—	—	—	?	—	—	—	—	—	—	—	—	also at Raevels.
Stocksia?	+	—	—	+	—	?	—	—	—	—	—	—	—	—	
Meliosma europaea <i>sp. nov.</i>	+	+	—	—	—	+	—	—	—	—	—	+	—	—	
Karwinskia paucicostata <i>sp. nov.</i>	+	—	—	—	—	+	—	—	—	—	—	—	—	+	M. Veitchiorum, and M. Beaniana.
Berchemia <i>sp.</i> ?	—	—	+	—	—	?	—	—	—	—	—	+	—	+	K. Humboldtiana.
Rhamnus <i>sp. nov.</i>	+	—	—	—	—	?	—	—	—	—	—	—	—	—	genus Berchemia.
															no European ally.

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Rhamnaceae genus nov.?	—	—	+	—	—	+	—	—	—	—	—	?	—	?	genera Hovenia, and Ceanothus.
Vitis vinifera Linn.	+	+	+	+	—	—	—	—	+	+	—	—	—	—	
„ cf. orientalis Boiss.	+	—	—	—	—	?	—	—	?	?	—	—	—	—	
Vitaceae, Genus?	+	—	—	—	—	—	—	—	—	—	—	—	—	—	
Sterculiaceae?	—	+	—	—	—	—	—	—	—	—	—	—	—	—	A. melanandra, and A. arguta.
Actinidia faveolata sp. nov.	+	+	+	+	—	+	—	—	—	—	—	+	—	—	
Stewartia Pseudo-camellia Maxim.	+	+	+	—	—	—	—	—	—	—	—	+	—	—	
Hypericum cf. Ascyron Linn.	+	+	—	—	—	?	—	—	—	—	—	+	—	+	
„ sp. 2 (= Tegelen sp. 7).	+	+	+	+	—	—	—	—	—	—	—	—	—	—	genus Scyphallandra, Ceylon and Indo-China.
„ sp. 3	—	+	—	—	—	—	—	—	—	—	—	—	—	—	
„ sp. 4	+	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ sp. 5	+	—	—	—	—	—	—	—	—	—	—	—	—	—	
Viola sp. 1	—	+	—	—	—	—	—	—	—	—	—	—	—	—	
„ sp. 2	—	—	+	—	—	—	—	—	—	—	—	—	—	—	genus Camptotheca.
„ sp. 3 (cf. V. rupestris)	+	—	—	—	—	—	—	—	—	—	—	—	—	—	
Violaceae, Genus? (? Scyphallandra)	+	+	—	—	—	?	—	—	—	—	—	?	—	—	
Nyssa silvatica Marsh	+	+	—	—	—	—	—	—	—	—	—	—	—	+	genus Proserpinaca. Also at Bidart, near Biarritz.
Camptotheca crassa sp. nov.	—	+	—	—	—	+	—	—	—	—	—	+	—	—	
Trapa natans Linn.	+	+	+	+	+	—	+	+	+	+	+	+	—	—	
Circaea crassa sp. nov.	—	+	—	—	—	+	—	—	—	—	—	—	—	—	genus Hippuris.
Proserpinaca reticulata sp. nov.	+	+	+	—	—	+	—	—	—	—	—	—	—	+	
Myriophyllum verticillatum Linn.	+	—	—	+	—	—	+	+	+	—	—	—	—	—	
Hippuris globosa sp. nov.	+	—	—	—	—	+	+	+	+	+	+	+	+	+	„ „
„ sp.	+	—	—	—	—	+	+	+	+	+	+	+	+	+	

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Aralia racemosa</i> Linn. ?	-	+	-	-	-	?	-	-	-	-	-	+			We received a similar seed from Japan in a packet of Zelkowa.
Araliaceae ?	-	+													
„ ?	-	+													
„ ?	-	-	+												
„ ?	+	-	-	-	-	-	-	-	-	-	-	+	-	-	
Hydrocotyleae, Genus ?	+														
Petroselinum sp.	+	-	-	-	-	?	+	-	+	+					
<i>Cicuta virosa</i> Linn.	-	+	-	+	+	-	+	-	-	-	-	-	-	+	
<i>Seselinæ</i> sp. 1.	+	+													
„ sp. 2.	-	+													
„ sp. 3.	-	-	+												H. himilayaca. of genus Monotropa. M. japonica, M. permollis. A. japonica. genus Trientalis. M. Browniana.
<i>Sium</i> ?	+														
<i>Peucedanum</i> ?	-	-	+												
Umbelliferae, Genus ?	+														
<i>Cornus controversa</i> Hemsl.	+	-	-	-	-	-	-	-	-	-	-	+			
„ cf. mas Linn.	-	-	+	-	-	?	-	?	-	?					
„ sp.	-	+													
„ sp.	-	-	+												
<i>Helwingia</i> sp.	-	+	-	-	-	+	-	-	-	-	+	+	-	-	
<i>Monotropa</i> ?	+	-	-	-	-	?	?	?	?	?	?	?	-	?	
<i>Maesa</i> sp.	-	-	+	-	-	?	-	-	-	-	-	+	+		
<i>Ardisia</i> sp.	?	+	-	-	-	?	-	-	-	-	-	+			
<i>Trientalis</i> ?	+	-	-	-	-	?	?	?	-	-	-	?	-	+	
<i>Mimusops septentrionalis</i> sp. nov. . .	+	-	-	-	-	+	-	-	-	-	-	-	+	-	

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Diospyros Lotus <i>Linn.</i>	-	-	+	-	-	-	-	-	+	+	+	+			S. obassia, and S. japonicum.
„ sp. 2.	-	+	-	-	-	?									
Styrax mucronatum <i>sp. nov.</i>	+	+	-	-	-	+	-	-	-	-	+	-	-		
Jasminum contiguum <i>sp. nov.</i> . . .	+	-	-	-	-	+									A. reptans.
„ undulatum <i>Ker Gawl.?</i> . . .	-	+	-	-	-	?	-	-	-	-	+	+			
Ajuga antiqua <i>sp. nov.</i>	+	-	-	-	-	+	+	+	+	-	-	-	-	-	
Sideritis scordioides <i>Linn.?</i>	+	-	-	-	-	-	-	-	?						genus Hancea.
Lycopus europaeus <i>Linn.</i>	+	+	-	+	+	-	+	+	+	+	+	-	+		
Hancea <i>sp.</i>	-	-	+	-	-	?	-	-	-	-	+	-	-		
Labiatae, Genus? <i>sp. 1.</i>	+	+													S. chinensis, S. canadensis, S. glauca.
„ „ <i>sp. 2</i> (=Tegelen, 1910 fig. 42)	+	-	+												
„ „ <i>sp. 3.</i>	-	+													
„ „ <i>sp. 4.</i>	+														
„ „ <i>sp. 5.</i>	+														
„ „ <i>sp. 6.</i>	+														
„ „ <i>sp. 7.</i>	+														
Solanum <i>sp.?</i>	+	-	-	-	-	?									E. elaterium.
Solanaceae, Genus?	-	+													
Scrophulariaceae, Genus? <i>cf. Digitalis.</i>	-	+													
Galium <i>sp.</i>	+														
Sambucus pulchella <i>sp. nov.</i>	+	+	+	-	-	+	-	-	-	-	-	+	+	+	
Valerianaceae?	-	+													
Ecballium? <i>sp. nov.</i>	-	+	-	-	-	?	-	-	+	+	-	-	-	-	
Eupatorium japonicum <i>Thunb. var.</i> .	+	+	-	-	-	-	-	-	-	-	-	+			

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
Helichrysum sp.	-	+													C. blattaroides and allies.
Senecio sp.	-	+													
Carduus sp. 1 (cf. C. nutans). . . .	+														
„ sp. 2	+														
Crepis cf. blattaroides Vill.	-	+	-	-	-	?	-	+	+	-	-	+	-	-	
„ fuscipappa Benth.	-	+	-	-	-	-	-	-	-	-	-	+			
„ sp.	+														
Compositae, Genus?	+														
„ „	-	+													

TABLE OF THE TEGLIAN FLORA, SHOWING DISTRIBUTION IN TIME AND SPACE.

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Eurhynchium speciosum Schimp.</i>	-	-	-	+	-	-	+	+	+						
<i>Amblystegium filicinum De Not.</i>	-	-	-	+	-	-	+	+	+	-	-	+	-	+	
<i>Philonotis fontana Brid.</i>	-	-	-	+	-	-	+	+	+	-	-	+	-	+	
<i>Homalothecium sericeum B. et S.</i>	-	-	-	+	-	-	+	+	+						
<i>Ditrichum tortile Hampe.</i>	-	-	-	+	-	-	+	+	-	+	+	+	-	+	
<i>Hypnum capillifolium Warnst.</i>	-	-	-	+	-	-	+	+							
<i>Pseudoleskea atrovirens (Dicks.)?</i> . . .	-	-	-	+	-	-	-	?							
<i>Equisetum ramosissimum Desf.</i>	-	-	-	+	-	-	+	+	+	-	-	+	-	+	
<i>Pinus sp.</i>	-	-	-	+											
<i>Juniperus sp.</i>	-	-	-	+											
<i>Sparganium sp.</i>	-	-	-	+											
<i>Potamogeton acutifolius Link.</i>	-	-	-	+	-	-	+	+	-	+					
„ <i>coloratus Hornem.</i>	-	-	-	+	-	-	+	+	+	-	-	-	+	+	
„ <i>crispus Linn.</i>	-	-	-	+	+	-	+	+	+	+	-	-	+	+	
„ <i>pectinatus Linn.</i>	-	-	-	+	+	-	+	+	+	+	-	-	+	+	
„ <i>pusillus Linn.</i>	-	-	-	+	+	-	+	+	+	+	-	-	-	+	
<i>Najas marina Linn.</i>	+	+	-	+	+	-	+	+	+	-	+	+	+	+	
„ <i>minor Allioni.</i>	-	-	-	+	+	-	+	+	+	-	-	+	+		
<i>Sagittaria sagittifolia Linn.</i>	+	-	-	+	+	-	+	+	+	+	+	+			
<i>Alisma Plantago Linn.</i>	+	+	-	+	+	-	+	+	+	+	+	+	+	+	
<i>Stratiotes aloides Linn.</i>	-	-	-	+	+	-	+	+	+	+					

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Gramineae	+	+	+	+	+										D. spathaceum.
Cyperus? sp. 1.	-	-	-	+											
„ ? sp. 2.	-	-	-	+											
Scirpus lacustris Linn.	?	-	-	+	+	-	+	+	+	+	+	+	-	+	
„ Tabernaemontani Gmel.	-	?	-	+	+	-	+	-	+						
„ sp.	-	-	-	+											
„ sp.	-	-	-	+											
„ sp.	-	-	-	+											
Heleocharis sp.	-	-	-	+											
„ sp.	-	-	-	+											
Dulichium vespiforme Reid	?	-	?	+	-	+	-	-	-	-	-	-	-	+	
Carex echinata Murr.	-	-	-	+	-	-	+	+	+	-	-	-	+	+	
„ hirta Linn.	-	-	-	+	+	-	+	+	+						
„ riparia Curtis.	-	-	-	+	+	-	+	+	+	+	-	-	-	+	
„ spp.	-	-	-	+											
Pterocarya limburgensis sp. nov.	+	+	+	+	-	+	-	-	-	-	-	+	-	-	P. hupehensis.
Carpinus Betulus Linn.	+	+	+	+	+	-	+	+	+	+					
„ sp. nov.?	-	-	-	+	-	?									
Alnus viridis Chaix?	-	-	-	+	-	-	-	+	-	-	-	+	-	+	
Urtica dioica Linn.?.	+	-	-	+	+	-	+	+	+	+	+	+			
„ urens Linn.?	-	+	-	+	+	-	+	+	+	+	-	+			
„ ?	-	-	-	+	-	?									
Rumex acetosella Linn.. . . .	-	-	-	+	+	-	+	+	+	+	+				
„ maritimus Linn.	-	-	-	+	+	-	+	-	+	-	-	-	-	+	

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	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
<i>Rumex cf. obtusifolius Linn.</i>	-	-	-	+	-	-	+	+	+	+					
„ <i>sp. nov.?</i>	-	-	-	+	-	?									
<i>Polygonum Bellardi All.?</i>	-	-	-	+	-	-	-	-	+	-	?				
„ <i>Convolvulus Linn.</i>	-	-	-	+	+	-	+	+	+	+	+				
„ <i>lapathifolium Linn. var.</i>	-	-	-	+	-	-	+	+	+	+	+	+	+	+	
„ <i>minus Huds.</i>	-	-	-	+	-	-	+	+	+	+	+	+	+		
„ <i>sp.</i>	-	-	-	+											
„ <i>sp.</i>	-	-	-	+											
„ <i>sp.</i>	-	-	-	+											
<i>Chenopodium rubrum Huds.</i>	-	-	-	+	+	-	+	+	+						
„ <i>urbicum Linn.</i>	-	-	-	+	-	-	+	+	+	-	-	+	-	+	
<i>Atriplex patula Linn.</i>	-	-	-	+	-	-	+	+	+	+	-	-	-	+	
<i>Stellaria aquatica Moench</i>	-	-	-	+	+	-	+	+	-	-	+				
„ <i>nemorum Linn.</i>	-	-	-	+	-	-	+	+							
<i>Herniaria?</i>	-	-	-	+											
<i>Lychnis Flos-cuculi Linn.</i>	-	-	-	+	-	-	+	+	-	+					
<i>Euryale limburgensis Reid</i>	-	-	-	+	-	+	-	-	-	-	+	+	-	-	E. ferox.
<i>Ceratophyllum demersum Linn.</i>	-	-	-	+	+	-	+	+	+	+	+	+	+		
<i>Aquilegia vulgaris Linn.</i>	-	-	-	+	-	-	+	+	+	+	+				
<i>Clematis Vitalba Linn.</i>	-	-	-	+	-	-	+	+	+	+					
<i>Ranunculus aquatilis Linn.</i>	-	-	-	+	+	-	+	+	+	+	+	-	-	+	
„ <i>cf. humilis Huet de Pav.</i>	-	-	-	+	-	-	-	-	+						
„ <i>repens Linn.</i>	-	-	-	+	+	-	+	+	+	+	-	+	-	+	
„ <i>sceleratus Linn.</i>	-	-	-	+	+	-	+	+	+	+	+	+	-	+	

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	REUVER	SWALMEN	BRUNSSUM				N.W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Thalictrum Bauhini Crantz.</i>	—	—	+	+	—	—	—	+	+						
<i>Magnolia Kobus. DC.</i>	+	+	—	+	—	—	—	—	—	—	—	+			
„ <i>sp.</i>	—	—	—	+											
<i>Eucommiaceae?</i>	—	—	+	+	—	?	—	—	—	—	—	?	—	—	<i>genus Eucommia.</i>
<i>Mespilus cuneata Sieb. et Zucc.</i> . . .	—	—	—	+	—	—	—	—	—	—	—	+			<i>section pungentes.</i>
<i>Rubus cf. pungens Cambess.</i>	+	—	—	+	—	?	—	—	—	—	—	+	—	—	
<i>Potentilla argentea Linn.</i>	—	—	—	+	—	—	+	+	—	—	+				
<i>Prunus cf. lusitanica Linn.</i>	—	—	—	+	—	?									
„ <i>Maximowiczii Ruprecht</i>	+	—	+	+	—	—	—	—	—	—	—	+			
„ <i>spinosa Linn.</i>	—	+	?	+	+	—	+	+	+	+					
<i>Phellodendron elegans (Reid)</i>	+	+	—	+	—	+	—	—	—	—	—	+	—	—	<i>P. japonicum.</i>
<i>Corema intermedia Reid</i>	—	—	—	+	+	+	—	—	+	—	—	—	—	—	<i>C. alba, Spain, Portugal, and Azores.</i>
<i>Staphylea sp. 1.</i>	—	—	—	+	—	?									
„ <i>sp. 3.</i>	—	—	—	+	—	?									
<i>Acer campestre Linn.</i>	—	—	—	+	+	—	+	+	+	+					
„ <i>opulifolium Vill.?</i>	—	—	—	+	—	—	—	—	+	+					<i>also at Raevens.</i>
„ <i>limburgensis sp. nov.</i>	—	—	—	+	—	+									
<i>Stocksia?</i>	+	—	—	+	—	?	—	—	—	—	—	—	—	—	
<i>Vitis vinifera Linn.</i>	+	+	+	+	—	—	—	—	+	+					
<i>Althaea crassicarpa sp. nov.</i>	—	—	—	+	—	+									
<i>Actinidea faveolata sp. nov.</i>	+	+	+	+	—	+	—	—	—	—	—	+	—	—	
<i>Hypericum Androsaemum Linn.</i> . . .	—	—	—	+	—	—	+	+	+	+					<i>A. melanandra, and A. arguta.</i>
„ <i>perforatum Linn.</i>	—	—	—	+	—	—	+	+	+						
„ <i>pulchrum Linn.</i>	—	—	—	+	—	—	+	+							

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	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Hypericum sp. 4.	—	—	—	+											
„ sp. 5.	—	—	—	+											
„ sp. 6.	—	—	—	+											
„ sp. 7.	+	+	+	+											
Viola cf. arvensis Murr.	—	—	—	+	—	—	+	+	+	+					
„ sp. 2.	—	—	—	+											
„ sp. 3.	—	—	—	+											
Trapa natans Linn.	+	+	+	+	+	—	+	+	+	+	+	+			
Myriophyllum verticillatum Linn. . .	+	—	—	+	—	—	+	+	+						
Araliaceae, Genus?	—	—	—	+											
Hippomarathrum sp. nov.	—	—	—	+	—	—	—	—	+	+	—	—	—	—	genus Hippomarathrum. Orient.
Cryptotaenia?	—	—	—	+	—	—	—	—	—	—	—	?	—	—	genus Cryptotaenia.
Petroselinum segetum Koch	—	—	—	+	—	—	+	—	+	+					
Cicuta virosa Linn.	—	+	—	+	+	—	+	—	—	—	—	—	—	+	
Laserpitium Siler Murr.	—	—	—	+	—	—	—	+	+						
Gentianaceae?	—	—	—	+											
Verbena officinalis Linn.	—	—	—	+	—	—	+	+	+	+	+				
Teucrium Botrys Linn.	—	—	—	+	—	—	+	+	+						
„ cf. Scordium Linn.	—	—	—	+	—	—	+	+	+	+					
Brunella vulgaris Linn.	—	—	—	+	+	—	+	+	+	+	—	+	—	+	
Stachys longiflora Boiss. et Bal. . .	—	—	—	+	—	—	—	+							
„ silvatica Linn.	—	—	—	+	+	—	+	+	—	+					
„ sp.	—	—	—	+											
Melissa officinalis Linn.	—	—	—	+	—	—	+	+	+	+					

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	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Calamintha sp.	-	-	-	+											
Origanum vulgare Linn.	-	-	-	+	-	-	+	+	+	+	+	+			
Thymus Serpillum Linn.	-	-	-	+	-	-	+	+	+	+	+	+			
Lycopus europaeus Linn.	+	+	-	+	+	-	+	+	+	+	+	+	-	+	
Mentha aquatica Linn.	-	-	-	+	+	-	+	+	+	+					
„ sp.	-	-	-	+											
Labiatae, Genus?	-	-	-	+	+										
„ „	-	-	-	+											
„ „	-	-	-	+											
„ „	-	-	-	+											
Physalis Alkekengi Linn.	-	-	-	+	-	-	+	+	+	+	+	+			
Solanum Dulcamara Linn.	-	-	-	+	+	-	+	+	+	+	+	+			
Veronica Chamaedrys Linn.	-	-	-	+	+	-	+	+	+	+					
Valeriana tripteris Linn.	-	-	-	+	-	-	-	+	+						
Campanulaceae, Genus?	-	-	-	+											
Bidens tripartita Linn.	-	-	-	+	+	-	+	+	+	+	+	+			
Carduus cf. nutans Linn.	-	-	-	+	+	-	+	+	+	-	+				
„ palustris Willd.	-	-	-	+	+	-	+	+							

TABLE OF THE CROMERIAN FLORA, SHOWING DISTRIBUTION IN TIME AND SPACE.

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Osmunda regalis</i> Linn.	-	-	-	-	+	-	+	+	+	+	+	+	-	+	
<i>Pinus silvestris</i> Linn.	-	-	-	-	+	-	+	+	+						
<i>Picea excelsa</i> Link.	+	+	+	-	+	-	+	+							
<i>Taxus baccata</i> Linn.	-	-	-	-	+	-	+	+	+	+	+	+			
<i>Sparganium ramosum</i> Huds.? . . .	-	-	-	-	+	-	+	+	+	-	-	+	-	+	
<i>Potamogeton crispus</i> Linn.	-	-	-	+	+	-	+	+	+	+	-	-	+	+	
„ <i>heterophyllus</i> Schreb.	-	-	-	-	+	-	+								
„ <i>natans</i> Linn.	-	-	-	-	+	-	+	+	+	+	-	-	-	+	
„ <i>obtusifolius</i> Mert. et Koch	-	-	-	-	+	-	+	+	+	-	-	-	-	+	
„ <i>pectinatus</i> Linn.	-	-	-	+	+	-	+	+	+	+	-	-	+	+	
„ <i>perfoliatus</i> Linn.	-	-	-	-	+	-	+	+	+	+	-	-	+	+	
„ <i>praelongus</i> Wulf.	-	-	-	-	+	-	+	+	-	-	+	-	-	+	
„ <i>pusillus</i> Linn.	-	-	-	+	+	-	+	+	+	+	-	-	-	+	
„ <i>trichoides</i> Cham.	-	-	-	-	+	-	+	+	+						
<i>Najas marina</i> Linn.	+	+	-	+	+	-	+	+	+	-	+	+	+	+	
„ <i>minor</i> Allioni.	-	-	-	+	+	-	+	+	+	-	-	+	+		
<i>Zannichellia palustris</i> Linn. . . .	-	-	-	-	+	-	+	+	+	+	+	-	-	+	
„ <i>pedunculata</i> Reichb.	-	-	-	-	+	-	+	+	+	+	+	+	-	+	
<i>Sagittaria sagittifolia</i> Linn.. . . .	+	-	-	+	+	-	+	+	+	+	+	+			
<i>Alisma Plantago</i> Linn.	+	+	-	+	+	-	+	+	+	+	+	+	+	+	
<i>Stratiotes aloides</i> Linn	-	-	-	+	+	-	+	+	+	+					

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
<i>Phragmites communis</i> Trin.	—	—	—	—	+	—	+	+	+	+	+	+	+	+	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Gramineae	+	+	+	+	+	—	—	—	—	—	—	—	—	—	
<i>Eriophorum vaginatum</i> Linn.	—	—	—	—	+	—	+	+	—	+	+	+	—	+	
<i>Scirpus fluitans</i> Linn.	—	—	—	—	+	—	+	—	—	—	—	—	—	—	
„ <i>lacustris</i> Linn.	?	—	—	+	+	—	+	+	+	+	+	+	—	+	
„ <i>Tabernaemontani</i> Gmel.	—	?	—	+	+	—	+	—	+	—	—	—	—	—	
<i>Heleocharis</i> sp.	—	—	—	—	+	—	—	—	—	—	—	—	—	—	
<i>Carex acutiformis</i> Ehrh.	—	—	—	—	+	—	+	+	+	—	—	—	—	—	
„ <i>dioica</i> Linn.	—	—	—	—	+	—	+	+	—	—	—	—	—	+	
„ <i>cf. helodes</i> Link.	—	—	—	—	+	—	+	+	+	—	—	—	—	—	
„ <i>hirta</i> Linn.	—	—	—	+	+	—	+	+	+	—	—	—	—	—	
„ <i>muricata</i> Linn.	—	—	—	—	+	—	+	+	+	+	+	—	—	—	
„ <i>riparia</i> Curtis.	—	—	—	+	+	—	+	+	+	+	—	—	—	+	
„ <i>rostrata</i> Stokes	—	—	—	—	+	—	+	+	+	—	+	—	—	+	
„ <i>vesicaria</i> Linn.	—	—	—	—	+	—	+	+	—	+	+	+	—	—	
„ <i>sp. 9.</i>	—	—	—	—	+	—	—	—	—	—	—	—	—	—	
„ <i>sp. 10.</i>	—	—	—	—	+	—	—	—	—	—	—	—	—	—	
<i>Salix cinerea</i> Linn.	—	—	—	—	+	—	+	+	+	+	—	—	—	—	
„ <i>sp. 2.</i>	—	—	—	—	+	—	—	—	—	—	—	—	—	—	
„ <i>sp. 3.</i>	—	—	—	—	+	—	—	—	—	—	—	—	—	—	
<i>Carpinus Betulus</i> Linn.	+	+	+	+	+	—	+	+	+	+	—	—	—	—	
<i>Corylus Avellana</i> Linn.	+	+	+	—	+	—	+	+	+	+	—	—	—	—	
<i>Betula alba</i> Linn.	—	—	—	—	+	—	+	+	—	+	—	+	—	—	
<i>Alnus glutinosa</i> Gaertn.	—	—	—	—	+	—	+	+	+	+	—	—	—	—	

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
<i>Alnus</i> sp.	—	—	—	—	+										
<i>Fagus silvatica</i> Linn.	—	—	—	—	+	—	+	+	—	+					
<i>Quercus Robur</i> Linn.?	+	+	+	—	+	—	+	+	+	+					
<i>Ulmus campestris</i> Linn.?	—	—	—	—	+	—	+								
<i>Urtica dioica</i> Linn.	?	—	—	+	+	—	+	+	+	+	+	+			
„ <i>urens</i> Linn.?	—	+	—	+	+	—	+	+	+	+	—	+			
<i>Rumex acetosella</i> Linn.	—	—	—	+	+	—	+	+	+	+	+				
„ <i>acutus</i> Linn.?	—	—	—	—	+	—	+	+							
„ <i>Hydrolapathum</i> Huds.	—	—	—	—	+	—	+	+	—	—	+				
„ <i>maritimus</i> Linn.	—	—	—	+	+	—	+	—	+	—	—	—	—	+	
„ <i>obtusifolius</i> Linn.	—	—	—	—	+	—	+	+	+	+	+				
<i>Polygonum amphibium</i> Linn.	—	—	—	—	+	—	+	+	+	+	+	—	—	+	
„ <i>aviculare</i> Linn.	—	—	—	—	+	—	+	+	+	+	+	+	—	+	
„ <i>Convolvulus</i> Linn.	—	—	—	+	+	—	+	+	+	+	+				
„ <i>Persicaria</i> Linn.	—	—	—	—	+	—	+	+	+	+	+	+			
<i>Chenopodium album</i> Linn.	—	—	—	—	+	—	+	+	—	+	+	+			
„ <i>rubrum</i> Huds.	—	—	—	+	+	—	+	+	+						
<i>Atriplex hastata</i> Linn.?	—	—	—	—	+	—	+	+	+	+	—	—	—	+	
<i>Stellaria aquatica</i> Moench	—	—	—	+	+	—	+	+	—	—	+				
„ <i>Holostea</i> Linn.	—	—	—	—	+	—	+	+	+	+					
„ <i>media</i> Villars	—	—	—	—	+	—	+	+	+	+	+	+	—	+	
<i>Arenaria serpyllifolia</i> Linn.	—	—	—	—	+	—	+	+	+	+	+	+			
<i>Nuphar luteum</i> Smith	—	—	—	—	+	—	+	+	+	+					
<i>Nymphaea alba</i> Linn.	—	—	—	—	+	—	+	+	+	+	+				

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	
Nymphaeaceae sp.	-	-	-	-	+	?									
„ „	-	-	-	-	+	?									
Ceratophyllum demersum Linn. . .	-	-	-	+	+	-	+	+	+	+	+	+	+		
Caltha palustris Linn.	-	-	-	-	+	-	+	+	+	+	+	-	-	+	
Ranunculus aquatilis Linn.	-	-	-	+	+	-	+	+	+	+	+	-	-	+	
„ Flammula Linn.	-	-	-	-	+	-	+	+	+	-	-	-	-	+	
„ Lingua Linn.	-	-	-	-	+	-	+	+	+	+	+				
„ nemorosus DC.	+	+	-	-	+	-	-	+	+	+					
„ repens Linn.	-	-	-	+	+	-	+	+	+	+	-	+	-	+	
„ sceleratus Linn.	-	-	-	+	+	-	+	+	+	+	+	+	-	+	
„ sp. 7	-	-	-	-	+	?									
„ sp. 8	-	-	-	-	+	?									
Thalictrum flavum Linn.	-	-	-	-	+	-	+	+							
Hypecoum procumbens Linn. . . .	-	-	-	-	+	-	-	-	+	-	+				
Spiraea Ulmaria Linn.	-	-	-	-	+	-	+	+	-	+					
Pirus Aria Ehrh.	-	-	-	-	+	-	+	+	+	-	-	+			
„ Malus Linn.	-	-	-	-	+	-	+	+	+	+	+	+			
Mespilus monogyna Jacq.	+	-	-	-	+	-	+	+	+	+	+	+	-	-	Crataegus auctorum.
„ oxyacantha Linn.	-	-	-	-	+	-	+	+	+	+	-	-	-	-	„ „
Rubus fruticosus Linn.	-	-	-	-	+	-	+	+	+	-	+				
„ Idaeus Linn.	-	-	-	-	+	-	+	+	+	+					
Potentilla silvestris Neck.	-	-	-	-	+	-	+	+							
Alchemilla arvensis Scop.	-	-	-	-	+	-	+	+	+	+					
Prunus spinosa Linn.	-	+	?	+	+	-	+	+	+	+					

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
<i>Euphorbia amygdaloides</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+					<i>C. alba.</i> <i>Spain, Portugal, and Azores.</i>
<i>Corema intermedia</i> <i>Reid</i>	-	-	-	+	+	+	-	-	+	-	-	-	-	-	
<i>Acer campestre</i> <i>Linn.</i>	-	-	-	+	+	-	+	+	+	+					
<i>Rhamnus Frangula</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+					
<i>Hypericum hirsutum</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	-	+					
„ <i>quadrangulum</i> <i>Linn.</i>	-	-	-	-	+	-	+	+							
<i>Elatine Hydropiper</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+						
<i>Viola</i> <i>cf.</i> <i>hirta</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+	-	+			
„ <i>palustris</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	-	-	+	-	+	
„ <i>cf.</i> <i>Riviniana</i> <i>Reichb.</i>	-	-	-	-	+	-	+	+	+	-	-	-	-	+	
<i>Trapa natans</i> <i>Linn.</i>	+	+	+	+	+	-	+	+	+	+	+	+			
<i>Circaea lutetiana</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+	+	+			
<i>Myriophyllum spicatum</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+	+	+	-	+	
<i>Hippuris vulgaris</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+	+	+	+	+	
<i>Chaerophyllum silvestre</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+						
<i>Torilis Anthriscus</i> <i>Bernh.</i>	-	-	-	-	+	-	+	+	+	+	+	+			
<i>Conium maculatum</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+					
<i>Apium</i> <i>sp.</i>	-	-	-	-	+										
<i>Cicuta virosa</i> <i>Linn.</i>	-	+	-	+	+	-	+	-	-	-	-	-	-	+	
<i>Œnanthe Lachenalii</i> <i>C. C. Gmel.</i> . . .	-	-	-	-	+	-	+	+	+	+					
„ <i>Phellandrium</i> <i>Lam.</i>	-	-	-	-	+	-	+	+	+	+					
<i>AEthusa Cynapium</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+	+					
<i>Pastinaca sativa</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+						
<i>Heracleum Sphondylium</i> <i>Linn.</i>	-	-	-	-	+	-	+	+	+						

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY							NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N. W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.
Cornus sanguinea Linn.	—	—	—	—	+	—	+	+	+	+	+				
Menyanthes trifoliata Linn.	—	—	—	—	+	—	+	+	—	+	+	—	—	+	
Ajuga reptans Linn.	—	—	—	—	+	—	+	+	+						
Brunella vulgaris Linn.	—	—	—	+	+	—	+	+	+	+	—	+	—	+	
Ballota nigra Linn.	—	—	—	—	+	—	+	+	+	+					
Stachys arvensis Linn.	—	—	—	—	+	—	+	+	+	—	+				
„ silvatica Linn.	—	—	—	+	+	—	+	+	—	+					
Calamintha arvensis Linn	—	—	—	—	+	—	+	+	+	+					
Lycopus europaeus Linn.	+	+	—	+	+	—	+	+	+	+	+	+	—	+	
Mentha aquatica Linn.	—	—	—	+	+	—	+	+	+	+					
Labiatae, Genus?	—	—	—	+	+										
„ „	—	—	—	—	+										
Solanum Dulcamara Linn.	—	—	—	+	+	—	+	+	+	+	+	+			
Verbascum Thapsus Linn.	—	—	—	—	+	—	+	+	+	+	+	+			
Limosella aquatica Linn.	—	—	—	—	+	—	+	+	+	—	+				
Veronica Chamaedrys Linn.	—	—	—	+	+	—	+	+	+	+					
Littorella juncea Berg.	—	—	—	—	+	—	+	+	+						
Galium Aparine Linn.	—	—	—	—	+	—	+	+	+	+	+	+	—	+	
Viburnum Opulus Linn.	—	—	—	—	+	—	+	+	+	+	—	+	—	+	
Valerianella olitoria Poll.	—	—	—	—	+	—	+	+	+	+					
Valeriana sambucifolia Willd.	—	—	—	—	+	—	+	+	—	—	+				
Eupatorium sp.	—	—	—	—	+										
Bidens tripartita Linn.	—	—	—	+	+	—	+	+	+	+	+	+			
Tussilago Farfara Linn.. . . .	—	—	—	—	+	—	+	+	+	+	+				

	REUVERIAN			TEGLIAN	CROMERIAN	EXTINCT	DISTRIBUTION OF NEAREST LIVING ALLY								NAME OF ALLY, AND NOTES.	
	REUVER	SWALMEN	BRUNSSUM				N.W. EUROPE	CENTRAL EUROPE	S. EUROPE AND MEDITERRANEAN	CAUCASUS	HIMALAYA	CHINA AND JAPAN	MALAYA AND AUSTRALIA	N. AMERICA	WHEN THE ALLY IS THE SAME SPECIES AS THE FOSSIL, THE NAME IS NOT REPEATED IN THIS COLUMN.	
<i>Arctium</i> sp.	-	-	-	-	+	-	+	+	+	+	+	+				
<i>Carduus heterophyllus</i> Linn.	-	-	-	-	+	-	+	+	-	-	-	-	-	+		
„ <i>nutans</i> Linn.	-	-	-	-	+	-	+	+	+	-	+					
„ <i>cf. nutans</i> Linn.	-	-	-	+	+	-	+	+	+	-	+					
„ <i>palustris</i> Willd.	-	-	-	+	+	-	+	+								
<i>Centaurea calcitrapa</i> Linn.?	-	-	-	-	+	-	+	+	+	-	+					
„ <i>sp.</i>	-	-	-	-	+											
<i>Picris hieracioides</i> Linn.	-	-	-	-	+	-	+	+	+	+	+					
<i>Crepis succisaefolia</i> Tausch	-	-	-	-	+	-	+	+								
<i>Leontodon autumnalis</i> Linn.	-	-	-	-	+	-	+	+	-	+						

DESCRIPTION OF THE SPECIES.

EUMYCETES.

The only fungi yet examined are some affecting the fruits of *Meliosma europaea*, and mentioned under that species (p. 113). This fungus may partly be accountable for the extermination of the *Meliosma*. Specimens of the diseased fruits (Plate XI, figs. 24, 25) were sent to Mr. G. MASSEE, of Kew, who reports as follows: —

FIG. 2.
Mycelium of
fungus, in seed
of *Meliosma*.

“In the diseased patches on the *Meliosma* seeds the tissue is disintegrated, and the mycelium of some fungus is present in quantity (Text-fig. 2). At the periphery of these patches the mycelium can be seen encroaching on the healthy tissue. From analogy the mycelium is that of a true parasite, but in the absence of fruit its relationship cannot be determined.”

MUSCI.

Amongst the seeds washed out of the clays at Tegelen, Swalmen, and Reuver were a few small fragments of moss, and it is not clear why mosses should be so extremely rare in these Pliocene deposits. The specimens were sent to Mr. H. N. DIXON for determination, and his notes on them are as follows: —

“The Reuverian collection consists of but half a dozen exceedingly small and fragmentary remains. Of these however, two were of distinct interest. One, a mere fragment from Swalmen with but little left of any of the leaves but the nerve and parts of the basal areolation, retained however sufficient of the latter to show that it belonged to a small group of mosses, § *Urocladium* of the genus *Pinnaetella* Fleisch. (*Porotrichum* spp. auctorum), consisting of some half dozen species confined to the south-eastern region of Asia (India, Malay Archipelago, Tonkin, Formosa, Japan), and especially characterized by an *intra-marginal* border or band of elongate cells, such as is found in a very few groups of mosses only (*Calymperes*, *Fissidens*, particularly). The Reuverian moss is scarcely distinguishable from *P. alopecuroides* (Hook.) Fleisch. except in the stouter nerve (35—40 μ wide) and the leaf-cells slightly larger and with a pronounced

tendency to be elliptical. These characters are probably quite sufficient to indicate a specific difference; but the relationship is close, and the fragment bears out in an interesting way the indications given by the rest of the plant remains.

MNIUM ANTIQUORUM CARD. ET DIXON SP. NOV.

The second from Reuver is perhaps still more interesting. It is a species of *Mnium* of the § *Trachycystis*, represented at the present day by two species only, both confined to China (including Saghalien and the Amur region) and Japan. It differs however from both of these, and in conjunction with Mons. CARDOT, who has kindly examined it, I propose the following name for it.

FIG. 3. *Mnium antiquorum*.

1. Stem $\times 3$.
2. 3. Leaves $\times 25$.
4. Leaf, restored, $\times 25$.
5. Apex of Leaf, $\times 100$.
6. Basal areolation, $\times 100$.

del H.N. Dixon

Mnium antiquorum CARD. et DIXON sp. nov. A *M. microphylo* Dz. et Molk. differt cellulis minoribus, parietibus magis incrassatis, atque foliis limbo incrassato bistratoso circumscriptis; a *M. flagellari* Sull. et Lesq. proximo foliis minoribus, irregulariter, obscure, simpliciter dentatis, nec spinulis bigeminatis armatis.

"Besides these occurred a fragment of a Harpidioid *Hypnum*, a Brachythecioid moss belonging to *Homalothecium* or one of the allied genera, in all probability distinct from any of the existing European species, and a further pleurocarpous moss with single nerve, species and genus indeterminable.

"The Tegelen mosses do not indicate any definite association, and in some respects appear to be a little heterogeneous; the bulk of them are hygrophytic, and do not indicate anything different from what might be expected in any Central European low lying marsh or river valley at the present time. Associated with these are however two, *Homalothecium sericeum* B. et S. and *Ditrichum tortile* Hampe, which are rupestral and terrestrial species respectively, neither being hygrophytic, while a third appears to me to be entirely inseparable from *Pseudoleskea atrovirens* (Dicks.) (*Ps. patens* Limp.), having exactly the irregular isodiametrical cells with single central papillae of that species, which however is an alpine rock plant, and could scarcely be associated with such species as *Eurhynchium speciosum*. There are two branches slightly differing in leaf-margin and outline, and I was inclined to consider one of these as *Leskea polycarpa*, the presence of which would be quite in accordance with expectation. I am however inclined to think them both forms of the same species, and the distinctly denticulate margin and sharply papillose cells would seem to preclude the identification of the second fragment, at least, with *L. polycarpa*. If I am right in referring these to *Pseudoleskia atrovirens* (DICKS.) it must in all probability have been transported from some distance."

The following are the species obtained: —

Eurhynchium speciosum Schimp (the bulk).

Amblystegium filicinum De Not (two or three branches).

Philonotis fontana Brid.

Homalothecium sericeum B. et S.

Ditrichum tortile Hampe (a fragment with remains of a seta).

Hypnum capillifolium Warnst.

? *Pseudoleskea atrovirens* (Dicks.)

FILICALES.

Pl. I, figs. 2, 3.

These two specimens, both from Brunssum, were figured as probably sporangia of ferns; there is however great doubt as to their correct position. The curious scars on fig. 4 suggest that this specimen also may belong to the same species; but it was found at Reuver.

EQUISETALES.

EQUISETUM SP.

Pl. I, fig. 1.

A node of *Equisetum* has been obtained from Reuver, but cannot be further determined.

GYMNOSPERMAE.

CONIFERAE.

With the exception of two cones of *Picea excelsa* and one young cone of *Sequoia* all the gymnosperms yet found are represented by detached fragments, very difficult to determine. The reason of this may be that they all have drifted from some far-distant uplands, and in drifting have broken up. The entire absence of the lowland gymnosperms, such as *Taxus* is surprising.

ARAUCARIA?

Pl. I, figs. 5 a, b, 6 a, b.

A broken scale of a cone, and a detached seed, which appear to belong to coniferae, suggested to us the genus *Araucaria*. Being unable to obtain fruits of *Araucaria* for comparison, we asked Professor A. C. SEWARD, who has made a special study of the genus, to look at them. He considers the specimens to be indeterminable. We think it well however to figure them, for they are unlike anything else we have found.

Scale (point destroyed), length 5.5 mm., breadth 9 mm. SWALMEN.

Seed (gnawed by mouse), length 15 mm., breadth 8 mm. SWALMEN.

Both these specimens were found at Swalmen, and they may belong to the same plant.

PICEA EXCELSA LINK.

Pl. I, figs. 7, 8.

Twigs and leaves are abundant at Swalmen, and a few have been found at Reuver and Brunssum. Two cones also occurred at Reuver. We have figured one of these, also one of the cone-like winter buds.

Length of cone 120 mm. REUVER, SWALMEN, BRUNSSUM.

LARIX EUROPAEA? DC.

Pl. I, figs. 9 a, b.

A scale of cone, bent upon itself, is difficult to examine and photograph. In size and shape it resembles the scale of *Larix europaea*, and it agrees very closely in the cell structure. The cells are somewhat smaller and the surface more rough than in *Larix*

europaea; but it is so close to the living larch of Europe that we have placed it doubtfully under this species.

Length about 12 mm., breadth 7.5 mm.

REUVER.

The larch now lives throughout Europe and boreal Asia.

PINUS SP.

Pl. I, figs. 10 a, b.

A small scale belonging to the cone of a species of *Pinus* cannot be further identified. Scale thick obovate with short limb, head rounded tetragonal, umbo not prominent. Ventral surface showing two hollows with impressions of the wings of seeds.

Length 5 mm., breadth 3.5 mm.

REUVER.

This may belong to some form of *P. laricio*, but we can find nothing exactly like it.

Small seeds, perhaps belonging to the same species, have been found at Reuver and Swalmen, and are shown on Pl. I, figs. 11, 12.

SEQUOIA?

Pl. I, figs. 13 a, b.

Cone minute; scales 11 or 12, including apical and 2 small basal, about 6 times as broad as long, each occupying about half the circumference of the cone; umbo depressed slightly rugose; pedicel thick, showing 5 fibrovascular bundles 4 of which are broken off short but one is preserved.

Length (cone) about 2 mm., breadth about 1.9 mm.

REUVER.

This minute cone seems to belong to *Sequoia*, though we cannot examine its anatomy. Its small size and the great comparative thickness of the twig suggest that the cone is very young, though its scales appear to be hard and woody. If this unique specimen belongs to a *Sequoia*, it represents some undescribed species, and it apparently marks the last appearance of the genus in Europe.

CONIFERAE.

In addition to the above described *Coniferae* we find the doubtful scale shown on Pl. I, figs. 14 a, b, and the characteristic seed illustrated on Pl. I, fig. 15. We cannot suggest the generic position of either of these.

GNETACEAE.

GNETUM SCANDENS ROXB.

Pl. XX, fig. 27.

Portion of the male inflorescence of a *Gnetum*, showing 8 nodes, is so close to that of the living *G. scandens* that we cannot separate it, so long as all the forms of

this variable plant are referred to a single species. The fossil however is such an extreme form of *G. scandens* that it deserves a varietal name, and we therefore call it var. *robustum*. It does not resemble any other of the living species.

Male inflorescence thicker, more cylindrical, and more compact than in the living varieties, nodes 8 + (specimen incomplete) separated by very short internodes, which are but slightly more slender than the nodes.

Length 8 mm., breadth 4 mm.

REUVER.

This appears to be the first record of the genus *Gnetum* in the fossil state. The living species are mainly tropical; but *G. scandens* extends into the mountains of Yunnan, where Dr. AUGUSTINE HENRY found it in the forests between 4000 and 5000 feet. It is a large climber, and has a wide range in India, China, and Burma, to Sumatra.

ANGIOSPERMAE.
MONOCOTYLEDONEAE.
SPARGANIACEAE.

SPARGANIUM CF. RAMOSUM HUDS.

Pl. I, figs. 16, 17.

A few endocarps belonging to a *Sparganium* allied to *S. ramosum* have been found. They do not satisfactorily agree with our recent fruits, but the material is insufficient for the description of a new species.

Endocarps ovate strongly angled shortly beaked.

Length 4 mm., breadth 1.5 mm.,

REUVER and SWALMEN.

SPARGANIUM CF. MINIMUM FRIES.

Pl. I, fig. 18.

A single endocarp represents a species near to *S. minimum*; but the material is insufficient for further characterization.

Endocarp ovate beaked smooth with neither ribs nor grooves.

Length 3.4 mm., breadth 1.5 mm.

REUVER.

SPARGANIUM NODULIFERUM SP. NOV.

Pl. I, figs. 19—25.

FRUCTUS BICONICOIDEUS, ENDOCARPIO OSSEO FUSIFORMI UTRINQUE ATTENUATO ACUTO IN TUBERCU LA INTER FASCICULOS VASCULARES MESOCARPII INTRUSO.

Fruit bi-conical; endocarp bony fusiform contracted into a point above and below, with rounded grooves in which lie the branching fibrous bundles of the epicarp, swelling between into elongated tubercles which disappear above and below.

Fruit with style, length 7 mm., breadth 3.5.; endocarp, length 5 mm., breadth 3.4 mm. Abundant at REUVER and SWALMEN, one endocarp at BRUNSSUM.

This well-marked species is strikingly unlike any of our living large-fruited forms of *Sparganium*, which have a spongy endocarp irregularly cylindrical or barrel-shaped, and have the branching vascular bundles raised on sharp ridges, not sunk in grooves. In *S. neglectum* the endocarp is much smaller, rounded, bony, and shows the

slender bundles adhering to its surface or only slightly sunk. The endocarp of *S. simplex* is also much smaller than our fossil; but it shows some approach to the fusiform shape, has the vascular bundles slightly sunk in the endocarp, and the bony endocarp between the bundles swells out slightly. *S. simplex* is the nearest living ally of our fossil; but its endocarp is very small, and only shows a slight approach to the nodose endocarp of markedly fusiform shape so characteristic of *S. noduliferum*. With the exception of the few endocarps already described as resembling *S. ramosum* and *S. minimum*, all our fruits, though variable, seem to belong to the present species.

Fruits of *S. noduliferum* have also been sent to us by Professor KINKELIN, who obtained them from the Pliocene of the Untermainthal. We have not seen the species from Tegelen.

POTAMOGETONACEAE.

POTAMOGETON.

This genus is well represented in the Reuverian beds, no fewer than 10 species having been found. None of these correspond with living British forms; but the genus is so difficult, and there is so much uncertainty in the determination of living forms, that we prefer not to describe our fossils as new on the evidence of endocarps alone. We merely number the species from 1 to 10. It is unfortunate that so little attention is paid to the endocarp in the recent plant, for in *Potamogeton* it is far more easy to figure and describe accurately than the soft epicarp, which tends to shrink and change greatly in drying.

All the species of *Potamogeton* here described seem to be mere variants of the living types. The Pliocene strata have not yet yielded anything resembling the *P. tenuicarpus* of the Lower Miocene of Bovey Tracey, which has a thin translucent endocarp with granulate surface. Nor has anything allied to the Lower Oligocene (or Upper Eocene) *Limnocarpus* been found. This latter has only two carpels, and a hard crustaceous much-pitted endocarp.

The figures and descriptions of most of the extinct species of *Potamogeton* are too imperfect to allow of comparison with our fossils.

POTAMOGETON SP. I.

Pl. II, fig. 1.

Nuts semi-orbicular truncate below inflated, with small but deep central depression, ventral margin nearly straight, dorsal margin semi-circular, attachment sub-basal; style apical long directed outwards; keel (not reaching quite to style) sharply crested, with a strong spine near the base; surface of endocarp showing irregular cells elongate radially; endocarp hard and thick.

Length (including style) 3.5 mm., breadth 2.2 mm.

BRUNSSUM.

This is the largest nut we have found, and its hardness makes it resist compression, so that it is less distorted than the other species. It only occurs at Brunssum.

POTAMOGETON Sp. 2.

Pl. II, fig. 2.

Nut obovate truncate at base, flat with large shallow curved central depression, ventral margin convex, dorsal margin semi-circular, attachment prominent basal; style sub-lateral directed forward short with parallel sides; keel sharp but not crested, without spines, reaching as far as the style; surface of endocarp not very hard, sculpture irregular cells elongate circumferentially.

Length (with style) 2 mm., breadth 1.5 mm.

BRUNSSUM.

This species also seems to be confined to Brunssum; its prominent truncate attachment is its most conspicuous character.

POTAMOGETON Sp. 3.

Pl. II, fig. 3.

Nut irregularly obovate, flat with small shallow curved central depression, ventral margin angled with broad blunt spur below middle, dorsal margin convex, attachment sub-lateral; style apical short conical; margins of nut on either side of keel with revolute wings ending in short tubercles below; keel not crested, reaching to the style; endocarp moderately hard, sculptured with coarse irregular pits.

Length 1.75 mm., breadth (including spur) 1.5 mm.

BRUNSSUM.

We have only seen one nut of this species; but the lateral wings make it quite unlike any of the other forms.

POTAMOGETON Sp. 4.

Pl. II, fig. 4.

Nut irregularly obovate, showing very clearly the curve of the seed, compressed, with shallow curved central depression, ventral margin convex above concave below sometimes with a thin wing-like process near the base, dorsal margin convex, attachment basi-lateral; style apical at ventral angle, directed inward; keel more or less crested (one specimen shows the crest expanded into a flat wing above) reaching to the style; sculpture of endocarp large cells elongate circumferentially.

Length 1.75 mm., breadth 1.4 mm.

BRUNSSUM, REUVER.

A common species at Brunssum, and found at Reuver, but very variable. Its most marked character is the conspicuous outline of the seed impressed on the endocarp, in this it resembles *P. densus*.

POTAMOGETON Sp. 5.

Pl. II, fig. 5.

Nut oblong-oval much inflated, with small but deep central depression, ventral margin convex above slightly incurved below, dorsal margin convex, attachment basal;

style subdorsal, directed outward, scarcely prominent; keel not reaching to style, very broad and flat, causing the nut to be subtriangular in section; endocarp hard and thick, sculpture coarse irregular cells.

Length 2.4 mm., breadth 1.6 mm., thickness 1.5 mm.

BRUNSSUM.

Of this species we have seen 4 nuts, all from Brunssum. The unusual thickness of the nut in proportion to its breadth causes the fossils to be compressed irregularly, or from back to front, not laterally as in most species.

POTAMOGETON Sp. 6.

Pl. II, fig. 6.

Nut broadly ovate sometimes almost orbicular somewhat compressed, with large deep central depression, ventral margin convex above concave below the long spine, dorsal margin gibbous, attachment lateral; style sublateral erect long, conical at base slender above; keel flat and crested, reaching to the style, with about 7 long thin spines; endocarp moderately thick, with a long thin spine on either side of the base, sculpture coarse irregular cells and rugosities.

Length 2.7 mm., breadth 2 mm.

SWALMEN.

These nuts agree closely in size, shape, and general characters with *P. tuberculatus*; but the spines are so very distinct that we cannot include it in the living species. The spines in our fossil are long, slender, and arranged in a single row. In *P. tuberculatus* instead of this single row there is a band of short tubercles. Also, in our fossil the endocarp has two long spines at the base; in *P. tuberculatus* these are very short and scarcely more than tubercles.

POTAMOGETON Sp. 7.

Pl. II, fig. 7.

Nut obovate somewhat inflated, with large central depression, ventral margin convex and prominent above concave below, dorsal margin semicircular, attachment basiolateral; style apical short and conical; keel somewhat crested, continued into the style, with a few obscure tubercles down the middle; endocarp fairly hard, sculpture irregular hexagonal pits.

Length (including style) 2.4 mm., breadth 1.8 mm.

REUVER.

We have several nuts of this species, all from Reuver. The most noticeable character is the prolongation of the keel into a point which becomes part of the style.

POTAMOGETON Sp. 8.

Pl. II, fig. 8.

Nut broadly obovate scarcely inflated, with large shallow central depression, ventral margin convex and prominent above deeply concave below, dorsal margin semicircular, attachment basiolateral; style apical long straight thick directed somewhat

outward; keel with prominent angle, forming together with the endocarp two short blunt spines at the base, reaching to the style; endocarp fairly hard, sculpture irregular cells elongate circumferentially.

Length (including style) 2.4 mm., breadth 2.2 mm.

REUVER.

POTAMOGETON Sp. 9.

Pl. II, fig. 10.

Nut irregularly orbicular very broad and rounded above incurved below on ventral side, attachment basal; endocarp with a small apical spine behind the style; keel very broad scarcely angled.

Length 2 mm., breadth 1.9 mm.

SWALMEN.

The single specimen here described seems to represent a different species; but it is too much distorted for fuller description.

POTAMOGETON Sp. 10.

Pl. II, fig. 11.

Nut obliquely obovate inflated, ventral margin gibbous above incurved below, dorsal margin semicircular, attachment terminal, central depression small and deep; style apical, short and conical; keel conspicuous but blunt.

Length 1.9 mm., breadth 1.7 mm.

REUVER.

We have only a single specimen belonging to this well-marked species. The endocarp is exceptionally thick, hard, and broadly pointed at the apex.

NAJADACEAE.

NAJAS.

This genus is represented by four well-marked species, three of which are extinct and unknown in other deposits. *Najas minor*, which is abundant in the Teglian is unknown in the Reuverian. We have consulted Dr. RENDLE as to the new species.

NAJAS MARINA LINN.

Pl. II, figs. 12—14.

Seeds small but indistinguishable from some forms of the recent plant, and like them varying considerably in width. In figs. 12 and 13 we have illustrated the variation in size and shape at the same locality; fig. 14 shows the interior of the testa with the loose sac-like tegmen.

Fig. 12 length 2.7 mm., breadth 1.4 mm.; fig. 13 length 3.6 mm., breadth 1.6 mm.

REUVER, SWALMEN.

This species is common at Reuver and Swalmen, but has not yet been found at Brunssum. It occurs also abundantly in the Teglian and Cromerian.

NAJAS ASPERA Sp. NOV.

Pl. II, figs. 15—17.

SEMINA AMBITU LANCEOLATA, IN APICEM OBTUSE ACUMINATUM CURVATA, RUGOSA, FOVEOLARUM SEXANGULARUM ORDINIBUS CIRCITER 40 IRREGULARIBUS ORNATA.

Seed lanceolate, curved into the bluntly pointed apex, broadest about $\frac{1}{3}$ from apex, then gradually narrowed towards the base; testa rugose with about 40 irregular rows of hexagonal pits, which become smaller less conspicuous and more elongate on the prominent raphe, walls of pits very thick and forming wavy nodulose lines, due to the hexagonal shape of the pit and the slight tuberculation where the cell-walls meet.

Length 3.2 mm., breadth 0.9 mm.

BRUNSSUM.

The seed of this rugose species resembles a small file, the rugosity being more conspicuous than the striation. Owing to the irregularity of the rows it is impossible to count them exactly, they appear to average about 40. This species does not seem to be very near to any living form; at present it has only been found at Brunssum.

NAJAS LANCEOLATA Sp. NOV.

Pl. II, figs. 18, 19.

SEMINA AMBITU ELONGATO-LANCEOLATA, SUPERNE IN ACUMEN OBTUSUM CURVATA, FOVEOLARUM HAUD ALTIUM ELONGATARUM MULTIANGULARUM ORDINIBUS CIRCITER 26 INSTRUCTA.

Seed elongate-lanceolate curved into a blunt point above, broadest about $\frac{2}{5}$ from apex, narrowed below and base rounded; testa thin smooth glossy, marked by about 26 rows of elongate polygonal shallow pits.

Length 2.7 mm., breadth 0.6 mm.

REUVER.

The glossy surface marked with shallow pits and the elongate shape make this seed very different from any known species. It has only been found at Reuver, where it is rare.

NAJAS FUSIFORMIS Sp. NOV.

Pl. II, figs. 20, 21.

SEMINA FUSIFORMIA, PARUM CURVATA; TESTA CRASSA, HAUD TRANSLUCIDA, ASPERULA, FOVEOLIS HAUD ALTIS SEXANGULIS IRREGULARIBUS NUMEROSIS HAUD IN ORDINES DISPOSITIS ORNATA.

Seed fusiform slightly curved; testa thick and opaque somewhat rough, sculpture numerous irregular shallow hexagonal pits, not arranged in definite lines, smaller and elongate on the black scarcely-raised raphe.

Length 2.8 mm., breadth 0.6 mm.

REUVER.

In size and shape this seed greatly resembles *N. flexilis*, though it is somewhat larger than our recent specimens. It is however clearly distinguished by its thick rough testa, covered by irregular pits which show little trace of linear arrangement. In this respect it resembles *N. marina*; but it is quite different in other characters.

ZANNICHELLIA?

Pl. II, figs. 22 a, b.

Half a carpel, which in general shape, size and cell-structure agrees very closely with *Zannichellia*. It differs in being without spines, and in becoming narrower towards the apex. Without more material we cannot further describe it.

Length 3.0 mm., breadth 1.0 mm.

REUVER.

ALISMATACEAE.

SAGITTARIA SAGITTIFOLIA LINN.

Pl. II, fig. 24.

A single carpel with part of the wing has been found at Reuver. It resembles our living *Sagittaria*, but like the *Alisma* is very small. For the sake of comparison we show on figs. 25, 26, the recent carpels of these two species. No doubt the seeds in carbonising have shrunk considerably, though scarcely to the great extent shown by our fossils; specimens from the Cromerian are however just as small as those from the Reuverian. Possibly the larger sizes of the fruits of our living *Alisma* and *Sagittaria* are due to the circumstance that the waters of the ponds and ditches in which they grow are now-a-days always more or less fertilized artificially by the washings from agricultural land or highways, or by drainage from farms and houses.

ALISMA PLANTAGO, LINN.

Pl. II, fig. 23.

Carpels of *Alisma* are found at Reuver and Swalmen. They agree with *A. Plantago*, but differ in their small size.

Length 1.8 mm., breadth 1.0 mm.

REUVER, SWALMEN.

GRAMINEAE.

Nodes of grasses are found, though in no great abundance or variety. We have seen no other remains of *Gramineae*.

CYPÉRACEAE.

Fruits belonging to *Cyperaceae* are plentiful, though the number of generic types and species is not so large as we might expect. There is an exceptional development of the genus *Dulichium*.

SCIRPUS TABERNAEMONTANI GMEL.?

Pl. II, fig. 27.

One nut and half of another seem very near this species; but they are not well preserved and have lost the setae.

Length (with remains of style) 2.2 mm., breadth 1.6 mm.

SWALMEN.

SCIRPUS LACUSTRIS LINN. VAR.

Pl. II, fig. 28.

Nut elongate obovate triquetrous gradually tapering into the style, attachment broad; setae broken, only the base of one or two remaining, they appear to have been broad; sculpture uniform hexagonal cells, not becoming elongate towards the base.

Length 3.4 mm., breadth 1.5 mm.

REUVER.

In surface sculpture this nut resembles *S. lacustris*, but differs in its elongate shape and is larger. *S. lacustris* under certain conditions has nuts varying greatly in size and shape, even on the same plant; but we have not yet been able to match the Reuver fruits.

SCIRPUS MUCRONATUS LINN.?

Pl. II, fig. 29, 30.

Nuts obovate triquetrous or plano-convex; style usually short and conical, but occasionally longer; setae wanting; surface sculpture of the same character as the last, but cells much smaller and inconspicuous, a few transverse rugosities.

Length 2.4 mm., breadth 1.75 mm.

REUVER.

This greatly resembles the nut of the living *S. mucronatus*, which we have therefore illustrated for comparison (figs. 31, 32); the most noticeable distinction is that the recent plant has the nut more truncate above and not merging into the style.

SCIRPUS CF. CARINATUS A. GRAY.

Pl. II, figs. 33, 34.

Nut elongate-obovate narrowed below triquetrous with blunt angles, all three faces concave, base of style short conical; bristles 6 in 2 rows attached to a thick collar, persistent stout broad flat, striate with recurved hooks on the edges, about as long as or longer than the nut; sculpture irregular hexagonal cells becoming elongate towards the base and giving rise to indefinite irregular striae.

Length 2.75 mm., breadth 1.7 mm.

REUVER, SWALMEN.

This species is abundant at Swalmen and Reuver. It is more robust and has stronger setae than the American *S. carinatus*, but we can find nothing nearer to it. Probably it is an extinct form.

SCIRPUS SP.

A small nut from Brunssum belongs to another species of *Scirpus*. It is obovate lanceolate triquetrous, but is too much broken for further determination or for photography. The surface sculpture consists of irregular elongate-hexagonal cells, becoming more elongate towards the base.

CLADIUM MARISCUS R. BR.

Pl. II, Fig. 35.

Fruit with part of glume in size and shape corresponding with *C. Mariscus*, and showing the very broad base of that species. Utricle shining smooth above crumpled at the base, surface with small irregular striae and minute rugosities.

Length 3 mm., breadth 1.8 mm.

REUVER.

The fossil only differs from our recent specimens of *C. Mariscus* (fig. 36) in the sculpture of the utricle, which is much more finely striate.

DULICHIMUM.

The genus *Dulichium*, now exclusively American, was formerly well represented in Europe, where it may have taken the place now occupied by riverside forms of *Carex* and *Scirpus*. Three well-marked species are found in the Reuverian; and of these one, though as a different variety, occurs in the Teglian; no species has yet been discovered in the Cromerian, though sedges were then so abundant, but the genus reappears in interglacial deposits. In addition to the three species described below, there are several forms which we have treated as varieties of one or other of the named species, though ultimately they may have to be given specific rank.

DULICHIMUM SPATHACEUM RICH.

Pl. III, figs. 1—4.

Fruits agreeing closely with this species in size, shape, and surface sculpture are abundant at Reuver (fig. 3) and Swalmen (fig. 4). They only differ from the recent specimens (fig. 1, 2) in our collection in having a rather shorter stalk. The difference is so slight that we cannot do otherwise than refer them to the same species.

Length (without style, 3.7 mm., breadth 1 mm.

REUVER, SWALMEN.

The plant has now a considerable range in North America; but is only known on that continent. As a European fossil it was first discovered by Dr. N. HARTZ* in an interglacial deposit in Denmark, and later Dr. J. STOLLER† recorded it from strata, probably of the same date, at Lauenberg an der Elbe; but it has not yet been discovered in the Teglian or Cromerian deposits.

* *Dulichium spathaceum* Pers., en nordamerikansk Cyperacé i danske interglacial Moser. *Meddelelser fra Dansk Geol. Foren.* No. 10.

† Über das fossile Vorkommen der Gattung *Dulichium* in Europa. *Jahrb. d. Königl. Preuss. Landesanstalt für 1909, Bd. XXX, Teil I, Heft 1.*

DULICHIMUM SPATHACEUM VAR. MARGINATUM VAR. NOV.

Pl. III, figs. 5, 6.

NUX QUAM IN TYPO BREVIOR, LATIOR BREVIUSQUE STIPITATA, MARGINE ANGUSTO IN ALAM AD STYLI BASEM ABEUNTE INSTRUCTA.

From Reuver we get nuts which apparently belong to a variety of *D. spathaceum*. Compared with typical nuts they are more ovate, shorter, broader, more shortly stalked, and have a narrow margin which develops into a narrow wing at the base of the style; in cell-structure they resemble *D. spathaceum*.

Length 3 mm., breadth 1.1 mm.

REUVER.

For the present we think that this fossil should be left as a variety of the living species, though in its robust form it differs noticeably from the American fruits of *D. spathaceum*.

DULICHIMUM SPATHACEUM VAR. ELLIPTICUM VAR. NOV.

Pl. III, fig. 7.

NUX AMBITU ELLIPTICA, ANGUSTE MARGINATA, SUPERNE IN STYLUM PLANUM INFERNEQUE IN STIPITEM BREVEM GRADATIM ANGUSTATA.

At Swalmen a few fruits of another variety of *D. spathaceum* have been found. The nut is flattened, elliptical, narrowed gradually into the flat style and short stalk, narrowly margined; base of style slightly winged; surface sculpture of small hexagonal pits, shallower and rather smaller than those of the type; setae grooved on back, narrower and more terete than those of the type.

Length 2.8 mm., breadth 1.1 mm.

SWALMEN.

We are uncertain whether this should be referred to a distinct species, or whether it is a variety of *D. spathaceum*, from the type of which it differs greatly. Only a few specimens occur, all at Swalmen; all are more or less distorted, probably because the walls are thin. Till more material is forthcoming we prefer to consider this as a varietal form.

DULICHIMUM VESPIFORME REID.

Pl. III, figs. 8—12.

As the illustrations of this species, described by us in 1908,* were not altogether satisfactory, and more is now known about the genus, we have rephotographed five of the type-specimens, for comparison with the newly discovered forms.

The year after we described this species, Dr. J. STOLLER (*loc. cit.*) announced the discovery of the same or an allied form in the interglacial deposits of Lauenburg and Friedrichshagen, and as far as we can judge from his figures this determination is correct.

* On *Dulichium vespiforme* sp. nov. from the brick-earth of Tegelen. Koninkl. Akad. van Wetenschappen te Amsterdam. *Versl. der Afdeel. Natuurk. Dl. XVI*, p. 898.

The fruits at Tegelen vary considerably in outline, and some are very near the form next to be described; none of these Reuverian specimens however quite correspond with those of the Teglian, though there is a close approach in some of them.

DULICHIMUM VESPIFORME var. TRIANGULARE var. nov.

Pl. III, figs. 13—16, 19, 20.

NUX OVOIDEA, ACUMINATA, BASI IN STIPITEM ABRUPTIUS APICEQUE IN STYLUM GRADATIM ANGUSTATA, TRIANGULARIS SAEPIUS QUAM PLANA.

Nuts ovate pointed, narrowed somewhat abruptly into the stalk and gradually into the style, more often triangular than flat; apex and style margined but not winged; surface sculpture as in *D. vespiforme*; setae slender flattened at the base, terete above, recurved hooks few.

Length about 2.2 mm., breadth 1 mm.

REUVER, BRUNSSUM.

This form in some respects is very near to the *D. vespiforme* of Tegelen. It resembles *D. vespiforme* in size and comes close to some of the broader forms in shape; but the typical nut of *D. vespiforme* has the sides more parallel and is more rarely triangular. Some of the flat rounded nuts seem to approach *D. urceolatum*; but they are always smaller, the stalk is shorter, they are narrowed more gradually into both stalk and style, they have not the flat wing, and they are frequently triangular, which *D. urceolatum* is not.

DULICHIMUM URCEOLATUM sp. nov.

Pl. III, fig. 17.

NUX GRANDIS, PLANA VEL BICONCAVA, URCEOLATA, BASI IN STIPITEM LONGUM APICEQUE IN STYLUM LONGUM GRACILEM ABRUPTUE CONTRACTA, MARGINIBUS ELEVATIS ET TUNC AD EXTREMUM ACUTUM OBLIQUE FASTIGATIS, HOC STYLI PARTEM BASALEM SECUNDUM UT ALA ANGUSTA PRODUCTO.

Nut large flat or concave urceolate, narrowed abruptly into a long stalk and abruptly into a long thin style; margins of nut raised and bevelled into sharp edges, which continue up the base of the style as a thin wing; stalk equal to half the length of the nut (not including the style); style as long as the nut; surface sculpture of the nut large hexagonal pits; setae broad and strong, coarsely striate grooved dorsally; recurved hooks on setae minute.

Length (including stalk and style) 4.8 mm., breadth 1.5 mm.

SWALMEN.

The typical form of this species (fig. 17) occurs only at Swalmen.

DULICHIMUM URCEOLATUM var.

Pl. III, fig. 18.

From Reuver and Swalmen we get fruits which differ from the type of *D. urceolatum* in being smaller, more ovate, with gradual passage into style and stalk, shorter stalk,

setae slender and terete at the apex. Neither this variety nor the typical *D. urceolatum* has yet been found at Brunssum. Extreme specimens of this variety seem to form a transition to broad flat specimens of *D. vespiforme* var. *triangulare*.

We have in these fossil fruits of *Dulichium* a series of gradations connecting the handsome rounded biconcave *D. urceolatum* (fig. 17), with the narrow form of *D. vespiforme* (fig. 8); other varieties perhaps connect *D. vespiforme* with certain extreme forms of *D. spathaceum*, and these form a transition into the narrow strap-shaped nut of fig. 3 and the living plant. The living plant however has fruits which vary but little, notwithstanding its considerable range in latitude.

We do not feel certain as to the proper interpretation of these variations. *Dulichium* in Pliocene times may have been a large genus, such as *Carex* is now, and each of our varieties perhaps ought to be called a species. Or, on the other hand, we may be dealing with a few species, each more variable than the living form. The latter interpretation seems at present to be the safest, and we therefore group all the forms under three species.

DULICHIMUM? SP. NOV.

Pl. III, fig. 21.

Nut ovate triquetrous, narrowing gradually into the stalk and more abruptly into the beak; stalk about $\frac{1}{4}$ length of nut; beak striate, conical below and marked by bases of small setae (?), stout, about $\frac{1}{2}$ length of nut without stalk, triquetrous spatulate at end (from compression?); surface of nut black, angles brown, faces finely granulate in places, marked by shallow hexagonal elongate pits, faintly marked by three straight brown lines, which suggest impressions of 8 or 9 setae now destroyed.

Length (including stalk and beak) 3.5 mm., nut alone 2.1 mm., breadth 1.1 mm.

REUVER.

This sharply triquetrous nut seems to represent a well-marked undescribed species belonging to some genus allied to *Dulichium*; but in the absence of setae we do not like to name it. The conical base and the three brown lines seen on the faces of one specimen suggest that the fruit had 8 or 9 slender deciduous setae attached in 3 rows, but not attached to a thickened collar as in *Dulichium*. The truncate end of the beak (spatulate at tip in one specimen) suggests a passage there into a deciduous herbaceous style.

As all known species of *Dulichium* have styles slender and uniform in substance, and setae attached to a thickened collar and hard and stiff to the tip, we can scarcely refer our fossils to this genus; they must wait the discovery of more perfect specimens.

CAREX.

Though the genus *Carex* is represented in the Reuverian deposits by about a dozen species, this number of forms is fewer than we should expect, when we consider

that three localities have been examined and a large amount of material has been picked over. The comparative scarcity of this genus may be connected, as already suggested, with the occupation of the river-banks by a dense growth of *Dulichium*, which lives under similar conditions. Unfortunately also the boiling and somewhat rough usage that is necessary to disintegrate the material, when large amounts have to be examined, tends to damage the utricles of the more delicate species, and to break off their fragile beaks. It is thus difficult to determine these fossils with certainty, especially as none of the species in this genus seems satisfactorily to match the recent forms.

We have therefore figured the fruits; but have only ventured to describe as new one species, which happens to be the largest, most abundant, and perhaps most characteristic of them all. As this species occurs plentifully at all three Reuverian localities, and is unknown either in the Teglian or Cromerian, or living, it may be a useful zone-fossil for correlation with other parts of Europe.

CAREX FLAGELLATA SP. NOV.

Pl. III, figs. 22—26.

FRUCTUS MAXIMUS; UTRICULUS RIGIDUS, INFLATUS, HAUD ROSTRATUS; NUX GRANDIS, TRIQUETRA, ELONGATO-OVOIDEA, BASI IN ANNULUM INCRASSATUM EXPANSA; STYLUS LONGUS, FLAGELLIFORMIS, SEMPER REPLICATUS.

Fruit very large; utricle stiff loose baggy, ovate wider below constricted suddenly above (not beaked), with about 22 regular thread-like prominent striae. Length 5.0 mm., breadth 3.0 mm. Nut triquetrous elongate-ovate, base narrowing and then expanded suddenly into a thickened ring and broad attachment; style long and whip-like, always recurved or doubled back on itself, as long as the nut; surface covered with deep hexagonal pits which give a rough appearance under low magnification.

Length of nut 3.3 mm., breadth 1.3 mm.; length of style about 3.0 mm.

SWALMEN, REUVER, BRUNSSUM.

The short baggy utricle compels the style to become doubled back as the nut develops, for the utricle is only sufficiently long for the nut. This is not an abnormality, but is characteristic of the species, for all the nuts in which the style is preserved show this sharp curve into a hook. It may be a useful modification for anchoring or transporting the fruit, which has become a bur such as can readily hold fast until the stiff hook breaks. This peculiarity, and the wide expanded base of the nut make the species very unlike any with which we have been able to compare it at Kew. It seems to be related to *C. Dickensii* of Japan; but that species has the very long whiplike style enclosed in a long narrow beak, which however is not long enough for the style, and causes the latter to become bent and wavy, but not recurved. *C. rostrata* has a similar whiplike wavy style; but in other respects does not resemble our fossil; its nut is much smaller. *Carex flagellata* was probably a river-side sedge, for it is very abundant.

CAREX SP. 2.

Pl. III, fig. 27.

Fruit large; utricle loose baggy below, prolonged upwards into a wide strongly striate beak; striae about 16, thread-like prominent.

Length 4.5 mm. (beak incomplete), breadth 2.5 mm. Nut (obscurely seen through the utricle) ovate long-beaked. REUVER.

A single specimen, showing a large thin utricle with long wide rostrum (incomplete), belongs to a well-marked species apparently closely resembling *C. Dickensii*. We have not seen any detached nuts which are likely to belong to this species; it must wait for further material.

CAREX SP. 3.

Pl. III, fig. 28.

Utricle large narrowly ovate gradually merging into the beak, strongly but irregularly striate.

Length 4.3 mm. (base incomplete), breadth 1.7 mm. SWALMEN.

A single specimen; the nut is unknown.

CAREX SP. 4.

Pl. III, figs. 29, 30.

Utricle regularly oval, varying in length, slightly stipitate, with about 15 raised thread-like striae.

Length 2.2 to 3.0 mm., breadth 1.3 to 1.5 mm. BRUNSSUM.

The nut of this striking *Carex* is unknown, and we have not sufficient material for dissection; we have not observed among the detached nuts from Brunssum any that are likely to belong to this species.

About 8 or 10 other species of *Carex* are represented by a few, or single nuts, sometimes with part of the utricle; but this material is insufficient for determination. Illustrations of most of these will be found on Pl. III.

PALMAE.

The only remains yet found in the Pliocene of Limburg belonging to this order prove to be very difficult to interpret. They seem to represent a genus no longer living; but as there is a possibility that we may be mistaken as to the order, we do not give the genus or species a name. The carpels only occur isolated; but their number must have been three.

GENUS?

Pl. XIX, figs. 19—21; Pl. XX, figs. 4 a, b.

Endocarp lanceolate slightly curved above, thick crustaceous, dividing lengthways into 2 valves in germination, rugose with irregular longitudinal channels and ridges; walls of uniform thickness, with short straight canals at the base and apex. Seed filling the long cavity, orthotropous; testa adhering to the endocarp; micropyle conspicuous, inserted into the apical canal of the endocarp.

Length 3.3 mm., breadth 1.3 mm.

REUVER.

With this open endocarp, showing the internal structure and the seed, were found several specimens of these endocarps with the two valves united, and some of them show remains of a fibrous mesocarp between the ridges. This justifies us in referring the specimens shown in figs. 20 and 21 to the same species, though they were found at another locality.

Endocarp lanceolate slightly curved at the tip, triangular, opening at the ventral angle; covered externally by a thick coarsely-fibrous mesocarp which clothes the whole carpel.

Length 3.8 mm., breadth 1.5 + mm.

SWALMEN.

With these fruits from Reuver and Swalmen we may perhaps associate a fragment of rachis, (Pl. XX, fig. 4) on which is impressed the shape of a complete fruit, broadly ovate in shape and of about the size required.

Length of fruit 5 mm., breadth 1.5 mm.

BRUNSSUM.

ARACEAE.

EPIPREMNUM CRASSUM SP. NOV.

Pl. IV, figs. 1—9.

SEMINA PARVA, RENIFORMIA VEL NAVICULIFORMIA, PARUM LATERALITER COMPRESSA; TESTA CRASSISSIMA DURISSIMAQUE.

Seed reniform or boat-shaped, somewhat compressed but rounded laterally, smooth or minutely granulate; attachment long-oval sunk reaching to the micropyle, which is surrounded by fine radiating striae; testa very thick and hard.

Length 2.5 mm., breadth 3 mm.

REUVER, SWALMEN.

In a few specimens outer layers of cells are preserved. An outer skin is rarely seen, it is black shining wrinkled large-celled finely striate transversely (*i.e.* at right angles to the curve of the seed). A second layer of large loose cells usually decays, but occasionally shows as a coarse network on the surface of the hard testa. These two layers belong to the fruit and may represent merely an exceptional hardening of parts usually succulent. The testa is thicker and denser than that of *E. pinnatum*, which we have figured for comparison (Pl. IV, figs. 10—12); it is light-brown, polished externally

or minutely pitted, with faint lines and granules curved in the direction of the axis and passing into a fine close striation around the micropyle. Tegmen occasionally preserved, adhering slightly to the testa, thin black lustrous, strongly and sharply wrinkled transversely between the rows of large quadrangular cells, which show no stretching longitudinally.

At Reuver and Swalmen these peculiar boat-shaped seeds occur abundantly. They can only be referred to one of the aroids with anatropous ovules, belonging to the section *Monsteroideae*; we see no reason for separating them from the living genus *Epipremnum*. They belong to an extinct species allied to the widely distributed *E. pinnatum*, which is the only species now extending into temperate regions; the others belong to the tropics.

The abundance of these fossil seeds makes it probable that they belonged to an aquatic species or to a climbing aroid overhanging the river. Their hardness, small size, and curved polished surface, without angles of any sort, show that they were adapted for dispersal by birds; but many of them have been nipped in half by birds.

EPIPREMNUM SP.

Pl. IV, figs. 13, 14.

Two very small seeds of *Epipremnum* perhaps represent a second species. They are about half the size of *E. crassum*; but in their shape and thin testa they more resemble the considerably larger seeds of *E. pinnatum*.

Length 1.3 mm., breadth 2.2 mm. (we have been obliged to figure these on double the scale of *E. crassum*, as they are so small). REUVER.

In default of more material we do not care to describe this as a different species; the two seeds may be undeveloped seeds of *E. crassum*.

DICOTYLEDONEAE.

JUGLANDACEAE.

PTEROCARYA LIMBURGENSIS SP. NOV.

Pl. IV, figs. 15—21.

ENDOCARPIUM INFRA APICULATUM, PARTE SUPERIORE LATISSIMUM, APICE TRUNCATUM, ROSTRO BREVI TRIANGULARI DISTINCTISSIMO INSTRUCTUM; COSTAE IRREGULARITER ANASTOMOSANTES. REUVER, SWALMEN, BRUNSSUM, TEGELEN.

Fruits of *Pterocarya* are very abundant at Reuver and Swalmen, and a few have been found at Brunssum; they evidently belong to the same species as that which occurs at Tegelen. The endocarps vary however so greatly in external characters that it is very difficult to describe them. If extreme forms only are studied, we should be inclined to refer our fossils to several species, differing in number and sharpness of the ribs and in other characters; but in a very large series intermediate forms seem to connect all these extremes. Some specimens approach the strongly beaked *P. caucasica* (figs. 26, 27) whilst most are more like the smaller short-pointed *P. hupehensis* of China (figs. 22, 23).

When a large series of the fossil endocarps is studied we find that certain definite characters emerge by which we can with certainty distinguish these three allied species. In the recent *P. caucasica* the endocarp is rounded below, widest in the middle, and narrows gradually upward into a broad robust beak. In the Chinese *P. hupehensis* the very broad endocarp is truncate below, widest at the lowest third, and from thence narrows into a short triangular beak. In *P. limburgensis* the endocarp is usually pointed below, widest in its upper third, truncate above with a sharply defined short triangular beak. Its ribs tend also more often to form loops, and are less straight and parallel than in the two living allied species. We do not however insist on this last character, for the ribbing is excessively variable in the endocarps of *Pterocarya*, and we have not yet been able to examine so large a series of the recent fruits as of the fossils.

The Tegelen fruits previously referred to *P. caucasica* must now be transferred to *P. limburgensis*; but as the figures previously given do not well show the characters of the species, the type specimens of *P. limburgensis* must be those from Reuver shown on Pl. IV. We have re-examined all our specimens from Tegelen, and also have a large series collected and sent to us by Dr. TESCH; we cannot in any way distinguish them from the Reuver forms.

CARYA ANGULATA SP. NOV.

Pl. IV, figs. 28, 29.

ENDOCARPium OVOIDEUM, UTRINQUE ANGUSTATUM ET APICULATUM, COSTIS PLURIBUS LONGITUDINALIBUS ACUTIS INSTRUCTUM.

Endocarp ovate narrowed and pointed above and below, with several sharp longitudinal ribs.

Length about 30 mm. (5 broken specimens).

REUVER.

This fruit somewhat resembles *C. alba* and is of about the same size; but it is narrower below, much more strongly ribbed, and does not show the reticulating grooves or the small tubercles seen on the exterior of the endocarp in *C. alba*. From the living *C. olivaeformis* it is clearly distinguished by its pointed shape and sharp ribbing.

Our fossil agrees closely with one of those figured by KINKELIN* as *Carya olivaeformis* Nutt. *fossilis* KINK. (fig. 17), but it is quite unlike the other specimens figured under the same name (figs. 12—16, 18). We doubt if all his figures can represent the same species. Like our fossil, KINKELIN's fig. 17 is strongly ribbed and pointed at either end. His other figures, and to these his descriptions specially apply, represent long-oval blunt-pointed nuts resembling the living *C. olivaeformis*. All our fossils show the sharp angles and pointed end — we have seen nothing in the Reuverian approaching to *C. olivaeformis*.

The Reuver material is not very satisfactory for description, but as it represents a well-marked Pliocene form, which appears to be common to Limburg and Austria, and is unlike any described species, we name the Reuver fossil *C. angulata*, and refer to this species also KINKELIN's fig. 17. We cannot employ KINKELIN's term *fossilis*, for this he applies not only to forms of *C. olivaeformis* but to two other quite different species; he does not use *fossilis* in a varietal sense, and he had long previously applied the term *fossilis* to *C. ovata*.

BETULACEAE.

CARPINUS BETULUS LINN.

Pl. IV, figs. 30—33.

Fruits of this species occur in profusion at Reuver and Swalmen, and a smaller number are found at Brunssum. They vary greatly in size, but in no essential character can they be distinguished from the living form. The four nuts figured show the range of variation, but these seem to be connected by numerous intermediates, and all attempts to separate two species have failed. We have seen no fruiting bracts.

* ENGELHARDT und KINKELIN, Oberpliocäne Flora und Fauna des Untermain Tales. *Abh. der Senckenbergischen Naturforschenden Gesellsch.* Bd. 29, Heft 3, Pl. XXX.

CORYLUS AVELLANA LINN.

Pl. IV, figs. 34, 35.

We have seen no perfect specimens, but broken nuts of *Corylus avellana* are found at REUVER, SWALMEN, and BRUNSSUM. They correspond in shape with this species, and not with any of the other living forms; but our fossils are always strongly striate longitudinally. This character is not usually seen on recent nuts, unless the outer layers have decayed; but we find in the Kew Herbarium a recent specimen showing this striation. Perhaps our fossils should be referred to *Corylus avellanoides* ENGELH.* of the brown coal of Saxony, which is figured as resembling *C. avellana* but is more striate.

BETULA.

Remains of *Betula* are rare, though three species occur, and these belong to two different sections of the genus. The discovery of a species clearly belonging to the section *Eubetula* is of considerable interest, for at the present day this section is confined to Asia, and as far as we can learn none of the previously known fossil species belong to it.

BETULA DIGITATA SP. NOV.

Pl. IV, figs. 37a, b, 38.

BRACTEA FRUCTIFERA DURA, LIGNOSA, AD MEDIUM TRIFIDA, NERVIS TRIBUS E BASI CUNEATA VALDE CONSPICUIS, LOBO MEDIANO ANGUSTE SPATULATO, LOBIS LATERALIBUS PARUM DIVERGENTIBUS ET TUNC EXTRA CURVATIS, SINU ROTUNDATO.

Fruiting bract hard woody, trifid to half its length, strongly 3-veined from the cuneate base, middle lobe narrow spatulate, lateral lobes slightly divergent and then curved outward (incomplete at tips), sinus rounded.

Length 6 mm.

SWALMEN.

Seed hard, broadly rhomboidal truncate at base acute above, shouldered on either side of the styles, little if at all winged.

Length 3.2 mm.

SWALMEN.

The bract is remarkable as belonging to the section *Eubetula* subsection *Costatae*, and comes very near to *Betula ulmifolia*, (figs. 36a, b.) with which we have photographed it. In the new species however the bract is shorter, more spatulate, its side lobes are given off at a more acute angle, and in the grooves on the ventral side it is hairy. The seed is wider than in *B. ulmifolia* (fig. 39), tends to be cuspidate on either side of the apex, and appears to have been almost without wings.

We have compared the fossil bract with that of all the species of the section, except four which do not happen to be in the Kew Herbarium; it does not agree with any of them, nor with the published descriptions of the other four. Whether the seed should be referred to the same species we are uncertain; it has considerable resemblance

* ENGELHARDT, Die Flora der Braunkohlenformation in Sachsen, fol. 1870, p. 36, pl. X, figs. 7, 8.

to the seed of *B. Delavayi*, as shown in drawings at Kew and in the "Pflanzenreich". If the bract and seed prove to belong to different species, the bract is the type of *B. digitata*.

BETULA Sp.

Pl. IV, fig. 40.

A female catkin, incomplete at either end, represents our common European birches; but is too imperfectly preserved for determination. The catkin is small, and appears to have been much shorter and more ovate than in *B. pubescens* or *B. verrucosa*, though the oval outline may perhaps be due to compression; the bracts are small, thin, strongly striate, and seem to have a blunt middle lobe. The reflexion of the bract, seen in the photograph, may be due to pressure, the shape of the lateral lobes cannot be made out, nor can the seed be seen.

Length 5 mm., breadth 3 mm.

REUVER.

We do not recognise this catkin as belonging to any European birch.

BETULA SPP.

Pl. IV, figs. 41—43.

Seeds of two other species of *Betula* (in addition to the seed provisionally referred to *B. digitata*) have been found. From Reuver, where the catkin just described was found, we have a large imperfect seed (not figured); but this seed seems too large to belong to the catkin, for it is nearly as wide as a whole scale. From Swalmen we have the small obovate seed shown in fig. 41, which in size might belong to the catkin; but they were found at different localities.

Two male catkins found at Reuver (figs 42, 43) evidently belong to two quite different species; but we have no means of connecting them with the plants yielding either the female cone or the isolated seed.

ALNUS.

Cones, bracts, and seeds of *Alnus* are abundant, and seem to fall into four groups. We have examined the cones of all the Palaearctic alders in the Kew Herbarium, but none of these agree with any of our fossils, though *A. elliptica* Req. seems near to our Species 1. We find the scales and seeds of living forms so variable, and so many recent and fossil alders have been described, that we think it safest not to name the Reuverian cones, but merely to describe them as nearly as we are able under species Nos. 1 to 4.

ALNUS Sp. 1.

Pl. V, fig. 1.

Cone oblong, length 12 mm., breadth 8 mm.; scales few large flat, front and side lobes wing-like, truncate above, margins crenulate, scarcely sculptured; front lobes

somewhat broader than long, attached together along median line at apex; side lobes broader and larger than the front, overlapping them slightly; central lobe very large, triangular inflated, scarcely sculptured, apex free ascending. REUVER.

This cone, as already mentioned, somewhat resembles that of type specimen of *Alnus elliptica* Req., which is placed under *A. glutinosa* in the Kew Herbarium; but it does not agree with the common form of *A. glutinosa*.

ALNUS SP. 2.

Pl. V, figs. 2—5.

Cone ovate-oblong, length 13 mm., breadth 10 mm.; scales few large; front and side lobes nearly equal, wing-like, free part truncate with rounded corners, irregularly rugose or striate longitudinally, length and breadth about equal; front lobes separated by a U- or V-shaped gap, side lobes slightly overlapping front ones; central lobe semi-circular embossed wrinkled, no free part. Seeds round or rounded-quadrilateral blunt at apex, sessile attachment cordate. Approaches *A. maritima*. REUVER, SWALMEN.

ALNUS SP. 3.

Pl. V, figs. 6—8.

Cone ovate or ovate-oblong, length 15 mm., greatest breadth 11 mm.; scales many, blade about 4 times as broad as long, straight or slightly rounded in front, thick embossed much wrinkled; front and side lobes involute; front lobes usually gaping, side lobes overlapping them slightly; both with thin narrow rounded margins, lower part thick highly sculptured; central lobe irregular broad oval about 3 times as broad as long, highly sculptured, with large central boss, bluntly pointed in front and scarcely free projecting outwards. This boss is sometimes flattened into the scale and gives the appearance of a large tubercle. Seed wedge-shaped ribbed longitudinally, front margin concave ending in a triangular point, broadest $\frac{2}{3}$ from base, base broadly truncate.

REUVER.

ALNUS SP. 4.

Pl. V, figs. 9—11.

Cone oblong, length unknown, as none are complete, breadth 8 mm.; scales few small; front and side lobes wing-like thin nearly equal, rounded in front; side lobes overlapping considerably; central lobe round inflated wrinkled. Seeds very large, projecting much beyond the scales, very broad apex blunt or even emarginate, base not seen.

REUVER.

This is a very marked species, distinguished by the great size of the seeds. These are nearly as large as the whole blade of the scale, and project above it for about $\frac{1}{3}$ of their length, giving the appearance of two additional large lobes.

In figs. 13 to 16 we have also shown a group of isolated seeds and scales

belonging to *Alnus*, for these isolated specimens are often better than any that we can dissect out of the cones. Fig. 12 shows a small cone, probably belonging to one of the species above described; but it cannot be satisfactorily identified. Figs. 17, 18 represent fragments of male catkins.

FAGACEAE.

FAGUS DECURRENS SP. NOV.

Pl. V, figs. 19, 20, 22—28.

CUPULA PARVA, BASI TRUNCATA, PEDUNCULO BREVI CRASSO CONOIDEO SUFFULTA; BRACTEAE EX OVATIS AD LANCEOLATAS, DENSE SETOSAE; SETAE ACUTAE, INTERDUM FURCATAE, STRIATAE; CUPULA OB SETAS BASI VALDE DECURRENTES UT VIDETUR, VALDE STRIATA.

Cupules and nuts of *Fagus* are very abundant at Reuver, Swalmen, and Brunssum, and a few specimens show the nuts in place. Notwithstanding the variability in the width of the fruiting bract all the specimens obviously belong to one species.

Cupule small truncate below, peduncle short thick conical; bracts usually narrower and more acute than in *F. silvatica*, but varying from ovate to lanceolate, very bristly; bristles pointed, occasionally forked, striate, and strongly decurrent at the base, giving the cupule a conspicuously ribbed appearance; inside of cupule grooved.

Length 15 mm. (rarely larger), breadth 12 mm. REUVER, SWALMEN, BRUNSSUM.

Nut resembling those of *F. silvatica* and *F. orientalis* in texture and like them broadly winged above, but much smaller and style apparently longer.

We have compared the fossil fruits with those of all the living species. Though they show points of resemblance to several, they also show consistent differences which must be regarded as of specific rank. The species which they most closely resemble are *F. silvatica* and *F. ferruginea*.

They agree with *F. silvatica* in having pointed recurved spines, and in the character of the nuts; but differ in their much smaller size, and in the strongly ribbed decurrent bases of their spines, which give the whole cupule a markedly striate appearance. In order to illustrate this difference we have figured (Pl. V, fig. 21) a recent somewhat decayed and weathered small cupule of *F. silvatica*. This was selected as the nearest approach we can discover to our fossil species.

The fossil cupules bear a close resemblance to those of *F. ferruginea* in all characters; but the seeds are much smaller and are not exerted, as is the case with *F. ferruginea*.

The illustrations of *F. pliocaenica* GEYL. et KINK.* greatly resemble our fossil in outline; but their specific description makes it impossible to refer our fossil to the same species. ENGELHARDT and KINKELIN write "von *Fagus silvatica* unterscheiden sich diese Becker nicht durch die Grösze, sondern nur durch den Mangel der Zotten". Ours on the other hand are decidedly smaller than *F. silvatica*, are still more spiny, and have

* Oberpliocäne Flora und Fauna des Untermaintales, Abh. Senckenbergischen Naturforsch. Gesellsch., Bd. 29, Heft 3 (1908), Pl. XXIX, Figs. 1, 3, 4.

the noticeably striated decurrent spines shown in our figures. The absence of spines on the specimens from the Untermaintal may possibly be due to decay; but such decay only tends to make more conspicuous the striation on the cupule of *Fagus decurrens*.

As we have a perfect series of gradations between the form with narrow bracts (fig. 28), and the form with wide bracts (fig. 19), and similar variations can be found on the same tree in *F. silvatica*, we prefer not to give them varietal names.

FAGUS? SP.

Pl. V, figs. 29 a, b.

The minute cupule of *Fagus* shown in this figure is very puzzling. It is hard and woody, and seems therefore to be nearly ripe. The cupule of *Fagus silvatica* is much larger than this specimen, even when quite soft and before the ovule is fertilized. It may be an abnormal development of *F. decurrens*, and as such we leave it until more material is discovered.

Length 3 mm., breadth 2.7 mm.

BRUNSSUM.

QUERCUS ROBUR LINN.

Pl. V, fig. 30.

A few cupules of *Quercus robur* occur at REUVER, a single specimen comes from BRUNSSUM, and one from SWALMEN. Most of the Reuver specimens are abortive, but we have half of a fully developed cupule and another which is almost fully developed. We see no reason for separating these from *Q. robur*, with which they agree closely. M. LAURENT also finds this species among the leaves examined by him.

ULMACEAE.

ZELKOWA KEAKI LINN.

Pl. XII, figs. 1—4.

Several fruits belonging to this species have been found. They seem to correspond in every respect with recent specimens received from Yokohama; but are somewhat smaller; our Yokohama fruits however are probably from a tree in cultivation.

Fruiting perianth 2-lobed; lobes unequal produced into points, midribs and lateral veins prominent; attachment usually quadrate.

Length 2 mm., breadth 3.5 mm.

SWALMEN, BRUNSSUM.

MORACEAE.

MORUS?

Pl. VI, fig. 1.

A seed found at Reuver has great resemblance to the seed of *Morus*; but without more and better material we do not like to include this genus in the Pliocene flora.

URTICACEAE.

Nuts belonging to the *Urticaceae* are not uncommon, and no fewer than five species are probably represented. Three of these appear to belong to *Urtica*, the other two suggest another genus with nuts resembling *Girardinia*. In addition we figure two other small nuts which may belong to the same family.

The nuts of *Urticaceae* unfortunately are not easy to determine, either generically or specifically, and we are obliged to leave the position of the Reuverian fossils still uncertain. All that can be done is to describe the forms as far as the available material will allow, without giving them specific names. It may be remarked in passing that the species belonging to this family have been photographed upside down, so as to show clearly the attachment. This has been done in other families also, where the base exhibits critical characters, and must be lighted so as to show them.

URTICA URENS LINN.?

Pl. VI, fig. 2.

Nut small, closely resembling that of *U. urens* in shape, surface sculpture, and attachment, but much smaller.

Length 1.2 mm., breadth 0.9 mm.

SWALMEN.

In size this corresponds with Teglian and Cromerian specimens.

URTICA DIOICA LINN.?

Pl. VI, fig. 3.

Nut minute, closely resembling that of *U. dioica* but much smaller.

Length 1.0 mm., breadth 0.75 mm.

REUVER.

In size this corresponds with Teglian and Cromerian specimens. The small size of these two species may therefore be due merely to shrinkage during carbonisation; the other differences are so slight as not to be of specific value. Both species are very rare in the Reuverian.

URTICA SP. 3.

Pl. VI, fig. 4.

Nut broadly ovate acute compressed widely margined, sides covered with reticulate veins.

Length 1.4 mm., breadth 1.1 mm.

SWALMEN, REUVER.

In outline this nut much resembles *U. urens*, but it is slightly smaller, more acute, and more conspicuously and widely margined. *Urtica urens* shows traces of similar reticulation; but the veins are much less conspicuous. This species is rare, only 2 nuts having been found at Swalmen and 2 at Reuver.

URTICACEAE Sp. 4.

Pl. VI, fig. 5.

Nut roundly ovate, somewhat truncate at base mucronate at apex, compressed, broadly margined, rough.

Length 1.2 mm., breadth 1.2 mm.

SWALMEN.

This nut, of which we have only seen one specimen, not well preserved, resembles that of the genus *Girardinia*.

URTICACEAE Sp. 5.

Pl. VI, fig. 6.

Nut ovate cordate at base pointed at apex, compressed, slightly margined, rough.

Length 1.8 mm., breadth 1.4 mm.

REUVER.

The unique nut of this species may belong to the same genus as the nut from Swalmen just described, but they do not belong to the same species.

URTICACEAE?

Pl. VI, figs. 7, 8.

The small nuts here shown seem also to belong to *Urticaceae*, but they are not sufficiently well preserved for description; they do not correspond with any of the species already described.

SWALMEN, REUVER.

The small number of specimens belonging to *Urticaceae* is due largely to the difficulty found in collecting them. In the clay of Tegelen small seeds were abundant, and many species could be found in a small amount of material. In the Reuverian deposits, on the other hand, small seeds are few and far between. So much time was therefore needed to examine a large amount of the finer material, that it was found more profitable to concentrate attention on the coarser material, for this latter contained numerous large fruits and seeds of which the anatomy could be better made out. Except for these *Urticaceae*, and an occasional seed of *Hypericum*, there is little in the finer material, *Batrachium* and other small fruits common at Tegelen being absent.

PROTEACEAE.

The occurrence or non-occurrence of the *Proteaceae* in European Tertiary strata has been so hotly debated, and so many of the leaves so described have proved to belong to other orders, that only with the greatest hesitation do we venture to bring forward a fresh piece of evidence. In this case, however, we are not forced to rely on the somewhat ambiguous pattern taken by the venation of a leaf, which in the *Proteaceae* happens to be a character of little diagnostic value. In the Pliocene deposits of Brunssum has been found the half of a hard woody fruit, so like that of *Hakea*, and so unlike

anything else that we can find, that we feel compelled to treat it as an unrecorded species of this genus, and perhaps therefore the last representative of this dying-out family in Europe.

HAKEA ANGULATA SP. NOV.

Pl. VI, figs. 9 a, b.

FOLLICULUS PARVUS, CRASSISSIMUS, DURISSIMUS VALDEQUE OSSEUS, BASI ACUTUS, SUPERNE OBLIQUE DILATATUS LATERALITERQUE COMPRESSUS, PARTE DIMIDIA INFERIORE VALDE BICOSTATUS VEL BIANGULATUS, MEDIO ALTIUS EXCAVATUS, SUPERNE IRREGULARITER STRIATUS.

Follicle small, very thick hard and bony, pointed below obliquely widened and laterally compressed above, strongly 2-ribbed or angled in the lower half, deeply indented in the middle, irregularly striate above; interior showing deep pit for seed and impression of wing above.

Length 7 mm., breadth 4 mm.

BRUNSSUM.

The hilum appears to be apical towards the convex side, the micropyle basal. The endocarp shows, as in the living *Hakea*, an inside striate lining composed of elongate fusiform cells, the side walls of which are thick and cord-like.

Though this fruit is unusually small for a *Hakea* it bears great resemblance to living species. Most of the species have the fruit and seed straight (*H. saligna*, figs. 10 a, b), or nearly so; but we observe in Kew Herbarium at least two species with a similar bend, in the one case towards the dorsal side in the other towards the ventral. The curious obliquity in the upper part of the fruit and in the wing of the seed forms therefore no difficulty in the reference of our fossil to *Hakea*.

The exceptional smallness of the fruit is remarkable; but this is a character met with again and again in those members of the Reuverian flora which were lingerers belonging to orders no longer surviving in Europe. We notice it for instance in *Epipremnum*, *Nelumbium*, *Liriodendron aptera*, and in the Anonaceous genus *Jongmansia*.

SANTALACEAE.

PYRULARIA EDULIS A. DC.

Pl. XIV, fig. 5.

A single specimen of a large endocarp was sent to us from Reuver. Unfortunately it had been allowed to dry, had fallen to pieces, and was cracked all over. We hardened and mended as well as we could; but much of it is missing or cannot be joined, and the fruit is not in a satisfactory state for photography.

Endocarp globose, crustaceous but rather thin-walled, surface badly preserved; inside showing at the base the large boss which supports the central free placenta, and at the apex a circular area differing in texture from the rest of the endocarp.

Length 28 mm., breadth 27 mm.

REUVER.

In proportion to its size, the walls of this endocarp are thin; it has therefore been crushed in and has burst round the edges. One half of the fruit has been lost, the figure showing the inside of the other half, with small portions of the lost half. Though badly damaged the basal boss is perfectly clear, as is the position of the apex. In shape, size, and structure, especially the placental boss, this fruit agrees exactly with *Pyralia edulis*, a small tree of the Himalaya, and of Yunnan at about 4500 feet. The only other known species of the genus is American, and its fruit is quite different.

ARISTOLOCHIACEAE.

ASARUM?

Pl. VI, figs. 11 a, b.

Seed ovate, dorsal side convex, ventral deeply concave with groove at base (figs. 11 a, b, should probably be inverted); testa finely punctate rather shining.

Length 3 mm., breadth 1.8 mm.

REUVER.

We have compared our specimen with the seed of *A. caudatum* (figs. 12 a, b), and find that they agree in general structure and match closely in the character of the testa. Unfortunately we have been unable to find seeds of the Chinese and Japanese species for comparison. In the absence of such material, and having only one fossil seed, we do not like to lay too much stress on what may be merely a superficial resemblance.

POLYGONACEAE.

Fruits belonging to this family are exceedingly rare, and the genus *Rumex* is entirely missing. Of *Polygonum* we have only seen 5 nuts, most of which are damaged.

POLYGONUM Sp. 1.

Pl. VI, fig. 13.

Nuts large compressed rounded mucronate.

Length about 3.5 mm., breadth 3.0 mm.

REUVER.

Two broken and decayed specimens, neither sufficiently well preserved for fuller description. They are larger than the nuts of any flat or plano-convex form in our collection, though at Kew we find nuts of *P. persicaria* equally large.

POLYGONUM Sp. 2.

Pl. VI, fig. 14.

Nut obovate, broadest slightly above the middle, then narrowing suddenly to a small point, biconvex and equally tumid on either side.

Length 2.5 mm., breadth 1.8 mm.

REUVER.

We cannot find any *Polygonum* to match this form.

POLYGONUM SP. 3.

Pl. VI, fig. 15.

Nut ovate mucronate narrowed at base, compressed.

Length 2.0 mm., breadth 1.6 mm.

REUVER.

A compressed and much decayed specimen, which may be only a badly preserved nut of the last species.

CHENOPODIACEAE.

The *Centrospermae* are poorly represented, we having seen only four specimens, each belonging however to a different genus, and perhaps to a different family.

GENUS?

Pl. VI, figs. 16 a, b.

Half a seed (which has germinated).

Seed orbicular flattened, keel narrowly compressed, radially striated, hilum basal, micropyle prominent.

Length 3.0 mm., breadth 3.0 mm.

REUVER.

The large size and prominent micropyle make it improbable that this seed belongs to *Chenopodium*; its flattened form resembles *Atriplex* rather than one of the *Amarantaceae*, but the keel and surface sculpture are peculiar. The poor preservation of the only specimen leaves however the determination doubtful.

APHANISMA?

Pl. VI, figs. 17 a, b.

A minute strongly 5-ribbed fruit, apparently containing a single seed, suggests the American genus *Aphanisma*, but in the absence of further specimens we cannot examine its internal structure.

Fruit minute globose somewhat depressed, with 5 strong ribs very prominent below less prominent above.

Length 1.5 mm., breadth 1.8 mm.

SWALMEN.

NYCTAGINACEAE?

Pl. VI, fig. 18.

Fruit inflated 5-angled, narrowed above into a long thick 5-angled style; base surrounded by a cupule formed by the persistent perianth and bracts; pedicel thick, turned to one side; surface of nut rugose transversely below, striate longitudinally above; bracts thick rugose transversely above and longitudinally towards pedicel.

Length (including style and pedicel) 9.5 mm., breadth 5.0 mm.

REUVER.

The general character of this curious fruit would seem to place it in the family *Nyctaginaceae*. It may be related to the South American *Bourgainvillea*.

CARYOPHYLLACEAE.

Pl. VI, fig. 19.

A fragment of the testa of a large seed is the only evidence we have for this family in the Reuverian stage. The seed appears to have germinated, and in germinating has turned inside out, so that the concave surface shown in fig. 19 is really the outside of the seed.

Tubercles in concentric rows, prominent towards the circumference, becoming small and crowded towards the centre, bases interlocking and foliate.

Length (of fragment) 3.25 mm.

REUVER.

Though the testa is much decayed it shows here and there the foliate sutures between the tuberculate cells, so characteristic of the *Caryophyllaceae*.

NYMPHAEACEAE.

NELUMBIUM MINIMUM SP. NOV.

Pl. VI, figs. 20 a, b.

TORUS (MANCUS) MINIMUS, CARPELLIS SALTEM 22; CARPELLA MINUTA, ARCTIUS CONFERTA, OVATA, APICE CONSPICUO MAMMILIFORMIA, STRIATA, BASI HAUD INTRUSA.

Part of the middle of a torus less than 5 mm. across, in which are imbedded 22 carpels; carpels minute closely packed and often faceted or dented by mutual pressure, ovate, apex prominent mammilate and striate, base not indented.

Breadth of torus 4.5 mm. Carpel, length 1.5 mm., breadth 1.0 mm. SWALMEN.

This unique specimen is a fragment of a torus, with the margin only preserved at one point; its lower surface is torn away so as to expose the base of the carpels. It shows 22 carpels more or less perfect; the curvature of its upper surface and the radiation of the nuts suggest that the total width may have been about 10 mm. and the number of carpels perhaps 40. The exceeding minuteness of this specimen makes it difficult at first to believe that it can belong to the same genus as the living *Nelumbium*. It shows however the characteristic carpels sunk in a flattened torus; its nucules greatly resemble those of *N. speciosum*, but are much smaller, more in number, without the basal pit, and have a more conspicuously mammilate apex. The channel of the large funicle passes out of the carpel on a level with the upper surface of the torus. There is nothing to suggest unripeness in this specimen; the carpels seem fully developed and hard, and are being set free by the breaking up of the torus. They appear to be crustaceous and fragile; and this may be one reason why no detached carpels have been found in the same deposit.

BRASENIA PELTATA PURSH.

Pl. VI, figs. 21—24.

Seed not well preserved, more oblong and somewhat broader, but apparently inseparable from the living species. Its testa shows the characteristic triradiate cells and

also the striation radiating from the micropyle. Only one specimen has been found. It is figured side by side with a recent seed.

Length 3.2 mm., breadth (crushed) 2.8 mm.

BRUNSSUM.

BRASENIA TUBERCULATA SP. NOV.

Pl. VI, figs. 25—27.

SEMINA OVALIA, HILUM VERSUS PARUM LATIORA; TESTA GRANULATA MINUTEVE TUBERCULATA, EMBRYOTEGAM VERSUS VALDE STRIATA.

Seeds oval somewhat broader towards the hilum, marked with one or more inconspicuous longitudinal grooves; testa granulate or minutely tubercled, strongly striate towards the embryotega; embryotega (only partly preserved in one specimen) with large micropyle; raphe broad and flat, only visible near the hilum.

Length 3.25 to 4.0 mm.; breadth 2.5 to 3.0 mm.

BRUNSSUM.

Compared with *B. peltata* the seeds on the average are considerably larger, and are broader in proportion to their length. The most noticeable distinction however is found in the minutely granular or shortly spiny exterior of the testa, which in the recent plant is smooth, or only shows small flattened tubercles. The characteristic triradiate cells of the genus can be seen under the microscope, but they are so masked by the tubercles, and the shadows of the tubercles, that they do not show in the photographs. The large-scale photographs of the apex of this species (fig. 27) and of *B. peltata* (fig. 23) show clearly the differences.

The Pleistocene forms of *Brasenia* seem to have been correctly referred to *B. peltata*. Some badly-preserved seeds of *Brasenia*, from a newly discovered Pliocene deposit at Bidart, near Biarritz, sent to us by Professor JULES WELSCH, appear to belong to *B. tuberculata*; they are associated with *Proserpinaca reticulata*.

NUPHAR CANALICULATUM SP. NOV.

Pl. VII, figs. 1—3.

SEMINA QUAM EA *N. lutei* MINORA MAGISQUE GLOBOSA; SUPERFICIEI FOVEOLAE MINORES ET OB CELLARUM PARIETES CRASSISSIMAS MAGIS PERPLEXAE; CELLARUM PARIETES VICINAE FOSSA CONSPICUA DISTINCTE SEJUNCTAE.

Seeds smaller and more globose than those of *N. luteum*; surface pitting smaller and more confused, owing to the great thickness of the cell-walls; adjacent cell-walls distinctly divided on the surface by a channel which shows conspicuously.

Length 4 to 3 mm., breadth 3 to 4 mm.

REUVER, SWALMEN.

These seeds are abundant at Reuver, and one has been found at Swalmen. We cannot refer them to a variety of *Nuphar luteum*. The difference of size and shape may be of little importance, as these characters vary considerably in water-plants, according to the conditions under which they live; but the very thick and conspicuously channelled ridge-like walls between the pits gives the seeds a very distinct appearance under the microscope, and the character seems certainly to be of specific value.

We have found no trace of the genus *Nuphar* in the Teglian; so there is apparently no continuity between the Reuverian species and that of the Cromerian, which last is indistinguishable from the living *N. luteum*.

NUPHAR SP.

Pl. VII, figs. 4, 5.

A single badly preserved seed of *Nuphar* cannot be referred either to *N. luteum* or to *N. canaliculatum*. It is distorted, damaged, and only part of the embryotega remains, so that it cannot be made the type of a new species. The surface is well preserved; it is dull, covered uniformly with very small irregular-shaped pits, which tend to become rectangular towards the embryotega, and to give rise to longitudinal striae, though this character is less marked than in *N. luteum*. The small part of the embryotega which is preserved shows a large micropyle with incurved edges and concentrically arranged pits; close beside it is the scar of the hilum.

Length 4.3 mm., breadth 3.2 mm.

REUVER.

The much finer surface sculpture makes it impossible to refer this seed either to *N. luteum* (fig. 6.) or to *N. canaliculatum*. In shape it appears to have been more regularly oval than either.

EURYALE.

A few years ago the genus *Euryale* was only known as a monotypic waterlily of China and Assam, usually in cultivation. In 1907 two different and extinct European species of the genus were described, unfortunately both under the name *E. europaea*. As the Russian plant figured by Dr. C. A. WEBER was published a few months before ours from Tegelen, we altered the name of the latter to *E. limburgensis*. Now the Reuverian deposits have yielded two other extinct species, so that instead of the genus being monotypic we have five well-marked species, and instead of being confined to Eastern Asia it proves once to have extended from end to end of the Palaearctic region.

All the species of *Euryale* have very large seeds, with surfaces more or less granular or nodose. This irregular roughness of the testa is exceptional in the *Nympheaceae*, and is quite unlike the lines of tubercles seen in the above described *Brasenia tuberculata*. The testa of *Euryale* varies from the highly polished but flatly granulate *E. limburgensis* (fig. 14) to the rough *E. ferox* (fig. 7) or the nodose *E. nodulosa* (figs. 8–10); but in every case the sculpture is irregular and does not fall into lines or bands as in most waterlilies.

EURYALE NODULOSA SP. NOV.

Pl. VII, figs. 8–10.

SEMINA IRREGULARITER GLOBOSA, SUPERFICIE UMBILICIS ET JUGIS MAGNIS ET IRREGULARIBUS TECTA; HILUM ANNULO INCRASSATO CINCTUM.

Six seeds belonging to a new species of *Euryale* have been found at Reuver. Their testa is somewhat thinner than in most of the other species, and therefore they

are a good deal crushed. The direction of the crushing varies so much in different specimens as to indicate that the original shape of the seed must have been globose, or nearly so, for seeds tend to fall on their flat faces, or with their longer axes horizontal. Of these seeds two have been crushed vertically, two laterally, and two askew.

Seed large, irregularly globose, polygonal, or roundly ovate; surface covered with large irregular knobs and ridges; raphe prominent; hilum surrounded by a thickened ring; embryotega large.

Length 8 mm., breadth 8 mm.

REUVER.

Compared with the recent *E. ferox* and the fossil *E. limburgensis* the seed differs, in (1) the remarkable nodules with which it is covered; in (2) the character of its surface sculpture, which is much finer and not so markedly pitted, and has the cells elongate transversely instead of being regularly hexagonal; in (3) the structure of the testa. In cross section the testa shows two coats, an outer coat formed by a single layer of palisade-cells, which greatly resemble those of *E. limburgensis*, and an inner coat of many layers of loose polygonal cells passing into flattened cells, which is very much thinner than in either *E. ferox* or *E. limburgensis*, the relative thicknesses of the two coats in the three species being 1 : 1.2; 1 : 2.5; and 1 : 4. The palisade-cells are about three times as long as they are broad, the walls are very thick and the cavity very small, the transverse breadth of the cavity being scarcely twice the thickness of the wall.

We have not been able to compare *E. nodulosa* with actual specimens of *E. europaea* WEBER, but a comparison with Dr. WEBER's figures and description shows that his *E. europaea* is smaller, is not nodular, has the palisade cells square or nearly so instead of being elongate radially, and the proportion of palisade cells to inner coat is about 1 : 3.5.

EURYALE LISSA SP. NOV.

Pl. VII, figs. 11–13.

SEMINA OBOVATA, LAEVIA, NITIDIUSCULA; HILUM EMBRYOTEGAM HAUD ATTINGENS; EMBRYOTEGA DEPRESSO-CONICA, IMMERSA; TESTA FOVEOLIS MINUTISSIMIS IRREGULARITER SEX-ANGULIS MARGINIBUS CRENULATIS INSTRUCTA.

Seed obovate, smooth rather shiny; raphe fairly prominent; hilum not reaching to embryotega; embryotega sunk depressedly conical; testa under high magnification shows externally small irregularly hexagonal pits with crenulate margins, which gives the surface a finely granulate texture.

Length 7 mm., breadth 6 mm.

BRUNSSUM.

Only two seeds have been found. One is compressed laterally, but is perfect except for the absence of the embryotega; the other is crushed vertically, and is a little broken round the embryotega, but the embryotega is in place. This species approaches most nearly to the Russian *E. europaea*; but is larger, more ovate, not truncate, and the cell-walls seen on the surface of testa are crenulate, not smooth as figured by Dr. C. A. WEBER. In section the testa shows a very thin palisade layer about $\frac{3}{5}$ the thickness of this layer

in *E. nodulosa*. The cells are about twice as deep as they are broad, their lateral walls are not so thick as in *E. nodulosa*, and the cell-cavity is larger in proportion. The relative thickness of palisade-layer to inner coats is about 1 : 2; the testa is thinner than in any other species of the genus.

CERATOPHYLLACEAE.

CERATOPHYLLUM? SP. NOV.

Pl. VII, figs. 15, 16.

Though nuts of a living species of *Ceratophyllum* are so common in the Cromerian and Teglialian, only a single doubtful specimen belonging to this family has yet been found in the Reuverian, and the family is still entirely missing in older deposits. The specimen now to be described is one half of a nut, which has germinated, and has also somewhat decayed. It, unfortunately, does not show the internal impression of the very characteristic embryo, which is so perfectly preserved in some fossil specimens from Cromer; we cannot therefore be certain that the Reuver fossil belongs to *Ceratophyllum*.

Nut broadly ovate quadrangular in cross-section, dividing into 2 valves in germination; valve strongly keeled irregularly tuberculate below rounded above, without persistent style. Inside showing very thick walls, with slight trace of an aperture at the base, and perhaps another at the apex (both very obscure), and torn remains of the adhering testa.

Length 4.5 mm., breadth 3.2 mm.

REUVER.

We draw attention to this curious fruit, and to Pl. XVIII, figs. 11a, b. If they do not belong to *Ceratophyllum* we can suggest no other position. They are about the size of recent nuts, but the first has several short tubercles at the base instead of 2 spurs, and both are without the persistent woody style.

RANUNCULACEAE.

This family is represented by 13 species, all of which however belong to the section *Anemoneae*. *Batrachium*, so abundant in all newer deposits, is entirely wanting. The other sections of the family have fruits and seeds more fragile or soft; therefore their non-discovery does not imply that they were absent.

ANEMONE SP. 1.

Pl. VII, fig. 18.

Fruits belonging to *Anemone* are not common, but those found may belong to 5 different species. The carpels of *Anemone* yield few specific characters beyond their outlines, and these are much obscured by hairs. The genus is also so large, that without more material we hesitate to determine the species or to describe the fossils as new. We have not come across any like them amongst the recent fruits we have examined.

Achene large, elongate-ovate laterally compressed, dorsal margin regularly curved, ventral margin inflated, apex narrowed gradually into the style; rugose with elongated irregular tubercles or short ridges, as in *A. nemorosa* (fig. 17) but coarser.

Length 3.4 mm., breadth 1.5 mm.

REUVER.

In size and outline this much resembles *A. nemorosa*; but the achene is more compressed laterally, rougher, and narrows more gradually into the style.

ANEMONE Sp. 2.

Pl. VII, fig. 19.

Achene ovate-lanceolate laterally compressed but keeled and margined, dorsal margin regularly curved, ventral margin inflated below the middle, apex bluntly pointed, base narrow, surface rough.

Length 2.3 mm., breadth 1.2 mm.

BRUNSSUM.

In general appearance this achene suggests *Clematis*, but the bluntly pointed apex seems never to have been continued into a hard beak.

ANEMONE Sp. 3.

Pl. VII, fig. 20.

Achene broadly ovate laterally compressed, dorsil margin gently curved, ventral margin straight above and suddenly curved below or bluntly angled in the middle, apex pointed, base rounded, surface granulate with small elongate tubercles.

Length 3.2 mm., breadth 1.9 mm.

BRUNSSUM.

The apex of this achene though pointed in general form is minutely truncate and may have been continued in a very thin feathery style.

ANEMONE Sp. 4.

Pl. VII, fig. 21.

Achene broadly semi-ovate laterally compressed, dorsal margin slightly curved, ventral margin semi-circular, style acute broad, base slightly stipitate, surface slightly granulate.

Length 2.2 mm., breadth 1.3 mm.

REUVER.

This small achene seems to belong also to *Anemone*, though the shape is unusual. Its pointed apex does not seem ever to have been continued into an articulated style.

ANEMONE Sp. 5.

Pl. VII, fig. 22.

Achene minute ovate compressed, dorsal margin curved, ventral margin angularly rounded, apex and base bluntly pointed, surface granulate.

Length 1.4 mm., breadth 0.9 mm.

REUVER.

This small much flattened achene appears also to belong to *Anemone*.

CLEMATIS GRATA WALLICH.

Pl. VII, figs. 23, 24.

Achene ovate compressed margined narrowed and truncate above and below, ventral margin curved, dorsal margin much curved, surface rugose with sharp irregular longitudinal ridges.

Length 4.1 mm., breadth 1.8 mm.

REUVER, SWALMEN.

Achenes agreeing with those of *C. Vitalba* of Europe in size and shape, but differing in the degree of rugosity. The fossils do not show the strong longitudinal ribs which are so conspicuous in the European *C. Vitalba*; they show instead many smaller longitudinal rugosities over the whole surface, and they seem to have been glabrous or nearly so. These characters, in which they differ from the typical *C. Vitalba*, bring them into agreement with *Clematis grata* of Wallich, a native of China and the Himalaya. *C. grata* in Kew Herbarium is reduced to a variety of *C. Vitalba*.

RANUNCULUS NEMOROSUS DC.

Pl. VII, figs. 25—27.

Achene obovate flattened margined sharply keeled, coarsely pitted in middle, less coarsely towards margin; style sub-lateral prominent.

Length 2.8 mm., breadth 1.9 mm.

REUVER, SWALMEN.

R. nemorosus is now living in southern and central Europe, and is also found fossil in the Cromerian of England. The Reuverian fossils correspond closely with the living plant (fig. 27) except that they have lost the herbaceous part of the style.

RANUNCULUS BRUTIUS TENORE.

Pl. VII, figs. 28, 29.

Achene undulating, with broad flat terminal style wide margin and keel, ventral margin slightly convex, dorsal margin suddenly curved inwards below, forming a right angle with the ventral margin.

Length, including remains of style, 3.25 mm., breadth 1.9 mm.

BRUNSSUM.

Our fossil closely corresponds to the living *B. brutius* (fig. 29), with which it agrees in the undulating surface of the achene and in its very wide flat and straight beak. One or two of our recent achenes show attachment and curvature as in our fossil, all the others tend to be stipitate. The species now lives in Italy, Greece, and Asia Minor.

RANUNCULUS LATERIFLORUS DC.

Pl. VII, figs. 30—33.

Achene elongate obovate, style terminal, attachment basal, laterally compressed and margined; coarsely pitted in the middle, more finely towards the margin, irregularly tuberculate.

Length 2.1 mm., breadth 1.5 mm.

REUVER, SWALMEN.

These achenes, which are fairly common, show no trace of arrangement in the tubercles. Two of the Reuver specimens are shorter and broader, and are perhaps terminal achenes. The achenes somewhat resemble, but are much larger and more elongate than those of *R. humilis* found at Tegelen. The resemblance to *R. lateriflorus* (fig. 30), is so close that we can only refer our fossils to that species, though the prominent beak has decayed. *R. lateriflorus* is a plant of southern Europe and the Levant. To *R. pendunculatus* LANGE, of Spain, a species closely allied to *R. lateriflorus*, the resemblance is less marked.

RANUNCULUS SP.

Pl. VII, fig. 34.

A single achene representing a fourth species of the genus has been discovered, but we can find no living species at all closely resembling it. Achenes of *Ranunculus* vary considerably in shape according to their position on the receptacle, we therefore will not describe this as new in the absence of more specimens. It is quite unlike the terminal achenes of *R. lateriflorus*, which has a globose head of fruit.

Achene elongate-obovate, style continuing ventral margin; sides compressed but tumid and strongly margined, covered with flattened tubercles and coarsely punctate. Length 2.2 mm., breadth 1.25 mm. REUVER.

The tubercles in this achene are so depressed as only to show with very oblique light.

THALICTRUM BAUHINI CRANTZ.

Pl. VII, figs. 35, 36.

Achene small fusiform, 8-ribbed, subcompressed laterally somewhat inflated below on the dorsal side; attachment basal.

Length 2.6 mm., breadth 1.25 mm. BRUNSSUM.

The close resemblance of this achene to that of *T. Bauhini* Crantz (fig. 36) will be seen by the figures. The principal difference is in the attachment, which in the one is basal, in the other lateral; this difference however may be due merely to the position of these particular achenes on the receptacle. Only two specimens of this fossil have been seen. *T. Bauhini* is a species of Central Europe and Asia Minor; it has been found also in the Teglian.

THALICTRUM SIMPLEX VAR. GALIODES NEST.

Pl. VII, figs. 37, 38.

Achene small symmetrically ovate, sharply pointed at either end, ribs prominent sharp.

Length 1.7 mm., breadth 1.0 mm. BRUNSSUM.

Corresponds closely with the recent fruit (fig. 38). This variety of *T. simplex* grows in Tyrol.

MAGNOLIACEAE.

MAGNOLIA KOBUS DC.

Pl. VIII, figs. 9—11.

Broken seeds and fragments have been found at REUVER and SWALMEN. They agree with the better preserved specimens found at TEGELEN and must be referred to the same species. A recent seed of *M. Kobus* has been figured for comparison (fig. 9). Both recent and fossil seeds of this species vary greatly in outline.

LIRIODENDRON TULIPIFERA LINN.

Pl. VIII, figs. 1—5.

Seeds of *Liriodendron* occur in great profusion, but only a few broken fruits have yet been obtained. The most perfect of these fruits is shown in fig. 2, though it happens to be a very small or abortive one, only about half the size of a properly developed carpel. It could not have contained seeds of the average size of our fossils. This specimen shows the base and lower part of the carpel, most of the wing being broken off. At first sight the carpel seems to be much wider than in the living *L. tulipifera* (fig. 5). But in the recent fruit the lower and marginal part of the wing tends to curl inward somewhat. The recent carpel has not been compressed; but in our fossil, pressure has flattened the wing, and has made the whole carpel appear wider than it should be. In width, shape, and average size the Reuverian specimens are quite indistinguishable from the American *L. tulipifera*; they do not approach the Chinese *L. chinensis*, which before its inflorescence and fruit was known, was thought to be a variety of *L. tulipifera*.

The appearance of the fossil fruit is sufficiently shown by fig. 2, which has been photographed on double the scale of the recent carpel, as it is an exceptionally small specimen.

The seeds of *Liriodendron* occur two together, as shown in fig. 1, and many of the fossil seeds still adhere in pairs, though the carpel has decayed. The two seeds (unless one happens to be abortive) are nearly always indented and faceted by mutual pressure, so that any description of the shape of the fossils is difficult. The fossil seeds are usually ovate or obovate, pointed above and below, have one side straightened, and near the straight side show a depressed area where the adjoining seed overlapped. The surface of the testa is granulate with minute tubercles or short longitudinal striae.

Length of seed 4.0 to 5.0 mm., breadth 2.3 mm. REUVER, SWALMEN, BRUNSSUM.

Abortive or badly developed seed are also common, and a good many symmetrically formed specimens have been noticed; these latter belong to carpels in which only one ovule has developed, they must not be taken to represent another species.

LIRIODENDRON APTERA SP. NOV.

PL. VIII, figs. 6—8.

CAPITULUM PARVUM, CARPELLIS MULTIS HAUD ALATIS ROSTRO BREVI TRIANGULARI TERMINATIS; SEMINA MINUTA, GRANULATA SED QUAM EA *L. tulipiferae* MINUS STRIATA.

Head small, of many carpels, attached nearly at right angles to a cylindrical receptacle, which expands suddenly at the base; carpel wingless, terminating in a short triangular beak; seed minute, granulate, but less striate than in *L. tulipifera*.

Length of head 8.5+ mm., breadth 9 mm. Length of carpel 4.5 mm.

Length of seed 1.5 to 3.0 mm., breadth 1.0 to 2.0 mm., REUVER.

Of this curious species we have the unique fruit shown in figs. 6, 7 and a few isolated seeds, all from Reuver. The minute compact head of carpels, terminating in short imbricate triangular beaks makes this fruit look very different from either of the living species of *Liriodendron*. The head is incomplete at the apex, and the carpels on one side of the axis have been shed, exposing the elongated receptacle covered with lozenge-shaped scars, and giving a good view of the anatomy. The base is complete, except for the shedding of some of the carpels. On the left of fig. 7, towards the base, the structure of a carpel is well seen. It shows the two seeds placed exactly as in the living species; and the length of these seeds is 2.3 mm., which is about half the length of seeds of *L. tulipifera*. The detached seed shown in fig. 8 is even smaller, so that in order to show it properly we have been compelled to figure it on double the scale of that of *L. tulipifera* (fig. 1). It is perfectly developed, and it does not agree with the small undeveloped seeds of *L. tulipifera* which are occasionally found in the same deposit.

ILLICIUM SP.?

Pl. VIII, figs. 12—13.

In figs. 12, 13 is shown half a carpel which appears to belong to the *Magnoliaceae* and suggests *Illicium*. The resemblance is not sufficiently close, and the state of preservation of the unique specimen is not good enough, to allow us definitely to refer it to that genus.

Carpel hard and bony compressed laterally attachment lateral; style terminal (jointed?); seed one, large flattened laterally broadly ovate (only the impression seen).

Length 7 mm., breadth 6 mm. REUVER.

ANONACEAE.

JONGMANSIA GEN. NOV.

Reuver and Swalmen both yield in considerable quantity a small hard seed, very irregular in shape, but when most symmetrical and least distorted resembling a minute coffee-bean. These seeds gave us the greatest difficulty, for they are unlike anything we could find in temperate regions. On showing them to Mr. H. N. RIDLEY, who has spent

many years in Malaya, he at once pointed out their resemblance to the anonaceous seeds which in Malaya are scattered everywhere by birds. At first we could not trace the curious partial septa, passing between the folds of the ruminant albumen, which are so characteristic a feature of the *Anonaceae*; but at length we discovered several specimens showing clearly the remains of these septa, which are very thin and fragile. As, however, these fossil seeds will not fit in with any living anonaceous genus, we are compelled to institute for them a new one, which we name after the discoverer of the specimens, Dr. W. J. JONGMANS.

FRUCTUS (BACCATUS?), COMPACTUS, E CARPELLIS TRIBUS UNISPERMIS CONSTITUTUS; SEMINA PARVA, TESTA DURA OSSEAQUE.

Fruit compact, of 3 1-seeded carpels (a berry?); seeds small, testa very hard and bony.

JONGMANSIA CYPRAEIFORMIS Sp. Nov.

Pl. VIII, figs. 14—21.

SEMINA PARVA, CYPRAEIFORMIA, PLUS MINUSVE LATERIBUS ANGULATA, TESTA CRASSISSIMA OSSEA INTUS INCOMPLETE PLURISEPTATA.

Seeds small, cypreaeform, more or less faceted laterally by mutual pressure (figs. 14—17), occasionally adhering laterally (figs. 18, 19); testa very thick and bony (fig. 21), showing internally numerous partial septa (figs. 20, 21).

Length 4 mm., breadth 3 mm.

REUVER, SWALMEN.

It is not easy to make out the position of this curious genus within the family, for it does not seem to belong to any recognised section. The mutual faceting, and occasional lateral adhesion, of the seeds suggest that the carpels were united into a single syncarpous fruit, only slightly succulent. In short, they were specially modified for dispersal by small birds. This seems to be borne out also by the minuteness of the seeds and the exceptional thickness of their testa. Few, if any, living *Anonaceae* have seeds so small and hard as these.

The *Anonaceae* at the present day form a large family, essentially tropical, with only a few stragglers into warm-temperate regions. None live in Europe.

LAURACEAE.

CINNAMOMUM Sp. 1.

Pl. VIII, figs. 22 a, b.

Two cupules of cinnamon have been found at Reuver and one at Swalmen; but the three specimens belong to three species, none of which agrees with any of the cupules found in Miocene deposits and figured by OSWALD HEER.

Cup large open, suddenly contracted below into a narrow stalk of nearly uniform width.

Length 7 mm., breadth 7 + mm.

SWALMEN.

In size and shape this closely resembles the cupule of *C. lampongum* Miq., which grows in the Malay Peninsula at low elevations.

CINNAMOMUM Sp. 2.

Pl. VIII, figs. 23 a, b.

Cupule of moderate size, funnel-shaped, with contracted aperture.

Length 6 mm., breadth 5 mm.

REUVER.

This cupule may be immature; but it cannot belong to the same species as either of the others. In shape and size it agrees with cupules of *C. nitidum* Blume in the Kew Herbarium; though these also seem to be immature. *C. nitidum* grows in India.

CINNAMOMUM Sp. 3.

Pl. VIII, figs. 24 a, b.

A small campanulate cupule with thin-walled open cup, broken at the margin, but showing remains of several sepals.

Length 3 mm., breadth 5 mm.

REUVER.

This cupule corresponds closely in size and shape with an unnamed species in Kew Herbarium, obtained by Dr. A. HENRY, in the province of Hupeh in China.

HAMAMELIDACEAE.

BUCKLANDIA STRIATA Sp. NOV.

Pl. VIII, figs. 25 a, b; Pl. XIX, figs. 1.

CAPSULA MAGNA, OVATA, EXTRA BASEM VERSUS VALDE STRIATA, LIBERA, BIVALVA, VALVIS AD PARTEM TRIENTEM SECTIS ET AD FISSURAM VALDE INCURVIS.

Capsule large ovate, strongly striate externally towards the base, free, 2-valved; valves cleft for $\frac{1}{3}$ length and strongly infolded at cleft.

Length 10 mm., breadth 8 + mm.

REUVER.

This fruit bears a good deal of resemblance to *B. populnea* R. Br. which we show (figs. 26, 27) for comparison. It is however considerably larger, wider at the base, and is strongly striate longitudinally. From other genera of *Hamamelidaceae* it is distinguished by its capsule being 2-valved, not divided into 4 nearly equal lobes, and by the non-adhesion of the calyx.

Seed long ovate pointed, acutely 3-angled above, rounded below.

Length 4.0 mm., breadth 2.1 mm.

BRUNSSUM.

This seed is smaller than that of *B. populnea* and the surface of the testa shows finer cell-structure; but in other respects the two correspond. The recent plant has seeds of two sorts, winged and not winged; our fossil corresponds to the form without wings.

As the seed was found at Brunssum and the capsule at Reuver, we cannot be

certain that they belong to the same species. We put them together provisionally, but make the capsule the type. The seed was unfortunately only identified at the last moment, too late to permit of the insertion of a photograph of the seed of the living species.

The genus *Bucklandia* is now found in the India region, where it occurs in the eastern Himalaya, Khasia, and Burma. It extends also into the Chinese province of Yunnan, and into Sumatra.

LIQUIDAMBAR ORIENTALE MILLER VAR.?

Pl. VIII, fig. 32.

Several good capitula or heads of fruits have been found at REUVER and a few fragments at SWALMEN. We have compared them with the Chinese and American species, and find that they more closely resemble *L. orientale* than these. Whether our fruit ought to rank as a variety of *L. orientale* we do not feel certain. There are perhaps more fruits in the head of the fossil; but our specimens are both crushed and somewhat worn, so that it is difficult to be quite certain as to the number. The fossil head does not resemble the Miocene *L. europaeum*, as figured by HEER*. From *L. pliocaenicum* GEYL. et KINK.† it is distinguished by the much greater number of fruits in the head.

CORYLOPSIS LIMBURGENSIS SP. NOV.

Pl. VIII, figs. 28—30.

SEMINA OVATA, UTRINQUE ACUMINATA, COMPRESSIUSCULA, BASI-LATERALITER AFFIXA; TESTA LAEVIS, NITIDA, STRIATULA.

Seed ovate pointed above and below, somewhat compressed, attachment basilateral; testa smooth and polished, minutely striate.

Length 4.3 to 5.0 mm., breadth 2.5 mm.

BRUNSSUM.

The two seeds of this species (figs. 28—30) differ somewhat in their proportions, but cannot otherwise be distinguished, fig. 30 shows the reverse of 29. They show the peculiar scar of attachment seen in *Corylopsis*, but differ from *Corylopsis sinensis* (fig. 31) in the greater amount of lateral compression (which seems to be original and not due to crushing), and in their more acute apex and base.

Corylopsis is a small genus of 8 species, all confined to Eastern Asia.

GENUS?

Pl. VIII, figs. 33, 34.

Seeds elongate ovate 3 keeled (and winged?).

Length 1.5 mm., breadth 0.6 mm.

BRUNSSUM.

* Flora Tertiaria Helvetica, vol. II (1856), pl. 51, fig. 2.

† As figured in ENGELHARDT u. KINKELIN, Oberpliocäne Flora und Fauna des Untermaintales, insbesondere des Frankfurter Klärbeckens. Abh. Senckenbergischen Naturforsch. Gesell., Bd. XXIX (1908), Pl. XXXII, figs. 17 a, b.

The two seeds figured may be the 3-keeled seeds belonging to one of the *Hamelidaceae* allied to *Liquidambar*; but no fruits belonging to any of these genera have yet been found at Brunssum.

EUCOMMIACEAE?

At the present day this is a monotypic family represented by a single tree, *Eucommia ulmoides* (Plate XVII, fig. 33) in the temperate belt of Western China. We cannot definitely place any of our fossil fruits in this family; but here we must draw attention to the curious samara figured in Plate XVII, figs. 34, 35, and described on p. 139. If this samara does not belong to the *Eucommiaceae* we are quite unable to suggest where it should be placed.

TEGELEN, BRUNSSUM.

ROSACEAE.

The *Rosaceae* were evidently abundant, especially the genus *Prunus*, which has 9 species, each represented by very few specimens. The rarity or absence of *Potentilla* is noticeable, for this genus is not uncommon at Tegelen; *Rosa* has not been observed. Thus far we have been unable to identify among our fossils any of the non-European genera so conspicuous in China; though one of the *Rubi* belongs to a section of the genus now purely Asiatic. This family is still very imperfectly known from the Reuverian. This is due to the circumstance that the hard endocarps as a rule do not float; therefore they are but sparingly transported by the river. We find only a few specimens belonging to each species, and these probably were transported and scattered by birds.

COTONEASTER ACUTICARPA SP. NOV.

Pl. IX, figs. 1, 2.

CARPELLA QUINQUE, PARVA, ANGUSTA, MARGINE VENTRALI RECTA, DORSALI SEMICIRCULARIA; STYLUS MARGINEM VENTRALEM TERMINANS, ULTRA CARPELLUM EXTENSUS.

Carpels 5, small narrow, ventral margin straight, dorsal margin semicircular; style terminating the ventral margin and projecting beyond the carpel; smooth nude area occupying about $\frac{1}{3}$ of the dorsal surface and separated by a very oblique boundary from the rugose attached area.

Length 3.0 mm., breadth 1.8 mm.

REUVER, SWALMEN, BRUNSSUM.

Allied to *C. pyracantha* (fig. 3, 4) but distinguished by the more elongated fruit narrower carpel semicircular not gibbous, and styles terminal not sunk.

PIRUS MALUS LINN. VAR.

Pl. IX, fig. 5.

A well-preserved seed and a fragment of another are quite indistinguishable from the recent *P. malus* (fig. 6), except that they are somewhat rougher.

Length 7.3 mm., breadth 4.0 mm.

BRUNSSUM.

PIRUS CF. MALUS LINN.

Pl. IX, fig. 7.

A single specimen resembles *P. malus* in shape and size, but is much more rugose dorsally. Unfortunately the seed is so curved towards the axis as to make it impossible properly to show the characters in a photograph, and fig. 7 shows the dorsal surface only. The seed cannot be referred to *P. Malus*, and we can find no other species which closely resembles it.

Length 8 mm., breadth 3.4 mm.

REUVER.

The dorsal flattening, curvature, and rugosity of this seed suggest a species in which the seeds are normally compressed dorsally, not from side to side.

MESPILUS MONOGYNA JACQ.

Pl. IX, figs. 8—10.

Endocarps belonging to *M.* (= *Crataegus*) *monogyna* occur at Reuver, and a doubtful specimen has been found at Swalmen. They do not appear to be distinguishable from the living form.

Length 5.7 mm., breadth 4.3 mm.

REUVER, SWALMEN?

MESPILUS SP. 2.

Pl. IX, fig. 11.

A much compressed endocarp suggests a *Crataegus* with 5 carpels. Its surface is rugose, and it therefore cannot belong to *Crataegus cuneata*, which we found at Tegelen.

Length 5.0 mm., breadth 3.2 mm.

BRUNSSUM.

The specimen is badly preserved, the transverse wrinkle, which makes it look like *Cotoneaster*, being merely an accidental fold.

RUBUS.

Endocarps and prickles belonging to *Rubi* are fairly common at Reuver, and a few have been found at Brunssum and Swalmen. Nearly all of the specimens belong to a single species, but three others are represented. The most abundant species appears to belong to the *Fruticosi*, though in some respects its endocarp more resembles the *Idaei*. The other three species probably represent three other sections of the genus. We have been unable to match any of the four; but in so difficult a genus we do not care to describe new species without more material.

RUBUS SP. 1.

Pl. IX, fig. 13.

A single endocarp differs greatly from any of the others, and we are uncertain to what section of the genus it should be referred. It has a curious superficial resemblance to *Potentilla*.

Endocarp semiovate, sides tumid, ventral margin straight, dorsal margin much inflated below, apex pointed mucronate terminal; sculpture few very long pits curved round a smooth depressed ventral area.

Length 1.7 mm., breadth 1.1 mm.

BRUNSSUM.

RUBUS Sp. 2.

Pl. IX, figs. 14, 15, 16.

Endocarp ovate varying much in length, compressed laterally, ventral margin gently curved, with a strong marginal rib, dorsal margin semicircular, apex pointed nearly terminal but curved strongly to the ventral side; sculpture deep irregular elongated pits with a band of smaller pits round the dorsal margin.

Length 1.5 to 2.5 mm., breadth 1.2 mm.

REUVER, BRUNSSUM?

Unlike most of the *Fruticosi* (fig. 12) the point turns sharply towards the ventral side; but it is not recurved as in the *Idaei*, nor is the ventral margin incurved.

This is the common *Rubus* of Reuver, and probably the Brunssum endocarp (fig. 14) may be referred to the same species, though it is more regularly ovate, is more rounded below, and the pits in that part are less drawn out.

RUBUS Sp. 3 (CF. PUNGENS CAMBESS).

Pl. IX, figs. 17, 18.

In 1910 we figured* two badly preserved endocarps of *Rubus* found at Tegelen. These were of peculiar shape, but were too much decayed for description. From Reuver we have now obtained a few better preserved and larger endocarps having the same peculiar form and well-preserved surfaces.

Endocarp roundly ovate, with a prominent sharp beak curved to the ventral side; sculpture thick strong ridges running in various directions.

Length 2.8 mm., breadth 2.1 mm.

TEGELEN, REUVER.

This endocarp (fig. 17) seems to belong to the Asiatic section *Pungentes*, and we figure *Rubus pungens* (fig. 19) as the nearest species we can find. This species, which however does not quite agree with our fossil, ranges from Korea, and Japan, to West Szechuan (at high levels), and the province of Hupeh in Western China.

We figure a second specimen from Reuver (fig. 18) which is somewhat differently sculptured. It also belongs to the *Pungentes*, and it may be a different species.

RUBUS Sp. 4.

Pl. IX, fig. 20.

A single endocarp from Reuver seems to represent another section of the genus, perhaps the *Saxatiles*.

* *Op. cit.* figs. 19, 20.

Endocarp roundly triangular and bluntly pointed, ventral margin slightly curved, dorsal margin nearly semicircular, apex terminal; sculpture sharp thin ridges becoming duplicated at the dorsal margin.

Length 2.3 mm., breadth 1.7 mm.

REUVER.

The endocarp is now quite flat, but this may be the effect of crushing; the *Saxatiles* have usually tumid endocarps.

PRUNUS SPINOSA LINN.

Pl. IX, fig. 21.

Endocarp roundly obovate, blunt, somewhat compressed; sides covered with large shallow pits or dents.

Length 10.0 mm., breadth 8.5 mm.

SWALMEN, BRUNSSUM?

We have only seen one specimen of this form, though two or three others, smaller and not so well preserved, may be varieties of the same species. One doubtful specimen has been found at Brunssum.

PRUNUS CF. SPINOSA LINN.

Pl. IX, figs. 22, 23.

Two specimens of a plum allied to *P. spinosa*, have been found at Reuver.

Endocarp compressed, broadly ovate, pointed above and below, sharply keeled; side reticulate or dented; walls moderately thick.

Length 8.0 mm., breadth 6.5 mm.

REUVER.

The material is insufficient to allow us to say more about this species. Its compressed pointed form suggests an approach to *P. domestica*; but it is much smaller, and the compression may be due largely to crushing.

PRUNUS CF. SPINOSA LINN.

Pl. IX, fig. 24.

Endocarp small, nearly flat, round or somewhat oval slightly pointed; striate near hilum and reticulate or dented above; thin-walled; keel very wide.

Length 7.0 mm., breadth 6.0 mm.

REUVER.

Only two specimens of this species have been seen, both from Reuver. The small size and very wide keel distinguish it from any form of *P. spinosa* that we have seen.

PRUNUS SP. 4.

Pl. IX, fig. 25.

Endocarp elongate-ovate, tumid, pointed above and below; striate towards the hilum, elongate-reticulate above; bluntly keeled.

Length 8.0 mm., breadth 4.0 mm.

REUVER.

This endocarp seems to have been nearly terete in section, as it is crushed at right-angles to the suture. It greatly resembles that of *Prunus Ramburii* of the Sierra Nevada, California, and is of the same size though somewhat narrower. The endocarps of *P. Ramburii* in the Kew Herbarium are unripe, but seem to be differently sculptured. We have only one specimen of the fossil.

PRUNUS SPINULOSA SIEB. ET ZUCC.

Pl. IX, figs. 26—28.

Endocarp oval, pointed above and below, moderately keeled, thin; sculpture 2 or 3 strong loops towards the upper end and large cord-like reticulations.

Length 10.5 mm., breadth 6.0 mm.

REUVER.

The only difference we can see between our fossils and the living Japanese species (fig. 28) is that the surface sculpture is more conspicuous in the recent endocarps, and that the fossil endocarps are flat. The flattening of the endocarps is obviously due to crushing, for some specimens are crushed from side to side, others edgewise. All our specimens are a good deal eroded, as though they may have been washed from some distant mountains, and this has often destroyed the smaller reticulation though the larger loops may be preserved.

PRUNUS STIPITATA Sp. NOV.

Pl. IX, figs. 29—31.

ENDOCARPIUM INFLATUM, OVOIDEUM, APICE ACUMINATUM, BREVITER STIPITATUM; SUPERFICIES INFERNE PROMINENTER LONGITUDINALITER PLURIJUGATA, SUPERNE CRASSE IRREGULARITER RETICULATA.

Endocarp inflated, oval, pointed above, shortly stipitate below; sculpture several strong longitudinal ridges below, coarse irregular reticulation above.

Length 8.0 mm., breadth 5.0 mm.

REUVER.

Only the three figured specimens of this species have been seen. The most curious characters will be found in the short stalk, up which the channel of the raphe passes (well shown in fig. 30), and in the bold irregular sculpture of long and short ridges, which scarcely form reticulations (best seen on the reverse of fig. 30). We can find nothing nearly approaching to our fossil, and as the form is very striking we have given it a name.

PRUNUS MAXIMOVICZII RUPRECHT.

Pl. IX, figs. 32—34.

Good specimens of endocarps belonging to this living species of Japan and Manchuria have been found at TEGELEN, and were described and figured by us (*loc. cit.* 1910, figs. 17, 18). We have now a few poorly preserved endocarps, evidently belonging to the same species, from BRUNSSUM and REUVER. The best of them are figured; but the specimens do not lend themselves to further description.

PRUNUS Sp. 8.

Pl. IX, figs. 35 a, b.

The very curious globose endocarp shown in figs. 35 a, b is distorted in such a way as to make description very difficult. It apparently belongs to the section *Cerasus*.

Endocarp tumid or irregularly globose, blunt, not keeled; surface undulating or nearly smooth striate near base.

Length 6.0 mm., breadth 6.0 mm.

REUVER.

As we have only a single specimen we can say nothing more as to this species.

PRUNUS TENUIPUTAMENTA Sp. NOV.

Pl. IX, figs. 36.

ENDOCARPIUM MAGNUM, TENUISSIMUM, OVATUM, ACUMINE LATERALITER DEFLEXO INSTRUCTUM, SUPERFICIE LAEVI.

A single gaping endocarp, which has probably germinated, represents this section of the genus.

Endocarp very thin, ovate, pointed, point turned to one side, surface smooth.

Length 10.5 mm., breadth 6.0 mm.

REUVER.

We can find nothing at all like this; it is allied to *P. Laurocerasus*.

LEGUMINOSAE.

WISTARIA?

Pl. XVIII, fig. 8.

The seeds of *Leguminosae* are seldom found, unless they have been either pyritised or phosphatised, as is the case with those of the London Clay. The pods also are usually too soft for the method of washing adopted for the Reuverian material, and most of them would be destroyed in the process. It thus happens that, though *Leguminosae* were probably as abundant in the Pliocene as in any other Tertiary deposit, we have nothing but two indeterminable carbonized cotyledons from SWALMEN, possibly representing *Wistaria*. No doubt if anyone could devote a large amount of time to splitting up the still-moist lignite layers, other remains of *Leguminosae* would be found. But till now those who have done the collecting have been fully occupied with the work of boiling down, and sorting large masses of boiled material. This method is evidently yielding excellent results, far more valuable than the methods formerly employed; though it is obvious that we shall not obtain a thorough knowledge of the proportions of the families until both methods have been used — and then we shall still have to remember that certain families have no hard seeds or fruits, no deciduous leaves, and are altogether succulent, so that unless we find their impressions in calcareous tufa we shall miss them altogether.

GERANIACEAE.

BIEBERSTEINIA SP. NOV.

Pl. X, figs. 1 a, b.

Carpel irregularly ovate, triangular in section, hard and bony; ventral surface ridged, with an elongated hilum; coarsely wrinkled, wrinkles radiating from attachment; dorsal surface nearly smooth.

Length 8 mm., breadth 4 mm.

REUVER.

We have only one specimen of this curious fruit. Its narrow attachment (fig. 1 b) seems at first to make a reference to *Biebersteinia* impossible; but an examination of the dorsal surface (fig. 1 a) shows that the carpel has been crushed edgewise, thus closing the hilum. We do not think that either the fissure on the back or the narrow attachment is original. If we are correct in referring this fruit to *Biebersteinia* it must represent an extinct species; but in the absence of more perfect material we do not give it a name.

Biebersteinia is a small genus, of 5 species, growing in west and central Asia.

ZYGOPHYLLACEAE.

NITRARIA?

Pl. X, fig. 2.

The fruit shown on fig. 2 has a striking superficial resemblance to the endocarp of *Nitraria*, especially of *N. Schoberi*; but it is smaller, and if ripe it must have been softer and thinner-walled. Having only one specimen we cannot examine it in section, and a desert plant like *Nitraria* seems unlikely to occur.

Length 4.2 mm., breadth 1.8 mm.

BRUNSSUM.

The 3 living species of *Nitraria* are desert plants of the old world and Australia.

RUTACEAE.

ORIXA RETICULATA SP. NOV.

Pl. X, figs. 3—5.

CARPELLA DUO, OVATA, APICE ACUMINATA, MARGINE VENTRALI PARUM CONVEXA, DORSALI VALDE CONVEXA, NERVIS RETICULATIM ANASTOMOSANTIBUS IN NERVUM INTRA-MARGINALEM AD LATUS DORSALE DEORSUM CURVATIS.

Carpels 2, ovate pointed above, ventral margin slightly convex, dorsal margin strongly convex; venation reticulately looped, curving downward into a marginal vein on the dorsal edge; carpel infolded towards the base on the ventral side, dehiscing along the dorsal and ventral sutures for $\frac{2}{3}$ of its length.

Length 5.5 mm., breadth 3.8 mm.

BRUNSSUM.

These fruits certainly belong to the section *Xanthoxyleae* of the family *Rutaceae*.

The nearest living plant appears to be the monotypic *Orixa*, a shrub or small tree of China and Japan. *Orixa japonica* (fig. 6.) has four carpels, which are larger, more rounded, and differently veined from ours. We can see no evidence that the Brunssum plant ever had more than two carpels; but the resemblances are so much closer to *Orixa* than to any other genus, that we feel bound to modify the genus slightly, so as to take in this species.

RUTA Sp.

Pl. X, fig. 7.

Carpel small, ovate cuspidate rounded dorsally; longitudinally striate or sparsely granulate; dehiscing widely above on the ventral face, scarcely adhering to the adjoining carpels.

Length 4.5 mm., breadth 2.5 mm.

BRUNSSUM.

The single carpel, which is all we have seen, evidently belongs to *Ruta*, and we have figured *Ruta corsica* (fig. 8) for comparison. Our fossil carpel, however, only adheres to the adjoining carpels for about $\frac{1}{8}$ of its length, whilst that of *Ruta corsica* adheres for a much greater distance, and the photograph shows where it has been torn away. We doubt if our fossil is specifically determinable.

RUTA Sp.

A single much crushed granulate seed also belongs to the genus *Ruta*; but it is not sufficiently well preserved for specific determination or photography. It does not belong to *R. graveolens*.

Length 3 mm.

REUVER.

The large size of this seed makes it improbable that it can belong to the capsule already described, and the two specimens do not come from the same locality. It seems therefore that two species of *Ruta* have been found among these fossils.

PHELLODENDRON ELEGANS (Reid).

Pl. X, figs. 10—12.

Seed obovate pointed below, point curved towards the ventral margin, ventral margin inflated above incurved below, dorsal margin and apex rounded, sides regularly tumid; sculpture about 12 sharp somewhat irregular longitudinal ridges crossed by short transverse ribs, giving a strongly decussate or rectangularly pitted surface; chalaza large and conspicuous.

Length 6.0 mm., breadth 3.7 mm.

TEGELEN, REUVER, SWALMEN.

Differs from *P. japonicum* (figs. 13, 14) and other living species in its larger size, more rounded outline, curved base, and the boldness and regularity of its sculpture. The seed from Reuver (fig. 10) is slightly more elongate than those from Tegelen (figs. 11, 12); but in other respects they agree.

This seed when originally described from Tegelen (*op. cit.*) was thought to belong to *Stratiotes* or some allied genus. A study of the living *Phellodendron* shows however that the fossil certainly belongs to this genus. *Phellodendron* in germinating divides into two valves (fig. 13), and most of our fossil seeds have opened in the same way (fig. 11). The testa is crustaceous and somewhat fragile; the fossils therefore are usually much broken.

PHELLODENDRON TESSELATUM SP. NOV.

Pl. X, fig. 15.

SEMINA MAGNA, SEMIOVOIDEA, SCULPTURA E FOVEOLIS REGULARIBUS QUADRANGULIS CONSTITUTA ORNATA.

Seed large semiovate, ventral margin nearly straight, dorsal margin rounded, point not projecting beyond the ventral line; sculpture of equal longitudinal and transverse ribs, forming regular quadrangular pits.

Length 7 mm., breadth 4 mm.

REUVER.

Differs from all the recent species in the regular tessellated pattern of its testa; and from *P. elegans* in its straight margin without incurved point, and the absence of strong longitudinal ribs. It is the largest seed in the genus. None of the recent species has so regular a surface-sculpture as is seen in either of our fossils.

GENUS?

Pl. X, figs. 9 a, b.

These figures represent the endocarp of some rutaceous genus, in which the endocarp dehisces and is ejected.

REUVER.

SIMARUBACEAE?

GENUS?

Some endocarps perhaps belonging to this family, or to *Sabiaceae*, are described on p. 113 and figured on Plate XI, figs. 26, 27.

MELIACEAE.

TURRAEA SP.?

Pl. X, figs. 16 a, b.

Seed oblong curved, compressed towards ventral margin; hilum broad lateral with somewhat winged margin, and remains of large aril(?) which partly envelopes the base of the seed; testa black shining, sculpture small irregular pits.

Length 5.5 mm., breadth 2.3 mm.

BRUNSSUM.

In all the above characters, except the aril, this seed agrees with *Turraea*; it comes nearest to *T. villosa* Benn., of Java, the testa of which agrees precisely with our fossil.

Having only one crushed seed, and taking into consideration the difference of the aril, we do not like to attribute it with certainty to this genus, though the affinity would seem to be very close. *Turraea* is recorded from Hainan, Travancore, the Phillipines, Malaya, Australia, and Tropical Africa.

EUPHORBIACEAE.

EUPHORBIA Sp.

Pl. X, fig. 17.

Seed anatropous oval inflated but flattened by pressure; caruncle and raphe large and conspicuous, surface of testa showing small irregularly hexagonal cells.

Length 2.4 mm., breadth 1.75 mm.

BRUNSSUM.

The size, shape, and general character of this seed, with its large caruncle, seem to place it without doubt in the genus *Euphorbia*; but the unique specimen is not in a sufficiently good state of preservation for us to carry the identification further.

EMPETRACEAE.

COREMA INTERMEDIA REID.

In 1908 we figured and described, as probably belonging to an unknown species of *Viburnum*, some small endocarps from the Cromerian at Pakefield.* Afterwards two endocarps belonging to the same plant were found at Tegelen (*op. cit.* 1910, p. 197, figs. 30, 31). A further study of the anatomy of the Cromerian specimens has proved that we were mistaken in this ascription, and that the fossil endocarps belong to the genus *Corema*. *Corema* is a small genus of heath-like plants, one of which inhabits Spain, Portugal, and the Azores, the other is confined to the Atlantic part of the United States. Our fossil is a new species of the genus, closely allied to the living Portuguese *Corema alba*, and recently has been described by us as *C. intermedia*.†

CORIARIACEAE?

Pl. X, fig. 18.

Coccus compressed towards the ventral margin; pericarp crustaceous thin, not keeled; seed somewhat compressed laterally, coarsely and irregularly striate.

Length 3.7 mm., breadth 2.0 mm.

SWALMEN.

In structure this fruit is very near *Coriaria*. It differs, however, from all living

* On the Pre-Glacial Flora of Britain. *Journ. Linn. Soc.—Botany*. vol. 38 (1908), p. 316, pl. 13, figs. 75-77.

† *Journal of Botany*, vol. LII (1914), p. 113, tab. 531.

species in the absence of the strong sulcations which are so characteristic of the genus. Possibly it belonged to an extinct closely allied genus.

Coriaria, which is the only living representative of the order, contains shrubs of Spain, the Mediterranean region, China, Nepal, Malaya, New Zealand, Polynesia, Central and South America.

ANACARDIACEAE.

PISTACIA ACUMINATA SP. NOV.

Pl. X, figs. 19, 20.

ENDOCARPIUM OVATUM, ACUMINATUM, ASYMMETRICUM, HILO BASALI PROMINENTE; STRIAE LONGITUDINALES, E HILO RADIANTES, LATERE VENTRALI GREGEM COMPACTUM SUMMUM APICEM ATTINGENTEM EFFICIENTES.

Endocarp ovate acuminate asymmetric; walls rather thin; hilum basal prominent; longitudinal striae radiating from the hilum, and along the ventral side forming a close band extending to the apex; surface sculpture small irregular hexagonal pits.

Length 6 mm., breadth 4 mm.

REUVER, SWALMEN.

This endocarp has so many characters in common with different species of *Pistacia*, that we feel little hesitation in referring it to that genus. It differs however from all the species we have been able to examine in being thinner-walled (though this may be due to crushing), in being more asymmetric and acuminate. The endocarp of *P. mutica* has been photographed (fig. 21) as showing the general form of the endocarp and the prominent hilum in this genus. *P. mutica*, however, does not show clearly the longitudinal fibres on its endocarp; these are better seen on *P. vera*. The species of *Pistacia* have endocarps differing greatly in size and shape, that of *P. vera* being 20 mm. long and of an oblong-oval shape, whilst *P. terebintha* is 5 mm. long and broader than it is long. Some species are quite rounded, or even emarginate at the apex. It will be seen, therefore, that our species occupies an intermediate position, combining characteristics now scattered among many different species; this may imply that it is an ancestral form.

Pistacia is confined to the northern hemisphere.

TESCHIA CRASSICARPA GEN. ET SP. NOV.

Pl. X, figs. 22a, b.

FRUCTUS CALYCE PERSISTENTE INCLUSUS; CALYX AD FRUCTUS BASEM ADNATUS, 5-LOBATUS, LOBIS DORSALIBUS DUOBUS IN ALAS FRUCTUM INVOLVENTES PRODUCTIS, LOBIS TRIBUS ANTICIS BREVIBUS LATIBUSQUE; FRUCTUS SILIQUOSUS, SEMINE SOLITARIO; RADICULA AD FACIEM INTERIOREM (SUPERIOR?).

Fruit enclosed in persistent calyx; calyx attached to the base of the fruit, 5-lobed; 2 dorsal lobes produced into wings enveloping the fruit; 3 front lobes short and broad;

fruit a pod with single seed; radicle on inner face (superior?). The shrivelled remains of the corolla are seen within the calyx.

Length 6.7 mm., breadth 4.8 mm.

SWALMEN.

This fruit appears to belong to the *Anacardiaceae*, and probably to the section *Rhoideae*; it may be near *Cotinus*. In the ripe fruits belonging to several genera of *Anacardiaceae* (*Parishia*, *Swintonia*, *Loxostylis*, etc.) the adherent calyx is much increased in size, often forming wings. One of the large wings was accidentally broken off the fossil.

Pl. X, figs. 23—26.

From Reuver and Swalmen we have obtained specimens of drupes apparently belonging to the *Anacardiaceae*.

Fruit drupaceous; drupe ovate pointed (fig. 26); exocarp thick striate; endocarp crustaceous thick dehiscent (or splitting into 2 valves in germination, fig. 23), obovate rounded, base projecting black, contrasting with the rest of the brown endocarp; hilum basilateral?; style lateral; testa fused with the endocarp, finely striate obliquely.

Length of fruit (with mesocarp shrunk) 6 mm., breadth 4.5 mm.; endocarp, length 5.2 mm., breadth 3.5 mm.

REUVER, SWALMEN.

We are unable to make certain as to the character of the seed in this fruit. The large black area at the base of the endocarp is striking; but the course followed by the vessels from this point is not clear. There is however a large lateral aperture at about $\frac{2}{3}$ distance from the base.

It is probable that these drupaceous fruits belong to the same species as the fruit with acrescent calyx shown in fig. 22; but until we obtain for dissection a second specimen in which the calyx is preserved we cannot make certain.

AQUIFOLIACEAE.

Ilex aquifolium LINN.

Pl. XI, fig. 2.

A single endocarp found at Reuver evidently belongs to this species, and needs no further description. We have figured it side by side with a recent specimen (fig. 1).

STAPHYLEACEAE.

Staphylea SP. 2.

Pl. XI, fig. 4.

Seed small for the genus, strongly faceted on one side (more than one seed developed) narrowed toward the base; testa finely granulate.

Length 6 mm., breadth 5 mm.

BRUNSSUM.

We cannot match this seed, which is unlike any recent form in the Kew Herbarium. It is quite different from the large seed found at Tegelen (*op cit.* 1910, figs. 11, 12, 13), and from the recent European *S. pinnata* (fig. 3).

STAPHYLEA SP. 3.

Dr. TESCH has recently obtained from Tegelen another broken seed belonging to *Staphylea*. It differs both from that just described and from the one previously figured from Tegelen.

We appear to have therefore 3 species of *Staphylea* in the Pliocene deposits of Limburg. But all are represented only by broken seeds, and there are still several of the newly discovered Chinese species the seeds of which we have been unable to examine. Under these circumstances we prefer not to name them as undescribed forms.

ACERACEAE.

Broken fruits and seeds belonging to at least 3 species of *Acer* have been found in the Reuverian. We have been unable to identify any of them with a living form, and none of them corresponds with either of the species found at Tegelen. Only one of these species of *Acer* is, however, represented by a fruit sufficiently well-preserved, and sufficiently well characterized, to be described and named as new.

ACER STRIATUM SP. NOV.

Pl. XI, fig. 5.

FRUCTUS PARVUS, RHOMBOIDEUS, AD ALARUM COMMISURAM INCURVUS; ALA ANGUSTA, CUM AXI ANGULUM 45° EFFICIENS; FRUCTUS UT ALAE STRIIS LONGITUDINALIBUS FILAMENTOSIS IN FRUCTU RETICULATIS SED IN ALIS APPROXIMATIS ET PARALLELIS TECTUS.

Fruit small, compressed, rhomboidal, incurved at the junction with the wing; wing narrow, given off at an angle of 45° with the axis; fruit and wing covered with thread-like longitudinal striae, which are reticulate on the fruit but close and parallel on the wing.

Length of fruit without wing 5 mm.

SWALMEN, REUVER.

This species is unlike any living maple in the Kew Herbarium. In the character of its venation, and in the very flat fruit it resembles the Chinese *A. carpinifolium* and *A. pictum*; but the shape of the seed is quite unlike in both these species, being elongate-ovate instead of round as in our fossil. The angle at which the wing is given off is also different.

ACER CF. LOBELII PAX.

Pl. XI, fig. 6.

This species, in the shape and venation as well as in the very flat unmodelled character of its fruit, seems nearest to *A. Lobelii* Pax, a tree of the Caucasus of the mountains of the near east, and also of China; but the fossil fruits are not in a good state of preservation, and we are unable further to describe them. They were found at SWALMEN.

ACER SP. 3.

Pl. XI, fig. 7.

Seeds of a third species of *Acer* occur at REUVER and SWALMEN. They may belong to *A. campestre*, but are very small for that species.

ACER LIMBURGENSIS SP. NOV.

Pl. XI, fig. 8.

SAMARA MAGNA, PARUM COMPRESSA, ROTUNDATO-TRIANGULARIS, ALIS EXCLUSIS 8.5 MM. LONGA, 8.0 MM. LATA, NERVIS CONSPICUIS CRASSE RETICULATIS; ALAE SUBPARALELLAE, APPROXIMATAE, TENUITER STRIATAE.

Fruit large somewhat compressed, roundly triangular, with coarsely reticulate conspicuous nerves; wings nearly parallel and closely adjacent, finely striate.

Length without wing 8.5 mm., breadth 8.0 mm.

TEGELEN.

We cannot identify this fruit with any living or fossil species. The specimen was obtained by Dr. TESCH after the publication of our descriptions of the Teglian plants.

HIPPOCASTANACEAE.

AESCULUS SPINOSISSIMA SP. NOV.

Pl. XI, figs. 9—13, 16.

CAPSULA SPINOSISSIMA; SPINAE ROBUSTAE, AD BASES VALDE CANALICULATAS CONFLUENTES.

Capsule densely spiny; spines robust confluent at their strongly channelled bases; seeds about the size of *AE. Hippocastanum*, but only fragments are preserved; testa more finely sculptured than *AE. Hippocastanum*, but similar in pattern.

Valve of capsule, length 30 mm., breadth 18 mm.

SWALMEN, REUVER.

This species is abundant at Swalmen, more rare at Reuver. Though no complete ripe capsule has been found, fragments are so abundant that it is easy to compare them with the living species. The fruits (fig. 9) and seeds greatly resemble those of *AE. Hippocastanum*, (fig. 14), and may belong to an ancestral form of that species; but the differences are so great that it is impossible to consider them as varieties of the same species. Our fossil is not closely allied to any other living form. Sterile fruits (figs. 10—13) are elongate ovate or globose, densely spiny all over, showing no smooth areas; their length is about 9 mm. Ripe fruits show occasionally less spiny patches; but are always more spiny than in *AE. Hippocastanum*, of which a weathered specimen, which shows best these spines, has been figured (fig. 14). The wild form of *AE. Hippocastanum*, from Greece, has fruits scarcely distinguishable from the cultivated form. The sculpture of the testa is somewhat finer in the fossil; it is shown in figs. 15, 16, which are taken from about the same part of a recent and a fossil specimen. This sculpture varies somewhat according to its distance from the hilum.

SAPINDACEAE.

GENUS?

Pl. XI, fig. 17.

The fruit shown in fig. 17 belongs to one of the *Sapindaceae* with 3 carpels strongly winged, probably in the section *Paullinieae*. The fruit is oblong, and coarsely reticulate on the sides; the wing is only partly preserved, but shows a strong dorsal vein and coarse reticulation. We cannot identify the genus, and the specimen is too incomplete for full description.

Length of carpel (without wing) 4.0 mm., breadth 2.5 mm.

REUVER.

STOCKSIA?

Pl. XI, fig. 18.

A small hard seed of unusual structure has been found at several localities in Pliocene deposits. It was first discovered at Tegelen in 1905 (*op cit.* 1907, fig. 124). Next several specimens were found at Raevens, in Belgium, in material collected by Baron GREINDL and M. PIERRE GÉRIMONT. The deposit was thought to be of the same age as that found at Tegelen; but unfortunately the locality yielded only this unknown seed, and a seed of *Alisma*. A short description of the seeds from Raevens was published by us in 1908*. Now we have the same curious seed from Reuver.

Seed small globose or slightly faceted, with a large ovate germination-valve having its apex at the micropyle; testa thick hard, with faint longitudinal granulate striation, in 3 layers, an outer thin black dense, a middle thick brown spongy with occasional large cavities, and a very thin inner black layer (tegmen?); hilum fitted with a conical plug. The inside of the testa, in the specimens we have been able to examine, shows no clear impression of the embryo.

Length 1.2 mm.

TEGELEN, RAEVELS, REUVER.

The large germination-valve is the most striking characteristic in these seeds. We have found valves of this sort in *Nyssaceae* and in *Sapindaceae*. *Nyssa* in other respects is quite unlike our seed; but in *Sapindaceae* section *Koelreuterieae* we find globose seeds with germination-valves and plugs resembling our fossil. Among the living species of *Stocksia*, however, the smallest seed we can find at Kew is much larger than our fossil. In the living species of *Koelreuteria* the valve is strap-shaped and shows externally as a raised area cut off from the rest of the testa by a groove; in our fossil the valve is not raised and would probably be quite inconspicuous in the fresh seed. As in the recent *Koelreuteria*, the hilum shows a conical plug, which is pushed outward by the swelling of the embryo in germination, and thus forces open the hinged valve. The testa of the fossil resembles that of *Koelreuteria* in its hardness, thickness, and division into layers; but we can find in the recent seed no counterpart of the large cavities, seen in one

* Les Éléments Botaniques de la Détermination de l'âge des Argiles à Briques de Tegelen, Reuver, Ryckevorsel et Raevens. *Bull. Soc. Belge de Géologie*, tome 21, p. 589.

cross-section of our fossil, in its middle layer. These cavities may possibly be accidental; but they make us doubtful as to the true position of this plant.

SABIACEAE.

MELIOSMA EUROPAEA SP. NOV.

Pl. XI, figs. 19, 20, 21, 24, 25.

ENDOCARPIUM MAXIMUM, GLOBOSUM, SUPERNE OBTUSE CARINATUM, INFERNE COMPLANATUM, CANALICULATUM VALDEQUE INVOLUTUM, FACIE INTERIORE AD STYLI BASEM CALCARATUM.

Endocarp (fig. 19) very large globose, bluntly keeled above, flattened below channelled and strongly infolded; spurred on the inner face at the base of the style. Mesocarp(?) ossified locally and forming a hard spongy plug infolded into the endocarp (figs. 20, 21), plug large broadly cuneate or sagittate, extending to and sometimes enclosing the spur at the base of the style.

Length 6 mm., breadth 8 mm.

REUVER, SWALMEN.

Our endocarps are somewhat larger than those of *Meliosma Veitchiorum* (fig. 22), which they greatly resemble. They are less pointed and more globose. We thought at first that the fossil endocarps could be referred to that species; but the discovery by Mr. WILSON of another closely-allied form, *M. Beaniana* Rich. and Wils., with endocarps (fig. 23) nearly as large, has caused us to re-examine the evidence. Mr. WILSON has sent us fruits of both these interesting Chinese species. The differences seen in the endocarps are not great, but constant, and we are evidently dealing with three closely-allied species, two of which still live in the mountains of Western China, the third is only known fossil in Limburg.

In the fossil endocarps the hard plug at the attachment is often diseased, and expands into a discoid spongy mass, at the end of which the abortive endocarp forms a small excrescence. Specimens are found showing every stage of this diseased growth, which was caused by a fungus. The outgrowth is often much larger than a perfect endocarp; but it does not enclose the endocarp, and seems only to form at its base. Mr. MASSEE cannot find any record of such an abnormality in any of the living species of *Meliosma*.

We illustrate (figs. 24, 25) two stages of this disease; but most of these galls are found detached from the endocarps. The fungus which causes this disease has been described and figured by Mr. G. MASSEE (*ante*, p. 52).

SABIACEAE OR SIMARUBACEAE.

GENUS?

Pl. XI, figs. 26, 27 a, b.

A peculiar drupaceous fruit, of which six specimens have been found at Reuver, was thought at first to belong to *Sabiaceae*; we now think however that it represents some unknown genus, probably belonging to the *Simarubaceae*.

Endocarp obovate inflated, slightly asymmetric, tending to split (in germination?) into 2 valves; exterior showing many strong longitudinal ridges near hilum, some of which disappear higher up, others branch and anastomose, forming a coarse reticulation over the apex; hilum projecting, annular with depressed centre; micropyle apical or nearly so. Seeds 2, attached laterally at $\frac{1}{3}$ of the distance from the hilum. Testa thin black shining, of large irregular hexagonal cells.

Length 7 mm., breadth 5 mm.

REUVER.

We have opened one of the endocarps (figs. 27 a, b) in order to show the internal structure. The vessels pass straight through the base of the endocarp; they are not diverted by infolds, as in *Sabiaceae*, and do not occupy a channel in the endocarp, as in some *Rosaceae*, such as *Prunus*.

RHAMNACEAE.

KARWINSKIA PAUCICOSTATA SP. NOV.

Pl. XII, fig. 5.

ENDOCARPIUM AB EO *K. Humboldtianae* MAGIS OVATUM COSTIS PAUCIORIBUS TANTUM DIFFERT.

Endocarp ovate, somewhat compressed laterally; locules 2 coherent, line of separation shown externally by a conspicuous groove; exterior with few and flat longitudinal ribs radiating from the base.

Length 7+ mm., breadth 6 mm.

REUVER.

This unique specimen evidently belongs to *Karwinskia*, a genus of 2 or 3 species now confined to the Pacific coast of North America. From *K. Humboldtiana* Zucc. (fig. 6) it differs only in the fewer number of ribs and in its more ovate form. Both fossil and recent endocarps show an outer layer of hexagonal cells, a middle layer of elongate cells arranged longitudinally, and an inner layer of cells elongate transversely. The recent endocarp shows a line of weakness along the upper third of its margin, through which germination evidently takes place. In our fossil this area is missing, and we think that the seed has germinated. In the fossil the locules have developed unequally; a broken specimen of *K. Humboldtiana* in the Kew Herbarium shows the same character.

BERCHEMIA SP.?

Pl. XII, figs. 7 a, b.

Endocarp ovate of 2 coherent locules; hilum basal; micropyle apical; wall of endocarp fairly thick and hard, surface smooth.

Length 3.3 mm., breadth 2.2 mm.

BRUNSSUM.

This fruit, of which we have only seen one specimen, appears to belong to *Rhamnaceae* and to be near to *Berchemia*. The endocarp however is very small, and the locules cohere less than they do in *Berchemia*.

RHAMNUS SP. NOV.

Pl. XII, fig. 8.

Seed (much crushed) elongate obovate mucronate; hilum ventral linear gaping, very large depressed; inside showing fine striae, which follow the curve of the embryo.

Length 6.2 mm., breadth 3.2 mm.

REUVER.

We have compared this seed with those of all species of *Rhamnus* in the Kew Herbarium which are comparable in size, and with many which are not. No species is mucronate, and in all which have the elongate gaping hilum this reaches much nearer to the apex than in our species. We cannot describe our seed as a new species, for it is too much crushed and distorted. We illustrate with it a seed of *Rhamnus infectoria* Linn. (fig. 9) which has a similar hilum.

GENUS Nov.?

Pl. XII, fig. 10.

Fruit ovate; endocarp obscurely 3-lobed, 3-loculed, septicidally dehiscent at apex for about $\frac{1}{7}$ its length; base showing 3 large pores.

Length 5 mm., breadth 3.8 mm.

BRUNSSUM.

This fruit appears to fall within the section *Rhamnaceae* of the family *Rhamnaceae*. Like many of the *Rhamnaceae* the fruit has been seated on a large disc formed by the calyx-tube, from which when ripe the fruit detaches itself, as in *Hovenia* (China, Japan, Himalaya) and *Ceanothus* (fig. 11, North America). In these genera, and, as we believe, in our fossil also, the disc is confluent with the pericarp. In the living genera however the disc is circular and carried some way up the fruit, leaving when shed a cincture round the fruit, below which the endocarp is exposed. In the fossil the disc must have been 3-lobed, and the pericarp and endocarp conterminous, so that when shed the pericarp reached to the lobes, and there was no cincture.

We should place this fruit near the genera *Hovenia* and *Ceanothus*. Though there is a slight dehiscence at the apex of our fossil it does not seem essential for germination, for the fruit was shed as a whole, and germination has apparently taken place through the basal pores, towards which the micropyle opens in *Rhamnaceae*.

It is noticeable that we have as yet only 4 fruits or seeds belonging to *Rhamnaceae*, but that these 4 specimens represent 4 genera.

VITACEAE.

VITIS VINIFERA LINN.

Pl. XII, figs. 12, 13.

Reuverian seeds are somewhat larger, less faceted, and more wrinkled transversely than those of the wild vine of the Caucasus; but otherwise they are indistinguishable. The prominent beak and cordate apex distinguish these seeds from any other

recent species represented in our collection. They correspond with the seeds found at Tegelen, and like them they seem to connect *Vitis Hookeri* Heer (Lower Miocene, Bovey Tracey) with the living *V. vinifera* *. The lignite of Bovey Tracey is of the same date as the lignite of Wetterau; but *V. Hookeri* is only known from England. It may be a temperate species, washed down from the high hills of Dartmoor. We do not like to refer *V. Hookeri* with confidence to the living *V. vinifera*, as nearly all the associated plants are extinct; but the close resemblance suggests that in *V. Hookeri* we have the ancestor of our grape-vine, appearing for the first time with such a modern-looking plant as *Rubus microspermus*, a species closely allied to our common *R. fruticosus*.

Seeds and tendrils of *V. vinifera* are common at REUVER, SWALMEN, and BRUNSSUM, as well as at TEGELEN. Most of them have been broken.

VITIS CF. ORIENTALIS BOISS.

Pl. XII, fig. 14.

Two specimens belonging to another species of *Vitis* have been found.

Seeds roundly obovate minutely beaked below, slightly cordate above; ventral face rounded, obliquely wrinkled; chalaza lanceolate; dorsal faces much flattened, with deep elongate pits.

Length 3.4 mm., breadth 2.8 mm.

REUVER.

Without more specimens we should not like definitely to refer these to *V. orientalis*, for the resemblance is not exact, and the testa is thicker in the fossils. We find it difficult to obtain perfectly ripe seeds of many species of *Vitis* for comparison.

GENUS?

Pl. XII, fig. 15.

A single specimen of a large seed, which has germinated, seems to belong to *Vitaceae*, but we cannot suggest its generic position. It does not appear to be referable to *Vitis*.

Seed large ovate pointed at base; ventral face slightly rounded; chalaza large roundly ovate, below the middle; dorsal face tumid, 2-facetted, with a long narrow shallow groove in each facet.

Length 7.5 mm., breadth 4.7 mm.

REUVER.

MALVACEAE.

ALTHAEA CRASSICARPA SP. NOV.

Pl. XII, fig. 16.

CARPELLA MAGNA, DURA, OBLIQUE OVATA, CARINIS ROTUNDATIS TENUITERQUE SULCATIS INTER SE FOSSA CONSPICUA SECRETA; COSTAE RADIANTES IN CARINIS VALIDAE, TRANS FOSSAM DORSALEM INTERRUPTAE, CITO IN LATERIBUS EVANESCENTES.

Carpel large thick hard, obliquely ovate; keels rounded, faintly grooved, separ-

* C. and E. M. REID, The Lignite of Bovey Tracey. *Phil. Trans. ser. B*, vol. 201 (1910), p. 165.

ated by a conspicuous channel; radiating ribs strong on the keels, interrupted over the dorsal channel, soon disappearing over the smooth much sunk lateral area.

Length 6.5 mm., breadth 5.0 mm.

TEGELEN.

A single carpel, found at Tegelen by Dr. TESCH in 1912, is all that we have seen of this species. The carpel somewhat resembles that of *A. pallida* (fig. 17) of South Europe; but it is considerably larger, more oblique, and of harder texture. We can find no other living species with which it is comparable. Nothing was before known of the genus *Althaea* in the fossil state.

STERCULIACEAE?

Pl. XII, figs. 18, 19.

Seed oblong cuneate, tubercled dorsally, faceted ventrally; hilum ventral large, with radiating striae; raphe and chalaza ventral.

Length 5.5 mm., breadth 3.0 mm.

SWALMEN.

Two specimens having a resemblance to the seeds of *Sterculiaceae* section *Buettnerieae*. We have been unable to identify them with any living genus; but can make no other suggestion as to their affinities.

DILLENIACEAE.

ACTINIDIA FAVEOLATA SP. NOV.

Pl. XIII, figs. 1—4.

SEMINA OVALIA, TUMIDA, LATERALITER PARUM COMPRESSA, OBTUSE CARINATA; TEGMEN FOVEOLIS REGULARIBUS SEXANGULIS AD HILUM MINORIBUS ET MAGIS ELONGATIS TECTUM.

Seed oval tumid, somewhat compressed laterally, bluntly keeled; hilum slightly produced and expanded; micropyle close to hilum; tegmen opaque crustaceous shining, covered with small deep regular hexagonal pits which become smaller and more elongate at the hilum; interior with low hexagonal bosses corresponding with the ends of the pits.

Length 3.5 mm., breadth 2.25 mm. BRUNSSUM, SWALMEN, REUVER, TEGELEN.

The seeds of the living species of *Actinidia* (figs. 5, 6) vary but slightly in size and shape. Our fossils differ from all that we have been able to examine, and fruits of nearly all the species are in the Kew Herbarium, but they approach more closely to the Chinese forms than to those of the tropics. From all the living forms they differ in the fineness, closeness, and the extreme regularity of the hexagonal pitting, which makes the fragments resemble pieces of honeycomb, whence the specific name.

The actinidias are usually rambling bushes growing like our blackberries, though one is a small tree. They are common in China and Japan, and occur also in India, but are now extinct in Europe.

Imperfect specimens of these seeds were discovered by us in 1905 at Tegelen

and figured (*op. cit.* 1907, figs. 119—121); but we were then unable to identify them. The fruit of *Actinidia* is edible and somewhat like a gooseberry; hence the seeds are probably scattered freely by birds. They are found at all four of the localities examined in Limburg; but we have not yet seen them from the somewhat newer Cromerian deposits.

THEACEAE.

STEWARTIA PSEUDOCAMELLIA MAXIM.

Pl. XIII, figs. 7—16.

Perfect fruits (figs. 8 a, b, 9, 11 a, b) somewhat compressed, detached carpels (figs. 12, 16,) and seeds (fig. 15) of this plant occur at REUVER and SWALMEN, and fragments have been found at BRUNSSUM. We have illustrated fossil and recent fruits (figs. 7, 10) side by side and can see no difference between them, when allowance is made for crushing in the fossil specimens. The living plant is a native of China and Japan.

GUTTIFERAE.

HYPERICUM.

The genus *Hypericum* is well represented in the Pliocene deposits of Limburg, 7 species having been found in the Teglian and 5 in the Reuverian, with only one species common to the two stages. Two other species occur in the Cromerian; but both of these are living European forms.

The genus now contains about 200 species, and there is great similarity in the seeds, which are always minute and cylindrical. In many the seed-wall is so translucent that lower layers of cells are seen through the superficial ones; thus making the surface sculpture appear more confused than it really is, and making comparison with the fossil seeds very difficult. Before we could compare our fossils thoroughly it would be necessary to carbonize, or otherwise render opaque, a specimen of each of the 200 living species of seeds. This is a task we have not been able to undertake, and as yet we can only determine a few of our fossils.

HYPERICUM *cf.* ASCYRON LINN.

Pl. XIII, figs. 17, 18.

Seed large cylindrical mucronate; testa rough, with 16 irregular rows of large hexagonal pits elongate transversely.

Length 1.4 mm., breadth 0.6 mm.

REUVER, SWALMEN.

The rugosity of the seed and the marked transverse elongation of the surface cells make this fossil unlike any species we have seen except *H. Ascyron*, a plant of Siberia and Japan, and also of North America. With some seeds of this species in our collec-

tion the cell-sculpture agrees exactly; but our fossil is considerably larger and more rugose. We figure the recent *H. Ascyron* (fig. 19) for comparison.

HYPERICUM Sp. 2 (= TEGELEN Sp. 7).

Pl. XIII, figs. 20, 21.

Seeds cylindrical (fig. 21 is crushed), bluntly pointed at either end; testa smooth shining; surface sculpture of small hexagonal pits not elongated, arranged in about 30 somewhat irregular longitudinal rows.

Length 1.0 mm., breadth 0.4 mm. REUVER, SWALMEN, BRUNSSUM, TEGELEN.

The walls of the pits are black whilst the sunk part is light-brown; this gives a reticulated appearance to the testa.

This seed is apparently the same as that from Tegelen, figured by us in 1910 (*op. cit.* fig. 10). Some of the Reuver seeds are quite as broad as the one there figured; the best seeds from the Reuverian happen to be narrow specimens. We are still unable to identify the species.

HYPERICUM Sp. 3.

Pl. XIII, fig. 22.

Seed cylindrical (crushed) rounded at ends; testa rough; pitting very obscure though the surface is well preserved.

Length 1.1 mm., breadth 0.75 mm. SWALMEN.

Only one seed has been found. The obscurity of the surface sculpture in this seed is partly due to the second layer of cells showing through the outer hexagonal layer, giving a confused appearance to the testa. The second layer is formed of digitate interlocking cells flattened above and below. These two layers of cells appear to be characteristic of many of the forms; but they vary in relative thickness in the different species. Sometimes the outer hexagonal or quadrate pits are deep; in which case the testa has a honeycombed appearance, as in *H. Ascyron*. In other species, as in the one we are now considering, this layer is thin and the digitate cells below are seen through it. Sometimes the walls of one or other of these layers of cells are thickened unequally; then various kinds of tubercles are formed.

HYPERICUM Sp. 4.

Pl. XIII, fig. 23.

Seeds small cylindrical slender bluntly pointed at either end; testa shining, with hexagonal pits elongate transversely in the proportion 3 to 2; pits arranged in regular longitudinal rows, middle of cells raised slightly, giving rise to flat rather obscure longitudinal striation.

Length 0.9 mm., breadth 0.4 mm.

REUVER.

This and species 2 may be somewhat closely allied.

HYPERICUM SP. 5.

Pl. XIII, fig. 24.

Seed of medium size, cylindrical-fusiform; testa with about 18 rows of hexagonal pits elongate transversely in the proportion 2 to 1, giving the rows of pits a ladder-like appearance.

Length 1.0 mm., breadth 0.5. mm.

REUVER.

Only one seed of this well-marked species has been seen.

VIOLACEAE.

VIOLA SP. 1.

Three seeds from Swalmen undoubtedly belong to the genus *Viola*, one appears to be unripe, the other two are broken, probably in germination. The seeds of the different species in this genus, however, so closely resemble one another, that in the absence of better material it would be useless to attempt any specific determination. As the small unripe seed is more coarsely pitted than the other two, it may belong to a different species. We have not figured these seeds.

Length about 1.3 mm.

SWALMEN.

VIOLA SP. 2.

Pl. XIII, fig. 26.

A seed from Brunssum seems different from either of those from Swalmen. It is somewhat crushed; but we have photographed it side by side with a seed of *V. lutea* (fig. 25), to which it bears considerable resemblance.

Length 1.5 mm., breadth 0.9 mm.

BRUNSSUM.

VIOLA SP. 3 (CF. *V. RUPESTRIS*).

Pl. XIII, fig. 27.

Two seeds from Reuver represent a third species of *Viola*, larger than either of the others, and of a different shape. It resembles the living *V. rupestris* more than any other with which we have been able to compare it.

Length 2.3 mm., breadth 1.4 mm.

REUVER.

GENUS?

Pl. XIII, figs. 28—30.

Seed broadly ovate or globose, bluntly pointed; chalaza large flat round; raphe external; surface of testa finely pitted, black.

Length 2.5 mm., breadth 2.3 mm.

REUVER, SWALMEN.

These seeds appear to belong to some genus of *Violaceae* other than *Viola*. They have the hilum, raphe, and large chalaza of that genus, and have also its method of germination; but they are larger and more globose than any species we know. They bear more resemblance to *Scyphallandra*, a genus of Ceylon and Indo-China, than to any other.

NYSSACEAE.

NYSSA SILVATICA MARSH.

Pl. XIII figs. 31—35.

Endocarp ovate or slightly obovate narrowed below rounded and mucronate above, dorsally rounded, ventrally somewhat compressed; fibrous bundles 9 or 10 sunk (occasionally branching); ribs broad rounded; germination valve triangular, occupying about $\frac{1}{3}$ of the length of the endocarp.

Length 8.0 to 11.0 mm. breadth 5.5 to 7.0 mm.

SWALMEN, REUVER.

Of the living species of *Nyssa* the American *N. silvatica* (figs. 34, 35) is the only one which approaches at all closely to our fossil, and from this species we find it quite impossible to separate the Reuver and Swalmen fruits. In size, shape, and sculpture, both the fossil and the recent endocarps vary a good deal; but the same range of variation occurs in each. At Reuver we find also a good many rather small specimens (fig. 33), with the ribs often little developed. We take these to be unripe or poor fruits belonging to the same species, for they are connected with the better fruits by a complete series of intermediates. None of the extinct species of *Nyssa* from the Oligocene and Miocene lignite bear much resemblance to our fossil.

Nyssa silvatica now ranges from Maine to Florida, it is found nowhere in the Old World.

CAMPTOTHECA CRASSA SP. NOV.

Pl. XIV, figs. 1 a, b, 3, 4.

SAMARA 2 (3?)-LOCULARIS, DURA, OSSEA, COMPLANATA, ALATA, BASI PARUM OBLIQUA, APICE DISCOIDEA PARUMQUE DILATATA.

Samara 2 (3?)-loculed; hard bony flattened winged, base somewhat oblique, apex discoid and slightly expanded, strongly ribbed longitudinally, ribs irregularly forking and uniting again near the apex, surface with fine irregular oblique grooves as in *C. acuminata* Decne. (figs. 2 a, b).

Length 22 mm., breadth 8 + mm.

SWALMEN.

The three specimens of this fruit, which are all that have been seen, are of about the same size, shape, and general appearance as samaras of *C. acuminata*; but are thicker, harder, and more strongly ribbed.

The genus *Camptotheca* now contains only 2 species, both confined to the mountains of Western China and the borderland of Tibet. It has a samara with 1 locule and 1 seed; but it has 2 styles (one of the illustrations in the *Pflanzenreich* shows 3 styles).

FIG. 4.
Camptotheca
crassa,
transverse section
of semara.

We sacrificed the smallest of the three fossil fruits (fig. 4) in order to make serial sections of it. The fruit was difficult to cut, and very friable, so that we could only shave off successive slices, and photograph the surface thus exposed; we were unable to obtain thin slices for preservation. Our photographs show clearly 2 locules, each with 1 seed, and some of the sections show perhaps a third locule in which no seed has been developed. One of these photographs is reproduced in text-figure 4. The fruit, as will be seen from Plate XIV, is a small one, and perhaps not properly developed; sections of the larger fruits might show 3 fertile locules.

The occurrence of 2, if not 3, locules should remove the fruit from *Camptotheca*; but the occurrence of 2 (or 3) styles in the living *Camptotheca*, and the close general resemblance between the fossil and recent fruits, makes it seem better to enlarge the genus rather than to constitute a new one. The nearest ally is *Davidia*, which however has 6 or more locules, and a very different fruit.

As the fruits of the recent *Camptotheca* grow in crowded heads, they vary greatly in size and in the shape of the wing; our fossils seem to have varied in the same way. The fossils are so hard and strong that they may have drifted a considerable distance without injury, except to the thin edge of the wing.

OENOTHERACEAE.

TRAPA NATANS LINN.

Pl. XIV, figs. 6—12.

Fruits of *Trapa natans* are abundant at BRUNSSUM, but small and very variable. Figs. 6—10 give some idea of the range of the variation, but it is unnecessary to describe the different forms. A few broken specimens occur also at SWALMEN and at REUVER.

Dr. TESCH has recently obtained from TEGELEN better specimens of the 2-horned variety there found. Two of these are now figured (figs. 11, 12).

CIRCAEA CRASSA SP. NOV.

Pl. XIV, fig. 13.

FRUCTUS CRASSUS, IN PEDICELLUM VALIDUM GRADATIM ATTENUATUS, UT PEDICELLUS VALDE 4-COSTATUS.

Fruit thick, gradually merging into the thick pedicel; both fruit and pedicel strongly 4-ribbed.

Length 5.0 mm., breadth 2.3 mm.

SWALMEN.

This fruit is nearer to *C. lutetiana* than to *C. quadrisulcata* (North Asia, China). It differs from both chiefly in its much thicker pedicel, which is more strongly ribbed than in *C. lutetiana*, and also in the way the fruit gradually tapers into the pedicel. We have only seen one specimen.

HALORRHAGACEAE.

PROSERPINACA RETICULATA SP. NOV.

Pl. XIV, figs. 14–19.

FRUCTUS NERVIS CONSPICUIS RETICULATIS ORNATUS.

Fruit a trilocular utricle (fig. 16) or nut, winged at the corners, and formed of combined perianth and ovary, trigonous broad below narrowed above, open at the top (by decay), showing 3 septa opposite the flat faces; sepals with a conspicuous midrib, stronger marginal rib spurred at right-angles (to support a membranous wing at the corners, as in *Halorrhagis*?), and large open loops; veins prolonged considerably beyond the aperture (fig. 14), indicating a long herbaceous calyx limb which has now decayed.

Length (including remains of crown of veins) 3 mm., without crown 1.7 mm., breadth (without wings) 1.6 mm. BRUNSSUM, REUVER, SWALMEN, BIDART.

This peculiar nut evidently belongs to the genus *Proserpinaca*, now exclusively American. The two living species are submerged aquatic plants resembling *Myriophyllum* and *Hippuris*.

The new species in its sculpture is strikingly different from either of the living forms (compare fig. 20) and in its winged or spurred angles it curiously resembles certain species of *Halorrhagis* (cf. *H. alata*). It is, however, evidently an aquatic plant. It occurs at all three localities in the Reuverian, and Professor JULES WELSH has also sent us specimens (figs. 18, 19) from a Pliocene deposit at Bidart, near Biarritz.

MYRIOPHYLLUM VERTICILLATUM LINN.

Pl. XIV, fig. 21.

Fruits indistinguishable from this species occur at REUVER; they are very rare.

HIPPURIS GLOBOSA SP. NOV.

Pl. XIV, figs. 24a, b.

FRUCTUS GLOBOSUS, ENDOCARPIO CRASSISSIMO.

Fruit globose or globosely ovate; mesocarp thick of many layers of spongy cells; epicarp wanting, but the impressions of large irregular cells can be seen on the outer surface of the mesocarp; endocarp composed of a single layer of thin shining cells having a shagreen-like appearance on its inner surface; seed-coat thin black shining continuous with a mass of loose tissue which fills the aperture of the fruit like a plug.

Length 1.8 mm., breadth 1.4 mm.

REUVER.

Half of a fruit, which has split in germination. In all the above characters, except the shape, which is globose not cylindrical, the fossil agrees with *Hippuris vulgaris* (figs. 22, 23). It also differs in having the mesocarp composed of a greater number of layers of smaller cells, though the resulting thickness of the carpellary wall is the same in both cases. The pericarp of *H. vulgaris* is composed of a thin layer of large cells with wavy margins. These have been worn away in our fossil but their impressions can be seen.

H I P P U R I S SP. 2?

Pl. XIV, figs. 25a, b.

A second fruit of *Hippuris*, globose like the last, but smaller, with thicker walls, and with much smaller seed-cavity has been found at REUVER. It may belong to a second species; but without more material we cannot decide whether these differences are specific.

ARALIACEAE.

ARALIA RACEMOSA LINN.?

Pl. XIV, fig. 26.

A complete fruit of *Aralia* has been found at SWALMEN. There can be no doubt as to its generic position, and except for size it is indistinguishable from the Chinese *A. racemosa* (fig. 27). To this species we refer it with some hesitation, for the specific characters in this genus are not well marked in the fruit.

GENUS?

Pl. XIV, figs. 28—30.

In addition to the *Aralia* just recorded, we have single specimens of several different fruits which may belong to the same family; but with this imperfect material we can only figure them, in the hope that more specimens may be discovered (figs. 28—30).

Another specimen which we at first thought to belong also to the *Araliaceae* is shown in fig. 31. This has 6 bolster-shaped carpels, forming a syncarpous fruit, deeply grooved longitudinally. We have nothing in our collection resembling this; but among some fruits of *Zelkova Keaki*, received from the Yokohama Nursery Company, we found, as an accidental impurity, a single withered fruit identical with our fossil. The recent specimen shows that each carpel is constricted transversely, as if it contained 3 or 4 seeds; and the same constrictions can be found in our fossil. The occurrence of more than one seed in each carpel would make the ascription to *Araliaceae* impossible; but we are unable to satisfy ourselves as to the internal structure of the badly-preserved recent specimen, and do not know to what family it can belong.

UMBELLIFERAE.

Fruits of about eight species of *Umbelliferae* have been found; but few of them are sufficiently perfect for absolute determination. The fossil fruits of many genera in this family tend to lose their ribs by decay or tearing off, and the vittae become more prominent through the shrinkage of the rest of the fruit. This adds considerably to the difficulty of determination.

HYDROCOTYLEAE? GENUS?

Pl. XV, fig. 1.

We have only seen a singly specimen of the fruit shown in fig. 1. It seems to belong to the section *Hydrocotyleae*, but we cannot identify the genus.

Length 2.4 mm., breadth 1.4 mm.

REUVER.

PETROSELINUM Sp.

Pl. XV, fig. 4.

A small fruit belongs apparently to this genus; but we cannot further identify it.

Length 1.6 mm., breadth 0.7 mm.

REUVER.

CICUTA VIROSA LINN.

Pl. XV, figs. 2, 3.

A few fruits have been found at Swalmen; they are not very well preserved and call for no remark.

SESELINAE Sp. 1.

Pl. XV, figs. 5—9.

Fruit narrow oblong, somewhat compressed dorsally, commissure flat; ribs 5, strong, the 2 lateral somewhat broader than the other 3; vittae single between the ribs.

Length 2.0 mm., breadth 1.1 mm.

REUVER, SWALMEN.

This fruit belongs to the section *Seselinae* and seems to be near to *Seseli*.

SESELINAE Sp. 2.

Pl. XV, figs. 10, 11,

Fruit small ovate; ribs narrow; vittae single between the ribs.

Length 1.5 mm., breadth 0.8 mm.

SWALMEN.

These fruits are not well preserved, and it is difficult to say whether they were

naturally compressed, or have been crushed in fossilization. They seem also to belong to the *Seselinae*.

SESELINAE, Sp. 3.

Pl. XV, fig. 12.

A larger and broader mericarp belongs to a third species of this tribe. It has rather thin ribs, and single vittae between the ribs. It is too much broken for further description.

Length 3.2 mm., breadth 1.4 mm.

BRUNSSUM.

SIUM?

Pl. XV, fig. 13.

A mericarp related to *Sium* has been found.

Length 1.9 mm., breadth 0.75 mm.

REUVER.

It is not sufficiently well preserved for description.

PEUCEDANUM?

Pl. XV, fig. 14.

Fruit large broadly ovate, compressed dorsally, winged laterally, commissure flat; ribs narrow.

Length 3.3 mm., breadth 2.1 mm.

BRUNSSUM.

A single mericarp greatly resembling *Peucedanum palustre*.

GENUS?

Pl. XV, fig. 15.

Mericarp very small, ovate acuminate; commissure prominent.

Length 1.2 mm., breadth 0.8 mm.

REUVER.

This minute mericarp is too badly preserved for determination; but is different from any of the other species.

CORNACEAE.

CORNUS CONTROVERSA HEMSL.

Pl. XV, figs. 16—18.

Endocarp globose irregularly ribbed and excavated, with a broad constricted band encircling the endocarp at the septum, some specimens showing a large open apical foramen.

Length 4.5 mm., breadth 4.0 mm.

REUVER.

The fossil endocarps agree closely with this Chinese and Japanese species (fig. 18), though in some specimens the large foramen is less marked. The best specimens showing the open foramen unfortunately are crushed laterally and do not make satisfactory photographs. The species is common at Reuver, but has not been found at the other localities.

CORNUS SP. 2.

Pl. XV, fig. 19.

Endocarp small globose slightly pointed at apex; with regular scarcely prominent ribs, and narrow strands of fibres; foramen shallow and simple.

Length 3.3 mm., breadth 3.3 mm.

SWALMEN.

This is the only specimen of *Cornus* found at Swalmen, and it is flattened by pressure. It differs from the *C. controversa* of Reuver in being thinner walled, and in the greater regularity and the obscurity of its ribs. It may be unripe; but it does not seem to belong to *C. controversa*, and no similar fruits have been found at Reuver.

CORNUS CF. MAS LINN.

Pl. XV, fig. 20.

Endocarp (broken) ovate; ribs numerous sharp branching.

Length 7.5 mm., breadth 4.0 mm.

BRUNSSUM.

A somewhat damaged endocarp of elongate-ovate shape suggesting *C. mas* of Europe, or the allied *C. officinalis* of Korea. More material is wanted for exact determination.

CORNUS SP.

Pl. XV, fig. 21.

Endocarp small elongate; ribs about 5 prominent sharp.

Length 5 mm., breadth 2 mm.

BRUNSSUM.

A damaged endocarp somewhat resembling the last, but much smaller and with fewer ribs.

HELWINGIA SP.

Pl. XV, figs. 22, 23.

Pyrene oblong, wedge-shaped, ventrally angled, longitudinally grooved; dorsally tubercled coarsely; opening large sunk gaping.

Length 6.0 mm., breadth 2.7 mm.

SWALMEN.

In size shape and character of the micropyle this pyrene bears a close resemblance to *Helwingia himalayaca* HOOK. f. et THOMS; but the sculpture is different and

the micropylar opening is larger, so that we are unable with certainty to refer it to this genus. Only one specimen has been found.

PIROLACEAE?

MONOTROPA?

Pl. XV, figs. 24a, b.

Fruit quadrate, divided longitudinally by 4 deep grooves; exocarp (?) tough leathery, finely reticulate and wrinkled.

Length 9 mm., breadth 7 mm. REUVER.

We can say nothing definite as to the position of this fruit, as there is only one specimen, which cannot be dissected. At first we took it to be an unripe capsule of *Monotropa*; but we are uncertain as to its dehiscence. We now think that it may be a 4-locular berry with tough leathery skin. The way in which the fruit has been flattened by pressure suggests that it is many-seeded or contains soft seeds.

MYRSINACEAE.

MAESA Sp.

Pl. XV, fig. 25.

Fruit small globose (flattened and somewhat distorted); accrescent calyx covering $\frac{2}{3}$ or $\frac{3}{4}$ length of fruit, thickened at rim and showing remains of teeth; a blunt longitudinal ridge on either side of calyx; apex of fruit striate longitudinally, prolonged into a pointed beak (since accidentally broken).

Length 2.5 mm., breadth 2.5 mm. BRUNSSUM.

A unique specimen, which therefore we cannot dissect. The fruit appears to belong to *Maesa*; but we have been unable to find any living species to agree with it. The fruit, with its long beak, is almost identical in shape with those of *M. japonica* Mor. and *M. permollis* Kurz (of Burma and Yunnan); but both these show longitudinal striae on the calyx, as do nearly all the species of *Maesa*. In *M. ramentacea* var. *ovata* CLARK they are little marked; but *M. ramentacea* and its variety have no prominent beaks. Our fossil has the calyx rough externally, and there are indications of the bases of glandular hairs; the surface of *M. permollis* is covered by such hairs.

The genus *Maesa* is now essentially tropical.

ARDISIA Sp.

Pl. XV, figs. 26a, b.

Epicarp loose thin yellowish-brown, much wrinkled irregularly by shrinkage, closely striate radially round the papillose sunk style, internally marked by the walls

of large loose cells of the pulp; mesocarp lost except part of the inner layer, which adheres to the endocarp; endocarp black shining thin closely wrinkled concentrically, wrinkles crossed longitudinally by the large irregular cells of the mesocarp.

Length 3 mm.

SWALMEN.

We have seen 3 specimens of this berry from Swalmen and a doubtful fragment from Reuver. The berries are crushed so flat, and look so hopeless for determination, that their botanical position was not recognised till it was too late to add an illustration of the recent *Ardisia*. Though *Ardisia* is spoken of as having a stone-fruit, the endocarp is often very thin, and our fruit seems to have the endocarp exceptionally thin; but this is not a character of generic value. In the appearance of the style and general character of the epicarp our fossil resembles *A. japonica*; though in the fossil the epicarp is more thin-walled, coriaceous, and closely-wrinkled. These transverse wrinkles are obviously original and not due to shrinkage of the fruit in drying, for the wrinkles do not distort the large irregular meshes formed by the cell-walls of the mesocarp, and these latter cells tend to be arranged radially, they are not elongate transversely.

Ardisia is a large genus, now essentially tropical, but having its northern limits in Japan.

PRIMULACEAE.

TRIENTALIS? SP.

Pl. XV, figs. 27a, b.

Seed irregularly ovate, faceted, ventral face angled at the elongate central hilum; sculpture of loose irregular hexagonal pits becoming elongate towards the hilum.

Length 1.7 mm., breadth 1.6 mm.

REUVER.

A single seed, which in size, shape, surface sculpture, and form of the hilum is exceedingly like *Trientalis europaea* (figs. 28a, b). We have not been able to compare this seed with many species beyond those in our own collection, for in the herbaria most *Primulaceae* are represented by flowers only. It evidently belongs to one of the larger-seeded *Primulaceae*. The dorsal facetting shown in the fossil is probably due to shrinkage and crushing, and is not original.

SAPOTACEAE.

MIMUSOPS SEPTENTRIONALIS SP. NOV.

Pl. XV, figs. 29a, b

SEMINA LATE OVATA QUADRATAVE, BASI TRUNCATA, LATERALITER COMPRESSA, PLANO-CONVEXA, HILO MAXIMO OBLONGO IMMERSO FISSURA MINUTA OBLIQUA ANGULO EXTERIORE APUD RAPHEM FISSURAQUE SIMILI ANGULO INTERIORE AD EXTREMUM CONTRARIUM INSTRUCTO.

Seed large hard polished, broadly ovate or quadrate truncate below, laterally compressed and plano-convex; testa minutely irregularly granulate; hilum very large

oblong sunk, continued by a minute short oblique fissure at the outer corner near the raphe, and by a similar fissure at the inner corner at the opposite end of the hilum.

Length 11 mm., breadth 12 mm., thickness 6 mm.

REUVER.

This large hard plano-convex seed certainly belongs to the *Sapotaceae*, and shows a great resemblance to *Mimusops browniana* BENTH. a tree of Queensland, but our fossil is considerably smaller. It does not show so close a resemblance to any other species with which we have been able to compare it, for most of the seeds of *Sapotaceae* differ in shape and are attached obliquely. We figure *Mimusops browniana* (figs. 30a, b) not only for its general resemblance, but as showing the same small oblique folds which we notice in our fossil. What is the origin of the folds we cannot say without recent material for cutting sections. Our fossil is unique and we cannot dissect it. The folds look like „germination grooves”, to assist the splitting of the very hard thick seed.

The genus *Mimusops* is now essentially tropical, as are nearly all the *Sapotaceae*.

EBENACEAE.

DIOSPYROS LOTUS LINN.

Pl. XVI, figs. 1, 2.

Kernel large semiovate laterally compressed; surface covered with small hexagonal pits.

Length 13.0 mm., breadth 5.5 mm.

BRUNSSUM.

This seed agrees in size, shape, attachment, and surface sculpture with that of *D. Lotus*, a tree wild in temperate Eastern Asia up to 1300 metres in China, and cultivated in the Mediterranean Region. We have only one fossil seed.

It is worth noting that when we first compared this seed with that of *D. Lotus*, though the agreement in size, shape, and method of attachment was so striking, we rejected the identification, because the surface sculptures were so different. The surface of the testa is very peculiar in *D. Lotus*, resembling that of *Jasminum*. This layer of long shining zig-zag cells (fig. 2) is easily rubbed off when macerated, leaving a second layer of zig-zag cells. This too can be removed, exposing a hard bony kernel with hexagonal pits, exactly as in our fossil (fig. 1). We mention this as a striking instance of the necessity, when comparing recent and fossil fruits and seeds, of making certain that we are comparing similar coats. Our fossils have been macerated; before comparison it is therefore necessary to macerate the recent specimens also.

DIOSPYROS SP. 2.

Pl. XVI, fig. 3.

Kernel ovate roundly pointed above and below, ventral edge gently curved, dorsal edge strongly curved; attachment prominent bent towards the ventral side; surface much wrinkled longitudinally and covered with minute pits.

Length 9 mm., breadth 4 mm.

SWALMEN.

The Swalmen species of *Diospyros* is quite different from that found at Bruns-
sum. Its kernel is smaller, narrower, more ovate, pointed below, and more finely
wrinkled. We can find no living *Diospyros* having these characters, and the species is
probably extinct; but as in this genus there is considerable variation in the seeds in a
single fruit, we do not care to found a new species on one specimen. Nearly all living
species of *Diospyros* have seeds with a straight ventral margin; none that we have seen
has the kernel so symmetrically oval.

STYRACACEAE.

STYRAX MUCRONATUM SP. NOV.

Pl. XVI, figs. 4, 5, 8.

SEMINA MAGNA, ELONGATO-OVATA, MUCRONATA, HILO PARVO.

Seed large elongate-ovate mucronate; hilum small.

Length 14 mm., breadth 7 mm.

REUVER, SWALMEN.

Our seeds appear all to have germinated and are more or less broken. We take
fig. 4 as the type of the new species; for it is not quite certain that fig. 5, which is
crushed vertically, belongs to the same plant. The type specimen has 3 raised lines,
marking the abortive locules, and its raphe is broad and conspicuous. The seed has split
open at the base and has curled back, making the specimen very difficult to photograph
satisfactorily. The character of the testa (fig. 8) corresponds closely with that of
S. japonicum (fig. 7).

It is noticeable that our fossil is allied to the Japanese and Chinese species
S. japonicum (fig. 6) and *S. Obassia*, not to the European *S. officinalis*; it is however
specifically distinct from either and we have been unable to match it among living
species.

OLEACEAE.

JASMIMUM UNDULATUM KER-GAWL.?

Pl. XVI, fig. 9.

Fruit elongate-ovate; epicarp close smooth not wrinkled; seed large, testa covered
with zigzag and wavy irregular striae.

Length 7 mm., breadth 4 mm.

SWALMEN.

This fruit is very much larger than the species next to be described, and retains
its outer coat. In size and shape it bears considerable resemblance to *J. undulatum*, a
species of China, Himalaya, and Burma; but so large a proportion of the jasmines in
the herbaria are not represented by fruiting specimens, that we cannot carry the deter-
mination further. We have only seen one specimen of the fossil fruit.

JASMIMUM CONTIGUUM SP. NOV.

Pl. XVI, figs. 10, 12.

BACCA 2-LOCULARIS, 2-SPERMA, LOCULIS AEQUALITER EVOLUTIS ARCTE ADPRESSIS IN FRUCTUM PARVUM IRREGULARITER OVATUM COHAERANTIBUS, ENDOCARPIO STRIIS TENUISSIMIS CONFERTIS FLEXUOSIS TECTO.

Berry 2-loculed and 2-seeded; locules equally developed closely adpressed cohering into a small irregularly ovate fruit; externally wrinkled with close-set wavy or zigzag lines.

Length 4.0 mm., breadth 2.3 mm.

REUVER.

This also is only represented by a single specimen; but it belongs to a different section of the genus from that above described. The very curious surface sculpture (fig. 12) corresponds with, though it is finer than, that of *J. fruticans* (fig. 11); but from that species it is clearly distinguished by the much smaller and more elongate 2-loculed fruit. It will be noticed that the surface pattern is so fine that to make it comparable with *J. fruticans* we have had to photograph this pattern on 4 times the scale of the recent fruit (fig. 11).

GENTIANACEAE.

Amongst the unknown plants figured by us from Tegelen in 1910 (*op. cit.* fig. 58) was a small globose strongly reticulate seed, in which the smooth polished testa is divided into irregularly triangular or polygonal areas by thin prominent ridges. We now find that seeds of this type occur among the tropical *Gentianaceae* (cf. *Schultesia*, *Chironia*), but we cannot carry the determination further.

LABIATAE.

AJUGA ANTIQUA SP. NOV.

Pl. XVI, figs. 13, 14.

AB AFFINI *A. reptante* NUCULIS PARVIS OVATIS ARCTE RETICULATIS DIFFERT.

Nutlet small ovate, closely reticulate.

Length 1.8 mm., breadth 1.2 mm.

REUVER.

Nutlet resembling that of *A. reptans* (figs. 15, 16) but smaller and more finely reticulate. It does not approach so closely to any other species of the genus. Two specimens have been found.

SIDERITIS SCORDIOIDES LINN.?

Pl. XVI, fig. 18.

Nutlet obovate, pointed below, attachment narrow; surface granulate with minute elongate tubercles.

Length 2.2 mm., breadth 1.4 mm.

REUVER.

Two nutlets, one somewhat damaged, agree so closely with *Sideritis scordioides* (fig. 17), a plant of the Mediterranean Region and Spain, that we have little doubt they belong to this plant; but the genus *Sideritis* is so large that we hesitate to name them with absolute confidence. A thin skin is easily rubbed off the recent *Sideritis* nutlets, leaving a surface like that seen on our fossil.

LYCOPUS EUROPAEUS LINN.

Pl. XVI, figs. 19, 20.

A few nutlets of this species have been found. They are figured side by side with recent specimens (figs. 21, 22), but call for no further remark. The living plant has an exceedingly wide range.

REUVER, SWALMEN.

HANCEA SP.

Pl. XVI, fig. 23.

Nutlet obovate narrowed below, attachment rounded projecting inward; surface finely striate.

Length 1.8 mm., breadth 1.3 mm.

BRUNSSUM.

The only genus of *Labiatae* having nutlets with the very peculiar attachment seen in our fossil is *Hancea*, a small genus living in China. The only species in the Kew Herbarium with ripe fruits is *H. nudipes* Hemsl.; our fossil differs only in the nutlet being obovate instead of rounded-oval (this may be due to crushing), and in being somewhat more striate.

Hancea are shrubs of 4 feet, growing in the mountains of China. WILSON records them at 4000 feet, and HENRY between 6000 feet and 7000 feet.

GENUS? SP. 1.

Pl. XVI, fig. 24.

Nutlet small elongate-obovate, dorsal face flattened, ventral face sharply angled; attachment elongate triangular; dorsal and ventral faces covered with fine but conspicuous longitudinal striae, which give a toothed appearance to the upper end.

Length 1.5 mm., breadth 0.8 mm.

SWALMEN, REUVER.

We are unable to suggest the generic position of this nutlet, which is quite unlike any labiate we have seen.

GENUS? SP. 2 (= Tegelen 1910, fig. 42).

Pl. XVI, figs. 25—27.

Nutlet obovate narrowed at the base inflated, keeled on the ventral face; surface minutely tubercled.

Length 2 mm., breadth 1 mm.

REUVER, BRUNSSUM.

These nutlets are somewhat crushed, but seem to agree with an unknown species from Tegelen (*op. cit.* 1910, fig. 42). We are still unable to suggest their generic position.

GENUS? Sp. 3.

Pl. XVI, fig. 28.

Nutlet minute obovate ventrally keeled; attachment terminal nearly circular.

Length 0.8 mm., breadth 0.5 mm.

SWALMEN.

A minute nutlet, in shape and size somewhat resembling *Mentha*.

GENUS? Sp. 4.

Pl. XVI, fig. 29.

Nutlet roundly obovate, produced at the base (attachment obscure); rounded dorsally; slightly keeled ventrally; surface closely covered with a fine little prominent granulation.

Length 2.0 mm., breadth 1.4 mm.

REUVER.

A single specimen, evidently different from any of the others.

GENERA? SPP. 5, 6, 7.

Pl. XVI, figs. 30—32.

Three other nutlets from Reuver are shown; but the specimens are too badly preserved for description.

SOLANACEAE.

SOLANUM Sp. ?

Pl. XVII, fig. 1.

Seed orbicular compressed laterally; covered with concentrically arranged large pits with thin crenulate margins.

Length 1.8 mm., breadth 1.8 mm.

REUVER.

This seed, of which we have seen one good specimen and a fragment of another, appears to belong to some *Solanum* not in our collection. We figure with it *S. nigrum* (fig. 2), to show the resemblance.

GENUS?

Pl. XIX, fig. 17.

Seed small orbicular compressed; covered with minute quadrate or hexagonal cells with thick crenulate walls.

Length 1.8 mm.

SWALMEN.

Half a seed, which has been torn open in germination. The shape, and the character of the surface sculpture leave no doubt that it belongs to the *Solanaceae*. We have no species in our recent collection so delicately sculptured.

SCROPHULARIACEAE.

GENUS?

Pl. XVII, fig. 3.

Seed minute, ovate-truncate; covered with elongate-quadrangle pits with thin wavy margins.

Length 0.8 mm., breadth 0.6 mm.

SWALMEN.

This seed appears to be nearly related to *Digitalis*.

RUBIACEAE.

GALIUM.

Pl. XVII, fig. 4.

Fruit minute, smooth or slightly granulate.

Breadth 1 mm.

REUVER.

The single specimen appears to have lost much of its outer surface, and is also a good deal crushed.

CAPRIFOLIACEAE.

SAMBUCUS PULCHELLA Sp. NOV.

Pl. XVII, figs. 7—10.

SEMINA PARVA, OBLONGO-OVATA, ACUTA, ARCTE GRACILITER ACUTE TRANSVERSE CORRUGATA.

Seed small oblong-ovate pointed; closely finely and sharply wrinkled transversely.

Length 1.8 to 2.8 mm., breadth 1.3 to 1.6 mm. REUVER, SWALMEN, BRUNSSUM.

The seeds of the different species of *Sambucus* bear a close resemblance to one another in general outline and character of sculpture. Our seed agrees in size with some of the species which have small seeds, such as *S. javanica*, *S. chinensis*, and the American *S. canadensis*, *S. glauca* (figs. 5, 6), and *S. intermedia*; but differs from these and all other living species by the greater number of its transverse rugosities. It varies, however a good deal in size, shape, and fineness of the sculpture, as will be seen by the 4 specimens figured; but these extremes are connected by numerous intermediate forms, and we are quite unable to recognise more than one species among them.

VALERIANACEAE?

Pl. XVII, figs. 11, 12.

Fruit inferior, one-seeded, crowned by remains of an asymmetric perianth, elongate-ovate, 5 ribbed.

Length 3.6 mm., breadth 1.2 mm.

SWALMEN.

We are unable satisfactorily to make out the structure of this fruit, of which we have only one (fig. 11) and a doubtful broken specimen of another (fig. 12). The fruit seems to have been loose and baggy, asymmetric, with 3 ribs on one side, 2 on the other, and perhaps 2 marginal. The lobed calyx is damaged, and it is difficult to make out the number of the lobes.

The characters suggest *Valerianaceae*, but we can find no genus or species having much resemblance.

CUCURBITACEAE.

ECBALLIUM? SP. NOV.

Pl. XVII, fig. 13.

Seed oval short wide, compressed dorsally, rough.

Length 4.5 mm., breadth 3.2 mm.

SWALMEN.

The one seed yet found is not in very good preservation, and we do not care to make it the type of a new species. It almost certainly belongs to the genus *Ecballium*; but the only species now living has the seed longer, narrower, and more pointed.

Ecballium elaterium is a plant of the Mediterranean Region and of the Caucasus.

COMPOSITAE.

EUPATORIUM JAPONICUM THUNB. VAR.

Pl. XVII, figs. 14, 15.

Fruits variable in length, but shorter, thicker, and more finely sculptured than in *E. cannabinum*.

Length 2.5 to 3.5 mm., breadth 0.7 mm.

SWALMEN, REUVER.

These fruits agree precisely with those of a specimen at Kew, collected by PÈRE FAURIE in the mountains of Japan; but they do not altogether agree with other specimens of *E. japonicum* in that Herbarium. PÈRE FAURIE's plant (figs. 16, 17) has the fruits more gradually attenuate, and even more finely sculptured than the ordinary *E. japonicum* (fig. 18); in these respects our fossil corresponds with his plant rather than with the type. PÈRE FAURIE's collection has not yet been thoroughly examined, and his plant may prove to be an undescribed species. The genus is a difficult one; but our fossil fruits are unlike anything now living in Europe. It is difficult to photograph the recent fruits (figs. 16—18) as the sculpture is much masked by glands.

HELICHRYSUM SP.

Pl. XVII, figs. 20, 21.

Fruits minute asymmetric, narrowed suddenly above and more gradually towards the base; covered with close set longitudinal nodose striae.

Length 1.3 mm., breadth 0.6 mm.

SWALMEN.

These fruits show a close resemblance to those of some species of *Helichrysum*, and we have figured *H. foetidum* (fig. 19) for comparison. Our fossil is much more finely striate.

SENECIO SP.

Pl. XVII, fig. 22.

Fruit long narrow ribbed and finely striate; constricted suddenly into a small collar.

Length 2.2 mm., breadth 0.6 mm.

SWALMEN.

A single fruit greatly resembling *Senecio aquaticus* (fig. 23), but with longer and narrower collar and thinner ribs.

CARDUUS 2 SPP.

Pl. XVII, figs. 24, 25.

Much damaged single specimens belonging to two different species of *Carduus* have been found at Reuver; but beyond these we have seen nothing referable to the *Cynareae*. Fig. 24 represents a species allied to *C. nutans*, with which it corresponds in surface sculpture. Fig. 25 is a smoother form, apparently without ribs or transverse sculpture; in these respects and in the large conical base of the style it agrees with *C. lanceolatus*. Both these specimens are too imperfect for specific determination.

CREPIS CF. BLATTAROIDES VILL.

Pl. XVII, fig. 26.

Fruits elongate, closely and regularly ribbed longitudinally, constricted immediately below the crown.

Length 6.0 mm., breadth 1.5 mm.

SWALMEN

We have one good specimen (fig. 26) and three or four damaged of this fruit. It is very near to *Crepis blattaroides* (fig. 27) a species of Central and Southern Europe; but it also resembles certain species of China. It is characterised by the great regularity of its longitudinal striae (with little trace of intermediate finer striae), and by the sudden and deep constriction just below the crown.

CREPIS FUSCIPAPPA BENTH.

Pl. XVII, fig. 28.

Fruit small flattened, lanceolate, broadest at about $\frac{1}{3}$ distance from base; primary ribs sharp prominent, intermediate ribs thread-like; transverse striae fine and inconspicuous; bases of coarse hairs or small bristles preserved here and there.

Length 2.9 mm., breadth 0.7 mm.

SWALMEN.

Our specimen agrees with *C. fuscipappa* (fig. 29) in size, shape, character of the ribbing, transverse striation, cell-structure, and setose surface. It shows no resemblance to any other species.

Crepis fuscipappa is a mountain species of India, and of the forests of China, from which Dr. AUGUSTINE HENRY records it at a height of 5000 feet and 7000 feet, and Mr. E. H. WILSON from the mountains of Yunnan at 5000 feet.

CREPIS Sp. 3.

Pl. XVII, fig. 30.

Fruit short oblong flattened, slightly narrowed below, suddenly narrowed at the crown, but not constricted below the crown; angled on the middle of the outer(?) face; longitudinal ribs strong and regular; transverse striae very faint and only seen in the depressions.

Length 3.5 mm., breadth 1.2 mm.

REUVER.

We are unable to identify this species, which is very different from anything in our collection. The occurrence of a conspicuous angle on one of the faces suggests that the specimen belongs to the outer ring of fruits in a head. Probably inner fruits would not show the angle; but we have at present seen only one specimen.

GENUS?

Pl. XVII, fig. 31.

Fruit minute flat, oblanceolate, suddenly narrowed at the crown; with a strong central rib running up to the crown on one of the flat faces, and numerous faint longitudinal striae.

Length 2.0 mm., breadth 0.7 mm.

REUVER.

We cannot suggest the generic position of this fruit, which is poorly preserved and seems to have germinated.

GENUS?

Pl. XVII, fig. 32.

The broken specimen shown in fig. 32 seems to belong to some large composite; but the apex is not preserved and the base is obscure. It shows a fine granular striation between the large ribs and is not the same as the fruits illustrated on Pl. XVII, fig. 30, to which at first we referred it.

SWALMEN.

INCERTAE SEDIS.

In addition to the various plants which we can place in definite genera or families, there are numerous fruits and seeds which differ from anything we have already figured, but which we are still unable to identify. These we now describe as well as we can, in the hope that some botanist with wider knowledge may be able to recognise them. Certain of them, however, are so difficult of interpretation that we must leave the illustrations to speak for themselves; but we have avoided figuring specimens that appeared to be hopelessly indeterminable. The fruits figured are only those which in our opinion show characteristics sufficient for their determination, if the nearest living species could be found. On the last plate we figure a group of fruiting bracts, fruiting branches, and miscellaneous specimens which may be fruits, but may on the other hand be merely galls. It seems advisable to draw attention to these objects, some of which are very curious.

CARPOLITHES Sp. 1.

Pl. XVII, figs. 34 a, b; 35 a, b.

In 1907 we figured from Tegelen (*op. cit.* figs 122, 123) some curious flat fruits, of which several had been found. We have since received from Dr. TESCH a still better specimen (figs. 34 a, b), and have also found a single damaged fruit in material from Brunssum. We are still quite unable to identify the plant; but its fruit is so characteristic that there should be no doubt as to its determination, if the plant is still living. We have suggested (p. 98) that it may be a new species of a new genus in the monotypic family *Eucommiaceae*, now represented by a tree which grows in Western China, and we now figure it side by side with a recent samara of *Eucommia ulmoides* (fig. 33).

Fruit (a samara?) oblong compressed laterally, winged, attached ventrally close to the lower end; epicarp now represented by an outer coat of loose reticulated fibres; endocarp coriaceous, with a group of strong fibres passing upwards from the attachment at about $\frac{1}{3}$ distance from the ventral edge, dividing, anastomosing, and curving out at right angles on either side to support a thin membranous wing. Wing and apex incomplete in all the specimens examined, but perhaps cleft as in *Eucommia*.

Length 18.0 mm., breadth 7.5 + mm.

TEGELEN, BRUNSSUM.

The lateral attachment makes this fruit appear very different from *Eucommia*; but closer examination shows that though the attachment in *Eucommia* is terminal the venation above is sharply bent towards the dorsal side. The venation of *Eucommia* greatly resembles that of our fruit; but there is no outer fibrous layer, such as is found in the fossil. The resemblance may be merely accidental.

CARPOLITHES Sp. 2.

Pl. XVII, fig. 36.

Fruit broadly pyriform, covered for $\frac{2}{3}$ of its length by an accrescent calyx; truncate

below and shortly stalked; calyx closely and irregularly striate, limb spreading; exposed part of fruit covered with small oblong irregularly radiating cells.

Length 1.4 mm., breadth 1.5 mm.

REUVER.

Externally this fruit somewhat resembles *Maesa*; but on opening one of the two specimens it showed apparently a number of parietal placentas extending nearly to the centre. The structure however is too obscure for us to feel confident, and the fruit must wait further material. Externally there is no sign that the fruit is capsular or dehiscent.

CARPOLITHES Sp. 3.

Pl. XVIII, figs. 1 a—d.

A pyrene or seed, hard bony irregularly faceted, apex pointed, attachment basal; splitting lengthways (in germination?) into 2 unequal valves.

Length 4.2 mm., breadth 2.0 mm.

REUVER.

CARPOLITHES Sp. 4.

Pl. XVIII, figs. 2 a, b.

Coccus coriaceous semioval; aperture ventral, close to base; with wing-like process attached a short distance below apex at the ventral angle.

Length 2.2 mm., breadth 1.0 mm.

BRUNSSUM.

One of several cocci.

CARPOLITHES Sp. 5.

Pl. XVIII, fig. 3.

Pyrene small oblong, flattened dorsally; style on ventral face just below apex.

Length 3.1 mm., breadth 1.3 mm.

REUVER.

Possibly an abnormal pyrene of *Cotoneaster*.

CARPOLITHES Sp. 6.

Pl. XVIII, fig. 4.

Fruit coriaceous, oblong compressed; narrowly margined at upper end and continued into a stiff winged style; outside faintly irregularly striate; interior, of which a small part is seen, shining, strongly and closely striate longitudinally. Base missing.

Length 7.5+ mm., breadth 4.0 mm.

REUVER.

CARPOLITHES Sp. 7.

Pl. XVIII, fig. 5.

The two fragments were found in the same batch of washed material, and apparently belong together; but the edges do not exactly fit, and we cannot be certain that they belong to the same fruit.

Fruit coriaceous, very thin and fragile, flattened, oblong or elongate-ovate; surface near the base covered with close thread-like flattened striae; stalk short; style long and slender.

Length 10.0 mm., breadth 3.5 mm.

REUVER.

CARPOLITHES Sp. 8.

Pl. XVIII, fig. 6.

Endocarp 1-seeded, bony, ovate compressed, splitting at the edge into 2 valves; attachment basal, canal passing obliquely upward and entering cavity at about $\frac{2}{3}$ distance from base. Interior (adherent testa?) closely striate transversely, striae (elongated cells) arranged in fascicles varying in direction.

Length 4.5 mm., breadth 2.5 mm.

REUVER.

CARPOLITHES Sp. 9.

Pl. XVIII, fig. 7.

Seed oval, compressed dorsally, testa hard, grooved asymmetrically on the ventral face; hilum at upper end of groove; micropyle at lower end of groove; embryo apparently coiled laterally.

Length 3.5 mm., breadth 2.5 mm.

SWALMEN.

CARPOLITHES Sp. 10.

Pl. XVIII, fig. 8.

Seed rounded-quadrangle flattened plano-convex; attached in the middle of the straight edge; surface with minute hexagonal pits.

Length 7 mm., breadth 6 mm.

SWALMEN.

We have two of these seeds, which greatly resemble the plano-convex seeds of *Wistaria*; but they do not show the testa. If they are only cotyledons the seed must be biconvex.

CARPOLITHES Sp. 11.

Pl. XVIII, figs. 9 a, b.

Endocarp triangular, with wide flat prominent pedicel; opening in 2 valves which curl backward; exterior with small cells elongate in direction of axis; interior covered with fine nodose longitudinal striae.

Length 2 mm., breadth near base 2 mm.

REUVER.

CARPOLITHES Sp. 12.

Pl. XVIII, figs. 10 a, b.

Seed large irregularly dented and faceted; testa very hard and thick, surface brown closely dotted with flattened black granules; texture bony with outer cells elongate radially; interior rough.

Length 6+ mm., breadth 10+ mm.

BRUNSSUM.

We have only the apex of this large seed, and the fragment shows neither micropyle nor hilum. The external dents look as if it were one of many seeds, closely packed and mutually distorting each other. The black surface-granules are probably the contents of a layer of resin-cells, the walls of which have disappeared.

CARPOLITHES SP. 13.

Pl. XVIII, figs. 11 a, b.

Nut ovate, splitting into 2 valves; valve slightly asymmetric, compressed laterally and wedge-shaped below, exterior with obscure elongate tubercles and ridges; wall very thick, cavity small and oblong; canal nearly straight basal towards the shorter side; micropyle apical and nearly obliterated.

Length 4.8 mm., breadth 3.2 mm.

REUVER.

This fruit has probably been photographed in an inverted position. We now think that it may be half a nut belonging to a second extinct species of *Ceratophyllum*, with which genus the characters above given would correspond; but there remains no trace of the thin testa.

CARPOLITHES SP. 14.

Pl. XVIII, fig. 12.

A poorly preserved fruit with accrescent calyx, different from any already described.

Length 4.0 mm., breadth 3.9 mm.

REUVER.

CARPOLITHES SP. 15.

Pl. XVIII, figs. 13 a, b.

Carpel thick and strong, but opening elastically into 2 valves; valve irregularly ovate, coarsely tubercled outside; ventral wall nearly straight very thick; dorsal wall rounded inflated below, flanged inside especially at the base; canal entering the cavity at the base near the ventral margin; interior finely striate transversely, showing towards the ventral side 3 thin parallel ridges, and at the lower end a deep and wide depression.

Length 3.4 mm., breadth 2.5 mm.

REUVER.

CARPOLITHES SP. 16.

Pl. XVIII, figs. 14 a, b.

A large ovate seed or kernel; ventral face flattened, with nearly central attachment; dorsal face rounded, divided by a central ridge which runs across the apex and round to the attachment.

Length 18 mm., breadth 15 mm.

REUVER.

Beyond an obscure trace of cell-structure we can make out nothing more. The

texture and general appearance suggest that this may be a phosphatized fruit derived from some more ancient deposit. If this be the case it is the only derivative fossil we have seen.

CARPOLITHES Sp. 17.

Pl. XVIII, fig. 15.

Fruit with 6 elongate carpels, attached ventrally.

Breadth 3 mm.

REUVER.

We have opened this specimen; but the anatomy is too obscure for description. It may be an unripe fruit.

CARPOLITHES Sp. 18.

Pl. XVIII, fig. 16.

Fruit obovate acute mucronate, with a wide basal attachment; surface irregularly wrinkled and finely striate longitudinally.

Length 4.3 mm., breadth 2.8 mm.

SWALMEN.

We have seen four specimens of this fruit.

CARPOLITHES Sp. 19.

Pl. XVIII, fig. 17.

Valve flat and slightly concave, broad below, narrowed above, bluntly angled at the base, smooth externally; internally divided lengthways by a slight ridge and finely striated; margin inflexed and flattened.

Length 13 mm., breadth 8 mm.

REUVER.

This appears to be a "germination valve" belonging to some large fruit which we do not recognise.

CARPOLITHES Sp. 20.

Pl. XVIII, fig. 18 a, b.

Berry oval mucronate (distorted by pressure); scar of attachment prominent open triangular; style short and hard; exocarp coriaceous thick, finely striate below, sparsely tubercled above.

Length 5.0 mm., breadth 3.8 mm.

SWALMEN.

The lateral position of the attachment and style, seen in the photographs, is due to flattening by pressure, as is shown by the transverse wrinkles. The berry is really symmetrical. The triangular shape of the scar at the base appears to be original, and not due to pressure.

CARPOLITHES Sp. 21.

Pl. XVIII, figs. 19 a, b.

We are quite uncertain whether these figures represent part of a hard bony fruit or not.

BRUNSSUM.

CARPOLITHES SP. 22.

Pl. XVIII, fig. 20 a, b.

We feel doubtful as to the interpretation of this specimen and must leave the illustrations to speak for themselves.

Length 6.0 mm., breadth 3.4 mm.

BRUNSSUM.

CARPOLITHES SP. 23.

Pl. XIX, fig. 2.

Fruit a superior symmetrical globose berry; peduncle long, striated (in the fossil broken and folded back across the berry), apex a minute point from which the cells radiate; surface cells minute with crenulate margins.

Length 2.0 mm., breadth 2.2 mm.

BRUNSSUM.

This minute berry is probably quite unripe. It may belong to *Vitis* or *Rhamnus*.

CARPOLITHES SP. 24.

Pl. XIX, fig. 3.

Bract minute hard symmetrical ovate, midrib sunk; dorsal surface coarsely tubercled, with thin narrow marginal wing showing about 6 rows of rectangular cells; ventral face faintly striate and granulate.

Length 2.3 mm., breadth 1.5 mm.

REUVER.

CARPOLITHES SP. 25.

Pl. XIX, figs. 4, 5.

Fruit coriaceous, compressed, oval mucronate; midrib thread-like running into the mucro on either face; striae numerous thread-like radiating from the base and disappearing towards the upper margin, not meeting at the apex, occasionally forking from below, not symmetrically arranged; base torn in both specimens; surface slightly granulate, dotted with small masses of resin.

Length 2.6 mm., breadth 1.8 mm.

BRUNSSUM.

CARPOLITHES SP. 26.

Pl. XIX, fig. 6.

Seed compressed oval, with a prominent marginal raphe; testa crustaceous, surface covered with large shallow elongate irregularly-hexagonal pits with thin crenulate walls.

Length 2.0 mm., breadth 1.2 mm.

REUVER.

CARPOLITHES Sp. 27.

Pl. XIX, figs. 7 a, b.

Nut biconvex dividing longitudinally into two valves (in germination?), ovate-mucronate narrowed below; each valve with a symmetrical group of 3 (in one instance 2) thin channelled ribs, very strong below, becoming less prominent above, but meeting at the apex; interior showing a short straight canal at the base, and a finely striate inner coat without sign of adhesion.

Length 2.0 mm., breadth 1.4 mm.

REUVER.

Better specimens were obtained after our illustrations were made, and from these additional details have been inserted in the above description. The fruit is evidently a small nut, with a single erect seed; the apex in the illustration is really the attachment.

We have placed provisionally with this species the single specimen which shows 2 instead of 3 ribs, for it obviously belongs to the same genus, if not to the same species. In addition, however, to the lesser number of ribs it is slightly larger, and obovate instead of ovate; it may represent a second species of this unknown genus.

CARPOLITHES Sp. 28.

Pl. XIX, fig. 8.

Fruit superior compressed(?) opening at the top, ovate stalked showing at the top of the stalk a ring of scars belonging to the perianth.

Length 2.1 mm., breadth 1.7 mm.

REUVER.

This may possibly be the utricle out of which the nuts shown in fig. 7 have come. The illustration has been reversed to show the resemblance.

CARPOLITHES Sp. 29.

Pl. XIX, fig. 9.

Seed minute flat broadly ovate, truncate at base, pointed at apex.

Length 1.6 mm., breadth 1.6 mm.

REUVER.

CARPOLITHES Sp. 30.

Pl. XIX, figs. 10 a, b.

This very irregular seed may perhaps be an abortive very small seed of *Vitis*.

REUVER.

CARPOLITHES Sp. 31.

Pl. XIX, figs. 11–14.

Fruit (or seed?) planoconvex, with 2 very unequal valves hinged at the base; ventral valve flat or slightly concave; dorsal valve much larger, inflated and somewhat recurved below, compressed above; scar of attachment at the junction of the two valves,

ventral through the recurving of the dorsal valve; exterior smooth or faintly striate at the attachment; interior of dorsal valve showing numerous strong sharp wrinkles.

Length 1.8 mm., breadth 1.3 mm.

REUVER, BRUNSSUM.

The peculiar flatness of the ventral face suggests that these specimens belong to a fruit dividing into 2 cocci, which divide and are shed like seeds. The wrinkling of the inner skin, independently of the outer coat, suggests that this skin is a testa belonging to a single seed, which completely fills the cavity. Two germination valves may be developed either in an endocarp or in a testa; but we have not yet seen anything resembling these among recent plants. The four specimens figured are all that have yet been found, they have been inverted in order to show clearly the attachment and the hinged valves. The micropyle must have been near the pointed end, where the fruit opens.

CARPOLITHES Sp. 32.

Pl. XIX, figs. 15 a, b.

Endocarp small hard rugose, with large basal aperture; tending to split ventrally.

Length 3.0 mm., breadth 1.5 mm.

REUVER.

CARPOLITHES Sp. 33.

Pl. XIX, fig. 16.

Fruit small stalked, with 5 carpels which dehisce along the ventral face and at the apex.

Length 2.8 mm., breadth 1.6 mm.

REUVER.

This fruit appears to be unripe; but it is quite unlike any species already described.

CARPOLITHES Sp. 34.

Pl. XIX, fig. 18.

Berry (unripe?) superior, locules 4, style 1; having at the base a closely adpressed perianth of 4 narrowly ovate coriaceous leaves, more than half the length of the berry.

Length 1.5 mm.

REUVER.

The specimen is much flattened by pressure.

CARPOLITHES Sp. 35.

Pl. XIX, fig. 22.

Bract ovate-acuminate, hard and thick, margin recurved, midrib strong and equally prominent on dorsal and ventral face.

Length 3.5 mm., breadth 1.7 mm.

BRUNSSUM.

A woody bract apparently belonging to a fruit. The venation is so obscure and faint that it is uncertain which end is the base.

CARPOLITHES Sp. 36.

Pl. XIX, fig. 23.

Seed minute, compressed(?), oblong or semi-ovate (one edge missing); closely covered with large regular hexagonal pits with thick walls.

Length 1.6 mm., breadth 0.7 mm.

REUVER.

The missing part must have contained the hilum and micropyle, and the damaged side appears to have been more curved than the one preserved. The linear arrangement of the cells at the upper end (in the figure) must point either to the hilum or to the micropyle, we cannot say which as that part is broken. The surface-sculpture is very striking.

CARPOLITHES Sp. 37.

Pl. XIX, figs. 24 a, b, 25 a, b.

Fruit(?) hard bony with numerous irregular folds which form imperfect locules; inside of locules striate transversely.

Length (of larger fragment) 13 mm.

SWALMEN.

These suggest hard woody placentas to which seeds were attached at the bottom of each fold, but the seeds must have been extremely irregular. We have the two fragments figured and a third 20 mm. in length; none of them shows any other part of the fruit. The anatomy is obscure.

CARPOLITHES Sp. 38.

Pl. XIX, figs. 26 a, b.

This minute specimen is obscure; we now think that it may be a very young seed of *Vitis*.

BRUNSSUM.

CARPOLITHES Sp. 39.

Pl. XIX, fig. 27.

Seed ovate compressed, with three strong thin ribs on either side; base missing; apex showing a large micropyle surrounded by minute radiating striae.

Length 3.5 mm., breadth 1.7 mm.

REUVER.

The aperture at the narrow end appears to be a micropyle; but if the seed has been torn in germination the micropyle must be at the opposite end, and the aperture preserved intact must be the hilum.

CARPOLITHES Sp. 40.

Pl. XIX, figs. 28 a, b.

Carpel, probably forming part of capsule. The anatomy of this specimen is too obscure for description. The deep groove shown in fig. 28 a is original, not due to pressure.

Length 3.0 mm., breadth 2.1 mm.

BRUNSSUM.

CARPOLITHES? Sp. 41.

Pl. XX, fig. 1.

Sac oval formed of one layer of reticulated fibres, forming a net with irregularly shaped meshes; fibres tough brown and translucent; no attachment or aperture visible.

Length 5 mm. (of another broken specimen 8 mm.) REUVER.

Another species of these curious nets was found by us in the Cromerian; but it is slightly smaller and has much finer and more delicate reticulation than the Reuver species. We did not figure it, thinking that it was probably of animal origin, though we were unable to discover to what animal it could belong. We now figure one of the Reuverian specimens, though we are still quite uncertain as to its position.

CARPOLITHES Sp. 42.

Pl. XX, figs. 2, 3.

Globose-urceolate with narrow erect constricted band round the wide aperture; walls thick, finely irregularly cellular.

Length 1.6 mm., breadth 2.9 mm. BRUNSSUM.

No attachment can be traced on these specimens, and we are uncertain which way up they should be placed. We cannot suggest to what order they belong. They may be galls.

CARPOLITHES Sp. 43.

Pl. XX, figs. 4 a, b.

Rachis flattened broad woody finely striate, showing impression of a broadly ovate sessile fruit.

Length (of fragment) 10 mm., breadth 6 mm. BRUNSSUM.

We can only suggest that this is part of the rachis of a palm, perhaps of the same palm as that of which the fruit is figured on Pl. XIX, figs. 19–21. But the fruits have only been found at Reuver and Swalmen, and this fragment of rachis comes from Brunssum. For a description of these fruits see p. 71.

CARPOLITHES Sp. 44.

Pl. XX, figs. 5, 6.

Bracts woody broadly triangular, with a strong midrib prolonged into a narrow ventrally channelled beak; ventral surface concave smooth; dorsal surface with converging veins and fine striae.

Length 4.0 mm., breadth 3.5 mm. SWALMEN.

This may be the fruiting bract of the palm described on p. 71, for the venation suggests a monocotyledonous plant.

CARPOLITHES Sp. 45.

Pl. XX, figs. 7 a, b.

Thick woody bract. The attachment appears to have been at the rough edge shown in the upper part of fig. 7 a; if so the figures have been inverted.

Length 3.2 mm., breadth 4.5 mm.

SWALMEN.

CARPOLITHES? Sp. 46.

Pl. XX, figs. 8 a, b.

Perhaps only part of a rolled up leaf. It was thought at first to belong to a fruit.

SWALMEN.

CARPOLITHES Sp. 47.

Pl. XX, figs. 9 a, b.

Apex of a dehiscent fruit(?), or hard top of a soft fruit(?). Outer surface showing a long sharp ridge culminating in a compressed point; inner surface with 2 long parallel septa, which may divide the interior into 3 locules. The specimen is so compressed that fig. 9 b. shows only the two septa and two of the locules.

Length 1.5 mm., breadth 4.0 mm.

REUVER.

CARPOLITHES Sp. 48.

Pl. XX, fig. 10 a, b.

An irregular depressed cone, with very thick wall and a small basal cavity or infold, which has been closed by pressure; exterior closely striate with lines of minute granules, radiating from a small depression at the apex and converging again into the cavity.

Length 2.5 mm., breadth 3.2 mm.

SWALMEN.

CARPOLITHES Sp. 49.

Pl. XX, figs. 11–13.

Bracts very thick and hard, irregularly ovate, very variable in shape; usually showing a midrib and strong pinnate venation.

Length 4.0 to 7.0 mm., breadth 1.4 to 2.0 mm.

REUVER.

The largest specimen shows more than one of these bracts in place.

CARPOLITHES Sp. 50.

Pl. XX, fig. 14.

Bracts ovate lanceolate, very thick and hard; with a strong midrib and fine pinnate venation.

Length 3.2 mm., breadth 1.7 mm.

BRUNSSUM.

Allied to No. 49, but both the Brunssum specimens show this pointed shape, finer venation, and smaller size.

Pl. XX, fig. 15.

Fig. 15 represents a minute spirally coiled organ, not a fruit or seed.
Length 2.6 mm.

REUVER.

GALLS.

Pl. XX, figs 16, 17.

These are probably leaf-galls.
Breadth 2.5 mm.

REUVER.

Pl. XX, fig. 18.

We are unable to make any suggestion as to the organ shown in this figure; it does not appear to belong to a fruit.

Length 1.3 mm.

SWALMEN.

Pl. XX, figs 19, 20.

These may be detached portions of some larger organ; we cannot identify either of them. Both were found at REUVER.

Pl. XX, figs 21—24.

These are probably galls. Figs. 21 and 22 are from Swalmen, and have been figured with only half the magnification of 23 and 24, which were found at Brunssum. The largest specimen is about 2.5 mm. in length.

Pl. XX, figs. 25 a, b.

This looks like a gall of very peculiar structure. The cap *a* became detached from the scar in the upper part of *b*.

SWALMEN.

Pl. XX, fig. 26.

Internode flattened laterally and constricted above and below. Midrib channelled, primary veins impersistent scabrid about 15 on each side, surface between faintly striate.

Length 2.5 mm., breadth 1.5 mm.

SWALMEN.

Professor J. W. H. TRAIL, of Aberdeen, kindly offered to examine some of the doubtful galls found among the seeds, and duplicates were sent to him. He writes "I have made as careful an examination as I could with lens and low power of microscope, as opaque objects, and my conclusions are stated below. I need hardly say that they are suggestions only; for it is very unsafe from the exterior only to dogmatise about the maker of a gall.

1. Very similar to the galls on *Quercus* spp. made by *Neuroterus laeviusculus* and *N. fumipennis*, so similar that they might be galls of one of the genus. They are very like MESCHINELLI's fungi, e.g. his *Sphaerites Caryae*; but to me they do not suggest the structure of a collapsed perithecium. The small raised point in the centre above (see Pl. XX, fig. 16, 17) is much like what one finds in galls of *Neuroterus*.

2, 3. Miniatures of galls of some *Cynipidae* in form and slender attachment (e.g. galls of *Rhodites Eglanteriae* on various roses, and *Dryophanta divisa* on *Quercus*; in thickness of wall they more resemble the latter).

4, 5. These resemble galls formed by some mites (*Eriophyidae*) in numbers on the upper surface of leaves (e.g. on *Prunus Padus* and other trees); but somewhat similar galls are formed by gall-midges also (e.g. on *Nepeta Glechoma* among herbs, and by *Oligotrophus annulipes* on beech-leaves). It is difficult to be certain of the maker, therefore, from the empty galls.

6. Little cups (Pl. XX, figs. 2, 3) which I find it difficult to compare with any gall known to me, though probably enough they are galls."

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ERRATA

(OWING TO AN OVERSIGHT, SOME PAGES OF THIS MEMOIR WERE
PRINTED WITHOUT THE AUTHORS' FINAL CORRECTIONS)

- p. 23, l. 6 from bottom, for "the" read "to"
 - p. 25, l. 13, for "species" read "forms"
 - p. 29, l. 4, for "flagellatus" read "flagellata"
 - p. 60, l. 4 from bottom, for "fig. 8" read "figs. 8, 9"
 - p. 85, l. 14 from bottom, for "nuts" read "carpels"
 - p. 86, l. 7 from bottom, for "4 to 3" and "3 to 4" read "4.3" and "3.4"
 - p. 92, l. 6, for "*pendunculatus*" read "*pedunculatus*"
 - p. 100, l. 6 from bottom, for "Szechnan" read "Szechuan"
 - p. 113, l. 7, from bottom, for "52" read "51"
 - p. 122, Explanation to fig. 4, for "semara" read "samara"
 - p. 138, l. 3 from bottom, for "in" read "is"
 - p. 153, l. 8 from bottom, for "Amsterlien" read "Amstelien"
 - p. 155, l. 12, for "POLIG" read "POHLIG"
-

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- » 8. *Epipremnum crassum*, p. 71. Seed, dissected to show micropyle, hilum, and tegmen. $\frac{6}{1}$. Swalmen.
- » 9. *Epipremnum crassum*, p. 71. Seed, ventral face. $\frac{6}{1}$. Reuver.
- » 10. *Epipremnum pinnatum*, p. 71. Seed, ventral face. $\frac{6}{1}$. Recent.
- » 11. *Epipremnum pinnatum*, p. 71. Seed, side view. $\frac{6}{1}$. Recent.
- » 12. *Epipremnum pinnatum*, p. 71. Seed, longitudinal section. $\frac{6}{1}$. Recent.
- » 13, 14. *Epipremnum*, sp., p. 72. Seeds. $\frac{12}{1}$. Reuver.
- » 15—17. *Pterocarya limburgensis*, p. 73. Endocarps, side view. $\frac{4}{1}$. Reuver.
- » 18. *Pterocarya limburgensis*, p. 73. Endocarp, interior. $\frac{4}{1}$. Reuver.
- » 19—21. *Pterocarya limburgensis*, p. 73. Endocarps, seen from above, and showing variation of the ribs. $\frac{4}{1}$. Reuver.
- » 22, 23. *Pterocarya hupehensis*, p. 73. Endocarps, side view. $\frac{4}{1}$. Recent, China.
- » 24, 25. *Pterocarya hupehensis*, p. 73. Endocarps, seen from above. $\frac{4}{1}$. Recent, China.
- » 26, 27. *Pterocarya caucasica*, p. 73. Endocarps. $\frac{4}{1}$. Recent.
- » 28a, b. *Carya angulata*, p. 74. Broken endocarp. $\frac{2}{1}$. Reuver.
- » 29. *Carya angulata*, p. 74. Broken endocarp. $\frac{2}{1}$. Reuver.
- » 30, 31. *Carpinus Betulus*, p. 74. Nuts. $\frac{4}{1}$. Swalmen.
- » 32, 33. *Carpinus Betulus*, p. 74. Nuts. $\frac{4}{1}$. Reuver.
- » 34. *Corylus Avellana* var., p. 75. Nut. $\frac{2}{1}$. Swalmen.
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- » 36a, b. *Betula ulmifolia*, p. 75. Bract. $\frac{6}{1}$. Recent.
- » 37a, b. *Betula digitata*, p. 75. Bract. $\frac{6}{1}$. Swalmen.
- » 38. *Betula digitata*?, p. 75. Seed. $\frac{6}{1}$. Swalmen.
- » 39. *Betula ulmifolia*, p. 75. Seed. $\frac{6}{1}$. Recent.
- » 40. *Betula* sp., p. 76. Female catkin. $\frac{6}{1}$. Reuver.
- » 41. *Betula* sp., p. 76. Seed. $\frac{12}{1}$. Swalmen.
- » 42. *Betula* sp., p. 76. Male catkin. $\frac{4}{1}$. Reuver.
- » 43. *Betula* sp., p. 76. Male catkin. $\frac{4}{1}$. Reuver.

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- » 2. *Alnus* sp. 2, p. 77. Cone. $\frac{4}{1}$. Swalmen.
- » 3. *Alnus* sp. 2, p. 77. Cone. $\frac{4}{1}$. Reuver.
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- » 6. *Alnus* sp. 3, p. 77. Cone. $\frac{6}{1}$. Reuver.
- » 7, 8. *Alnus* sp. 3, p. 77. Bract and 2 seeds dissected out of fig. 6. $\frac{6}{1}$. Reuver.
- » 9, 10. *Alnus* sp. 4, p. 77. Bract and seed dissected out of fig. 11. $\frac{6}{1}$. Reuver.
- » 11. *Alnus* sp. 4, p. 77. Cone. $\frac{4}{1}$. Reuver.
- » 12. *Alnus* sp., p. 78. Cone. $\frac{4}{1}$. Reuver.
- » 13, 14. *Alnus* sp., p. 77. Isolated seeds. $\frac{6}{1}$. Reuver.
- » 15, 16. *Alnus* sp., p. 77. Isolated scales. $\frac{6}{1}$. Reuver.
- » 17, 18. *Alnus* sp., p. 78. Fragments of male catkin. $\frac{4}{1}$. Reuver.
- » 19, 20. *Fagus decurrens*, p. 78. Cupules. $\frac{2}{1}$. Swalmen.
- » 21. *Fagus silvatica*, p. 78. Cupule. $\frac{2}{1}$. Recent.
- » 22, 23. *Fagus decurrens*, p. 78. Cupules. $\frac{2}{1}$. Reuver.
- » 24. *Fagus decurrens*, p. 78. Nut. $\frac{2}{1}$. Reuver.
- » 25, 26. *Fagus decurrens*, p. 78. Nuts. $\frac{2}{1}$. Brunssum.
- » 27, 28. *Fagus decurrens*, p. 78. Cupules, broad and narrow vars. $\frac{2}{1}$. Brunssum.
- » 29 a, b. *Fagus* sp., p. 79. Young cupule? $\frac{12}{1}$. Brunssum.
- » 30. *Quercus Robur*, p. 79. Cupule. $\frac{2}{1}$. Reuver.

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- Fig. 1. *Morus*?, p. 79. Seed. $\frac{12}{1}$. Reuver.
- » 2. *Urtica urens*?, p. 80. Nut. $\frac{12}{1}$. Swalmen.
 - » 3. *Urtica dioica*?, p. 80. Nut. $\frac{12}{1}$. Reuver.
 - » 4. *Urtica* sp. 3, p. 80. Nut. $\frac{12}{1}$. Swalmen.
 - » 5. *Urticaceae* sp. 4, p. 81. Nut. $\frac{12}{1}$. Swalmen.
 - » 6. *Urticaceae* sp. 5, p. 81. Nut. $\frac{12}{1}$. Reuver.
 - » 7. *Urticaceae*?, p. 81. Nut. $\frac{12}{1}$. Swalmen.
 - » 8. *Urticaceae*?, p. 81. Nut. $\frac{12}{1}$. Reuver.
 - » 9 a, b. *Hakea angulata*, p. 82. Follicle, inside and outside. $\frac{6}{1}$. Brunssum.
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 - » 12 a, b. *Asarum caudatum*, p. 83. Seed. $\frac{12}{1}$. Recent.
 - » 13. *Polygonum* sp. 1, p. 83. Nut. $\frac{12}{1}$. Reuver.
 - » 14. *Polygonum* sp. 2, p. 83. Nut. $\frac{12}{1}$. Reuver.
 - » 15. *Polygonum* sp. 3, p. 84. Nut. $\frac{12}{1}$. Reuver.
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 - » 17 a, b. *Aphanisma*?, p. 84. Fruit. $\frac{12}{1}$. Swalmen.
 - » 18. *Nyctaginaceae*?, p. 84. Fruit. $\frac{4}{1}$. Reuver.
 - » 19. *Caryophyllaceae*, genus unknown, p. 85. Part of large seed. $\frac{12}{1}$. Reuver.
 - » 20 a, b. *Nelumbium minimum*, p. 85. Torus. $\frac{6}{1}$. Swalmen.
 - » 21. *Brasenia peltata*, p. 85. Seed. $\frac{6}{1}$. Brunssum.
 - » 22. *Brasenia peltata*, p. 85. Seed. $\frac{6}{1}$. Recent.
 - » 23. *Brasenia peltata*, p. 85. Testa. $\frac{24}{1}$. Recent.
 - » 24. *Brasenia peltata*, p. 85. Testa. $\frac{24}{1}$. Brunssum.
 - » 25, 26. *Brasenia tuberculata*, p. 86. Seeds. $\frac{6}{1}$. Brunssum.
 - » 27. *Brasenia tuberculata*, p. 86. Testa. $\frac{24}{1}$. Brunssum.

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- Fig. 1, 2. *Nuphar canaliculatum*, p. 86. Seed. $\frac{6}{1}$. Reuver.
- » 3. *Nuphar canaliculatum*, p. 86. Testa. $\frac{24}{1}$. Reuver.
- » 4. *Nuphar* sp., p. 87. Seed. $\frac{6}{1}$. Reuver.
- » 5. *Nuphar* sp., p. 87. Testa of fig. 4. $\frac{24}{1}$. Reuver.
- » 6. *Nuphar luteum*, p. 87. Testa. $\frac{24}{1}$. Recent.
- » 7. *Euryale ferox*, p. 87. Seed. $\frac{4}{1}$. Recent.
- » 8–10. *Euryale nodulosa*, p. 87. Seeds. $\frac{4}{1}$. Reuver.
- » 11, 12. *Euryale lissa*, p. 88. Seeds. $\frac{4}{1}$. Brunssum.
- » 13. *Euryale lissa*, p. 88. Testa of fig. 11. $\frac{24}{1}$. Brunssum.
- » 14. *Euryale limburgensis*, p. 87. Seed. $\frac{4}{1}$. Tegelen.
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- » 17. *Anemone nemorosa*, p. 90. Achene. $\frac{12}{1}$. Recent.
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- » 19. *Anemone* sp. 2, p. 90. Achene. $\frac{12}{1}$. Brunssum.
- » 20. *Anemone* sp. 3, p. 90. Achene. $\frac{12}{1}$. Brunssum.
- » 21. *Anemone* sp. 4, p. 90. Achene. $\frac{12}{1}$. Reuver.
- » 22. *Anemone* sp. 5, p. 90. Achene. $\frac{12}{1}$. Reuver.
- » 23. *Clematis grata*, p. 91. Achene. $\frac{6}{1}$. Swalmen.
- » 24. *Clematis grata*, p. 91. Achene. $\frac{6}{1}$. Recent, China.
- » 25. *Ranunculus nemorosus*, p. 91. Achene. $\frac{12}{1}$. Swalmen.
- » 26. *Ranunculus nemorosus*, p. 91. Achene. $\frac{12}{1}$. Reuver.
- » 27. *Ranunculus nemorosus*, p. 91. Achene. $\frac{12}{1}$. Recent, Alps.
- » 28. *Ranunculus brutius*, p. 91. Achene. $\frac{12}{1}$. Brunssum.
- » 29. *Ranunculus brutius*, p. 91. Achene. $\frac{12}{1}$. Recent.
- » 30. *Ranunculus lateriflorus*, p. 91. Achene. $\frac{12}{1}$. Recent.
- » 31. *Ranunculus lateriflorus*, p. 91. Achene. $\frac{12}{1}$. Swalmen.
- » 32, 33. *Ranunculus lateriflorus*, p. 91. Achenes. $\frac{12}{1}$. Reuver.
- » 34. *Ranunculus* sp., p. 92. Achene. $\frac{12}{1}$. Reuver.
- » 35. *Thalictrum Bauhini*, p. 92. Achene. $\frac{12}{1}$. Brunssum.
- » 36. *Thalictrum Bauhini*, p. 92. Achene. $\frac{12}{1}$. Recent.
- » 37. *Thalictrum simplex* var. *galioides*, p. 92. Achene. $\frac{12}{1}$. Brunssum.
- » 38. *Thalictrum simplex* var. *galioides*, p. 92. Achene. $\frac{1}{2}$. Recent, Tyrol.

PLATE VIII.

- Fig. 1. *Liriodendron tulipifera*, p. 93. 2 seeds. $\frac{6}{1}$. Reuver.
- » 2. *Liriodendron tulipifera*, p. 93. Part of small carpel. $\frac{6}{1}$. Swalmen.
- » 3. *Liriodendron tulipifera*, p. 93. Seed. $\frac{6}{1}$. Reuver.
- » 4. *Liriodendron tulipifera*, p. 93. Seed. $\frac{6}{1}$. Recent, America.
- » 5. *Liriodendron tulipifera*, p. 93. Carpel. $\frac{3}{1}$. Recent, America.
- » 6. *Liriodendron aptera*, p. 94. Head of carpels. $\frac{4}{1}$. Reuver.
- » 7. *Liriodendron aptera*, p. 94. Reverse of fig. 6, showing longitudinal section. $\frac{4}{1}$. Reuver.
- » 8. *Liriodendron aptera*, p. 94. Seed. $\frac{12}{1}$. Reuver.
- » 9. *Magnolia Kobus*, p. 93. Seed. $\frac{4}{1}$. Recent, Japan.
- » 10, 11. *Magnolia Kobus*, p. 93. Seeds. $\frac{4}{1}$. Reuver.
- » 12, 13. *Illicium* ?, p. 94. Carpel, inside and outside. $\frac{4}{1}$. Reuver.
- » 14–17. *Jongmansia cypreaeformis*, p. 95. Seeds. $\frac{6}{1}$. Reuver.
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- » 22a, b. *Cinnamomum* sp. 1, p. 95. Cupule. $\frac{4}{1}$. Swalmen.
- » 23a, b. *Cinnamomum* sp. 2, p. 96. Cupule. $\frac{4}{1}$. Reuver.
- » 24a, b. *Cinnamomum* sp. 3, p. 96. Cupule. $\frac{4}{1}$. Reuver.
- » 25a, b. *Bucklandia striata*, p. 96. Capsule. $\frac{4}{1}$. Reuver.
- » 26. *Bucklandia populnea*, p. 96. Capsule, outside. $\frac{4}{1}$. Recent, Bootan.
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- » 28–30. *Corylopsis limburgensis*, p. 97. Seeds. $\frac{6}{1}$. Brunssum.
- » 31. *Corylopsis sinensis*, p. 97. Seed. $\frac{6}{1}$. Recent.
- » 32. *Liquidambar orientale*, p. 97. Head. $\frac{2}{1}$. Reuver.
- » 33, 34. *Hamamelidaceae*, p. 97. 2 Seeds. $\frac{12}{1}$. Brunssum.

PLATE IX.

- Fig. 1, 2. *Cotoneaster acuticarpa*, p. 98. Endocarps, inside and outside. $\frac{6}{1}$. Reuver.
- » 3, 4. *Cotoneaster pyracantha*, p. 98. Endocarps, inside and outside. $\frac{6}{1}$. Recent.
- » 5. *Pirus Malus* var, p. 98. Seed. $\frac{4}{1}$. Brunssum.
- » 6. *Pirus Malus*, p. 98. Seed. $\frac{4}{1}$. Recent.
- » 7. *Pirus* cf. *Malus*, p. 99. Seed. $\frac{4}{1}$. Reuver.
- » 8. *Mespilus* (= *Crataegus*) *monogyna*, p. 99. Endocarp. $\frac{6}{1}$. Reuver.
- » 9. *Mespilus monogyna*, p. 99. Endocarp. $\frac{6}{1}$. Recent.
- » 10 a, b. *Mespilus monogyna*, p. 99. Endocarp. $\frac{6}{1}$. Swalmen.
- » 11. *Mespilus* (= *Crataegus*) sp. 2, p. 99. Endocarp. $\frac{6}{1}$. Brunssum.
- » 12. *Rubus fruticosus*, p. 100. Endocarp. $\frac{12}{1}$. Recent.
- » 13. *Rubus* sp. 1, p. 99. Endocarp. $\frac{12}{1}$. Brunssum.
- » 14. *Rubus* sp. 2, p. 100. Endocarp. $\frac{12}{1}$. Brunssum.
- » 15, 16. *Rubus* sp. 2, p. 100. Endocarps. $\frac{12}{1}$. Reuver.
- » 17, 18. *Rubus* cf. *pungens*, p. 100. Endocarps. $\frac{12}{1}$. Reuver.
- » 19. *Rubus pungens*, p. 100. Endocarp. $\frac{12}{1}$. Recent.
- » 20. *Rubus* sp. 4, p. 100. Endocarp. $\frac{12}{1}$. Reuver.
- » 21. *Prunus spinosa*, p. 101. Endocarp. $\frac{4}{1}$. Swalmen.
- » 22, 23. *Prunus* cf. *spinosa*, p. 101. Endocarps, outside and inside. $\frac{4}{1}$. Reuver.
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- » 25. *Prunus* sp. 4, p. 101. Endocarp. $\frac{4}{1}$. Reuver.
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- » 28. *Prunus spinulosa*, p. 102. Endocarp. $\frac{4}{1}$. Recent, Japan.
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PLATE X.

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- » 2. *Nitraria*?, p. 104. Fruit. $\frac{12}{1}$. Brunssum.
 - » 3—5. *Orixa reticulata*, p. 104. Fruits. $\frac{6}{1}$. Brunssum.
 - » 6. *Orixa japonica*, p. 105. Fruit. $\frac{6}{1}$. Recent, Japan.
 - » 7. *Ruta* sp., p. 105. Capsule. $\frac{6}{1}$. Brunssum.
 - » 8. *Ruta corsica*, p. 105. Capsule. $\frac{6}{1}$. Recent, Corsica.
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 - » 10. *Phellodendron elegans*, p. 105. Seed. $\frac{4}{1}$. Reuver.
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 - » 13, 14. *Phellodendron japonicum*, p. 105. Seeds, inside and outside. $\frac{4}{1}$. Recent.
 - » 15. *Phellodendron tessellatum*, p. 106. Seed. $\frac{4}{1}$. Reuver.
 - » 16 a, b. *Turraea* sp., p. 106. Seed. $\frac{6}{1}$. Brunssum.
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 - » 20. *Pistacia acuminata*, p. 108. Endocarp. $\frac{6}{1}$. Reuver.
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 - » 22 a, b. *Teschia crassicarpa*, p. 108. Fruit. $\frac{6}{1}$. Swalmen.
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PLATE XI.

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- » 3. *Staphylea pinnata*, p. 109. Seed. $\frac{4}{1}$. Recent.
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- » 5. *Acer striatum*, p. 110. Fruit. $\frac{4}{1}$. Swalmen.
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PLATE XII.

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- » 16. *Althaea crassicaarpa*, p. 116. Carpel. $\frac{6}{1}$. Tegelen.
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PLATE XIII.

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- » 7. *Stewartia Pseudo-camellia*, p. 118. Fruit. $\frac{2}{1}$. Recent, Japan.
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- » 11 a, b. *Stewartia Pseudo-camellia*, p. 118. Fruit, apex and base. $\frac{2}{1}$. Reuver.
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- » 13. *Stewartia Pseudo-camellia*, p. 118. Carpel. $\frac{2}{1}$. Recent, Japan.
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- » 15. *Stewartia Pseudo-camellia*, p. 118. Seed. $\frac{2}{1}$. Swalmen.
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- » 18. *Hypericum* cf. *Ascyron*, p. 118. Seed. $\frac{12}{1}$. Reuver.
- » 19. *Hypericum* *Ascyron*, p. 119. Seed. $\frac{12}{1}$. Recent, Japan.
- » 20. *Hypericum* sp. 2, p. 119. Seed. $\frac{12}{1}$. Brunssum.
- » 21. *Hypericum* sp. 2, p. 119. Seed. $\frac{12}{1}$. Swalmen.
- » 22. *Hypericum* sp. 3, p. 119. Seed. $\frac{12}{1}$. Swalmen.
- » 23. *Hypericum* sp. 4, p. 119. Seed. $\frac{12}{1}$. Reuver.
- » 24. *Hypericum* sp. 5, p. 120. Seed. $\frac{12}{1}$. Reuver.
- » 25. *Viola lutea*, p. 120. Seed. $\frac{12}{1}$. Recent.
- » 26. *Viola* sp. 2, p. 120. Seed. $\frac{12}{1}$. Brunssum.
- » 27. *Viola* sp. 3 (cf. *rupestris*), p. 120. Seed. $\frac{12}{1}$. Reuver.
- » 28, 29. *Violaceae*, genus?, p. 120. Seeds. $\frac{12}{1}$. Reuver.
- » 30. *Violaceae*, genus?, p. 120. Seed. $\frac{12}{1}$. Swalmen.
- » 31, 32. *Nyssa silvatica*, p. 121. Endocarps. $\frac{4}{1}$. Swalmen.
- » 33. *Nyssa silvatica*, p. 121. Endocarp (small). $\frac{4}{1}$. Reuver.
- » 34, 35. *Nyssa silvatica* var. *biflora*, p. 121. Endocarps. $\frac{4}{1}$. Recent, America.

PLATE XIV.

- Fig. 1 a, b, 3, 4. *Camptotheca crassa*, p. 121. Samaras. $\frac{2}{1}$. Swalmen.
- » 2 a, b. *Camptotheca acuminata*, p. 121. Samara. $\frac{2}{1}$. Recent, Tibet.
- » 5. *Pyrularia edulis*, p. 82. Endocarp. $\frac{1}{1}$. Reuver.
- » 6–10. *Trapa natans*, p. 122. Fruits. $\frac{2}{1}$. Brunssum.
- » 11, 12. *Trapa natans*, p. 122. Fruits, two-horned var. $\frac{2}{1}$. Tegelen.
- » 13. *Circaea crassa*, p. 122. Fruit. $\frac{6}{1}$. Swalmen.
- » 14. *Proserpinaca reticulata*, p. 123. Fruit. $\frac{12}{1}$. Reuver.
- » 15. *Proserpinaca reticulata*, p. 123. Fruit. $\frac{12}{1}$. Brunssum.
- » 16. *Proserpinaca reticulata*, p. 123. Fruit, transverse section. $\frac{12}{1}$. Brunssum.
- » 17. *Proserpinaca reticulata*, p. 123. Fruit. $\frac{12}{1}$. Swalmen.
- » 18, 19. *Proserpinaca reticulata*, p. 123. Fruits. $\frac{12}{1}$. Bidart.
- » 20. *Proserpinaca pectinata*, p. 123. Fruit. $\frac{12}{1}$. Recent, America.
- » 21. *Myriophyllum verticillatum*, p. 123. Fruit. $\frac{12}{1}$. Reuver.
- » 22, 23. *Hippuris vulgaris*, p. 124. Fruits, interior and exterior. $\frac{12}{1}$. Recent.
- » 24 a, b. *Hippuris globosa*, p. 123. Fruit, interior and exterior. $\frac{12}{1}$. Reuver.
- » 25 a, b. *Hippuris* sp. 2?, p. 124. Fruit, interior and exterior. $\frac{12}{1}$. Reuver.
- » 26. *Aralia racemosa*?, p. 124. Fruit. $\frac{6}{1}$. Swalmen.
- » 27. *Aralia racemosa*, p. 124. Fruit. $\frac{6}{1}$. Recent, China.
- » 28 a, b. *Araliaceae*, genus?, p. 124. Fruit. $\frac{6}{1}$. Swalmen.
- » 29 a, b. *Araliaceae*, genus?, p. 124. Fruit. $\frac{6}{1}$. Swalmen.
- » 30. *Araliaceae*, genus?, p. 124. Fruit. $\frac{6}{1}$. Brunssum.
- » 31. Order?, p. 124. Fruit. $\frac{12}{1}$. Reuver.

PLATE XV.

- Fig. 1. *Hydrocotyleae?* genus?, p. 125. Fruit. $\frac{12}{1}$. Reuver.
- » 2, 3. *Cicuta virosa*, p. 125. Fruits. $\frac{12}{1}$. Swalmen.
 - » 4. *Petroselinum* sp., p. 125. Fruit. $\frac{12}{1}$. Reuver.
 - » 5, 7, 8, 9. *Seselinae* sp. 1, p. 125. Fruits. $\frac{12}{1}$. Reuver.
 - » 6. *Seselinae* sp. 1, p. 125. Fruit. $\frac{12}{1}$. Swalmen.
 - » 10, 11. *Seselinae* sp. 2, p. 125. Fruits. $\frac{12}{1}$. Swalmen.
 - » 12. *Seselinae* sp. 3, p. 126. Fruit. $\frac{12}{1}$. Brunssum.
 - » 13. *Sium?*, p. 126. Fruit. $\frac{12}{1}$. Reuver.
 - » 14. *Peucedanum?*, p. 126. Fruit. $\frac{12}{1}$. Brunssum.
 - » 15. *Umbelliferae*, genus?, p. 126. Fruit. $\frac{12}{1}$. Reuver.
 - » 16, 17. *Cornus controversa*, p. 126. Endocarps. $\frac{6}{1}$. Reuver.
 - » 18. *Cornus controversa*, p. 126. Endocarp. $\frac{6}{1}$. Recent, Japan.
 - » 19. *Cornus* sp. 2, p. 127. Endocarp. $\frac{6}{1}$. Swalmen.
 - » 20. *Cornus* cf. *mas*, p. 127. Endocarp. $\frac{4}{1}$. Brunssum.
 - » 21. *Cornus* cf. *mas*, p. 127. Endocarp. $\frac{4}{1}$. Brunssum.
 - » 22. *Helwingia* sp., p. 127. Pyrene. $\frac{6}{1}$. Swalmen.
 - » 23. *Helwingia himalayaca*, p. 127. Pyrene. $\frac{6}{1}$. Recent, Himalaya.
 - » 24 a, b. *Monotropa?*, p. 128. Fruit. $\frac{4}{1}$. Reuver.
 - » 25. *Maesa* sp., p. 128. Fruit. $\frac{12}{1}$. Brunssum.
 - » 26 a, b. *Ardisia* sp., p. 128. Fruit. $\frac{6}{1}$. Swalmen.
 - » 27 a, b. *Trientalis?*, p. 129. Seed. $\frac{12}{1}$. Reuver.
 - » 28 a, b. *Trientalis europaea*, p. 129. Seed. $\frac{12}{1}$. Recent.
 - » 29 a, b. *Mimusops septentrionalis*, p. 129. Seed. $\frac{2}{1}$. Reuver.
 - » 30 a, b. *Mimusops Browniana*, p. 130. Seed. $\frac{2}{1}$. Recent, Australia.

PLATE XVI.

- Fig. 1. *Diospyros Lotus*, p. 130. Seed. $\frac{4}{1}$. Brunssum.
- » 2. *Diospyros Lotus*, p. 130. Seed. $\frac{4}{1}$. Recent, China.
- » 3. *Diospyros* sp. nov.?, p. 130. Seed. $\frac{4}{1}$. Swalmen.
- » 4. *Styrax mucronatum*, p. 131. Seed, side view. $\frac{4}{1}$. Reuver.
- » 5. *Styrax mucronatum*, p. 131. Seed, base. $\frac{4}{1}$. Reuver.
- » 6. *Styrax japonicum*, p. 131. Seed. $\frac{4}{1}$. Recent, Japan.
- » 7. *Styrax japonicum*, p. 131. Testa. $\frac{24}{1}$. Recent, Japan.
- » 8. *Styrax mucronatum*, p. 131. Testa. $\frac{24}{1}$. Reuver.
- » 9. *Jasminum undulatum*, p. 131. Fruit. $\frac{6}{1}$. Swalmen.
- » 10. *Jasminum contiguum*, p. 132. Fruit. $\frac{6}{1}$. Reuver.
- » 11. *Jasminum fruticans*, p. 132. Fruit. $\frac{6}{1}$. Recent.
- » 12. *Jasminum contiguum*, p. 132. Testa. $\frac{24}{1}$. Reuver.
- » 13, 14. *Ajuga antiqua*, p. 132. Nutlets. $\frac{12}{1}$. Reuver.
- » 15, 16. *Ajuga reptans*, p. 132. Nutlets. $\frac{12}{1}$. Recent.
- » 17. *Sideritis scordioides*, p. 133. Nutlet. $\frac{12}{1}$. Recent.
- » 18. *Sideritis scordioides*?, p. 132. Nutlet. $\frac{12}{1}$. Reuver.
- » 19, 20. *Lycopus europaeus*, p. 133. Nutlets. $\frac{12}{1}$. Swalmen.
- » 21, 22. *Lycopus europaeus*, p. 133. Nutlets. $\frac{12}{1}$. Recent.
- » 23. *Hancea* sp., p. 133. Nutlet. $\frac{12}{1}$. Brunssum.
- » 24. Labiatae, genus? 1, p. 133. Nutlet. $\frac{12}{1}$. Swalmen.
- » 25, 26. Labiatae, genus? 2, p. 133. Nutlets. $\frac{12}{1}$. Reuver.
- » 27. Labiatae, genus? 2, p. 133. Nutlet. $\frac{12}{1}$. Brunssum.
- » 28. Labiatae, genus? 3, p. 134. Nutlet. $\frac{12}{1}$. Swalmen.
- » 29. Labiatae, genus? 4, p. 134. Nutlet. $\frac{12}{1}$. Reuver.
- » 30. Labiatae, genus? 5, p. 134. Nutlet. $\frac{12}{1}$. Reuver.
- » 31. Labiatae, genus? 6, p. 134. Nutlet. $\frac{12}{1}$. Reuver.
- » 32. Labiatae, genus? 7, p. 134. Nutlet. $\frac{12}{1}$. Reuver.

PLATE XVII.

- Fig. 1. *Solanum* sp.?, p. 134. Seed. $\frac{12}{1}$. Reuver.
- » 2. *Solanum nigrum*, p. 134. Seed. $\frac{12}{1}$. Recent.
 - » 3. Scrophulariaceae, genus?, p. 135. Seed. $\frac{12}{1}$. Swalmen.
 - » 4. *Galium* sp., p. 135. Fruit. $\frac{12}{1}$. Reuver.
 - » 5, 6. *Sambucus glauca*, p. 135. Seeds. $\frac{12}{1}$. Recent, America.
 - » 7. *Sambucus pulchella*, p. 135. Seed. $\frac{12}{1}$. Swalmen.
 - » 8–10. *Sambucus pulchella*, p. 135. Seeds. $\frac{12}{1}$. Reuver.
 - » 11, 12. Valerianaceae?, p. 136. Fruits. $\frac{12}{1}$. Swalmen.
 - » 13. *Ecballium?* sp. nov., p. 136. Seed. $\frac{6}{1}$. Swalmen.
 - » 14, 15. *Eupatorium japonicum* var., p. 136. Fruits. $\frac{12}{1}$. Swalmen.
 - » 16, 17. *Eupatorium japonicum* var., p. 136. Fruits. $\frac{12}{1}$. Recent, Japan.
 - » 18. *Eupatorium japonicum*, p. 136. Fruit. $\frac{12}{1}$. Recent, Yokohama.
 - » 19. *Helichrysum foetidum*, p. 137. Fruit. $\frac{12}{1}$. Recent.
 - » 20, 21. *Helichrysum* sp., p. 137. Fruits. $\frac{12}{1}$. Swalmen.
 - » 22. *Senecio* sp., p. 137. Fruit. $\frac{12}{1}$. Swalmen.
 - » 23. *Senecio aquaticus*, p. 137. Fruit. $\frac{12}{1}$. Recent.
 - » 24, 25. *Carduus* 2 spp., p. 137. Fruits. $\frac{6}{1}$. Reuver.
 - » 26. *Crepis* cf. *blattaroides*, p. 137. Fruit. $\frac{6}{1}$. Swalmen.
 - » 27. *Crepis blattaroides*, p. 137. Fruit. $\frac{6}{1}$. Recent.
 - » 28. *Crepis fuscipappa*, p. 138. Fruit. $\frac{6}{1}$. Swalmen.
 - » 29. *Crepis fuscipappa*, p. 138. Fruit. $\frac{6}{1}$. Recent, China.
 - » 30. *Crepis* sp. 3, p. 138. Fruit. $\frac{6}{1}$. Reuver.
 - » 31. Compositae, genus?, p. 138. Fruit. $\frac{12}{1}$. Reuver.
 - » 32. Compositae, genus?, p. 138. Fruit. $\frac{12}{1}$. Swalmen.
 - » 33. *Eucommia ulmoides*, pp. 98, 139. Samara $\frac{1}{1}$. Recent, West China.
 - » 34 a, b. Eucommiaceae?, p. 98, 139. Samara. $\frac{2}{1}$. Tegelen.
 - » 35 a, b. Eucommiaceae?, p. 98, 139. Samara. $\frac{2}{1}$. Brunssum.
 - » 36. *Carpolithes* sp. 2, p. 139. Fruit. $\frac{12}{1}$. Reuver.

PLATE XVIII.

- Fig. 1 a, b, c, d. *Carpolithes* sp. 3, p. 140. Seeds. $\frac{6}{1}$. Reuver.
- » 2 a, b. *Carpolithes* sp. 4, p. 140. Coccus. $\frac{12}{1}$. Brunssum.
 - » 3. *Carpolithes* sp. 5, p. 140. Pyrene. $\frac{6}{1}$. Reuver.
 - » 4. *Carpolithes* sp. 6, p. 140. Fruit. $\frac{4}{1}$. Reuver.
 - » 5. *Carpolithes* sp. 7, p. 140. Fruit. $\frac{6}{1}$. Reuver.
 - » 6. *Carpolithes* sp. 8, p. 141. Endocarp. $\frac{6}{1}$. Reuver.
 - » 7. *Carpolithes* sp. 9, p. 141. Seed. $\frac{6}{1}$. Swalmen.
 - » 8. *Carpolithes* sp. 10, p. 103, 141. Seed. $\frac{4}{1}$. Swalmen.
 - » 9 a, b. *Carpolithes* sp. 11, p. 141. Endocarp, exterior and interior. $\frac{6}{1}$. Reuver.
 - » 10 a, b. *Carpolithes* sp. 12, p. 141. Seed, exterior and interior. $\frac{2}{1}$. Brunssum.
 - » 11 a, b. *Carpolithes* sp. 13 (*Ceratophyllum*?), pp. 89, 142. Nut. $\frac{6}{1}$. Reuver.
 - » 12. *Carpolithes* sp. 14, p. 142. Fruit. $\frac{6}{1}$. Reuver.
 - » 13 a, b. *Carpolithes* sp. 15, p. 142. Carpel, exterior and interior. $\frac{6}{1}$. Reuver.
 - » 14 a, b. *Carpolithes* sp. 16, p. 142. Seed or kernel. $\frac{2}{1}$. Reuver.
 - » 15. *Carpolithes* sp. 17, p. 143. Fruit. $\frac{6}{1}$. Reuver.
 - » 16. *Carpolithes* sp. 18, p. 143. Fruit. $\frac{6}{1}$. Swalmen.
 - » 17. *Carpolithes* sp. 19, p. 143. Valve of fruit. $\frac{2}{1}$. Reuver.
 - » 18 a, b. *Carpolithes* sp. 20, p. 143. Berry, base and apex. $\frac{6}{1}$. Swalmen.
 - » 19 a, b. *Carpolithes* sp. 21, p. 143. Fruit. $\frac{6}{1}$. Brunssum.
 - » 20 a, b. *Carpolithes* sp. 22, p. 144. Fruit. $\frac{6}{1}$. Brunssum.

PLATE XIX.

- Fig. 1. *Bucklandia striata*, p. 96. Seed. $\frac{12}{1}$. Brunssum.
- » 2. *Carpolithes* sp. 23, p. 144. Berry. $\frac{12}{1}$. Brunssum.
 - » 3. *Carpolithes* sp. 24, p. 144. Bract. $\frac{12}{1}$. Reuver.
 - » 4, 5. *Carpolithes* sp. 25, p. 144. Fruits. $\frac{12}{1}$. Brunssum.
 - » 6. *Carpolithes* sp. 26, p. 144. Seed. $\frac{12}{1}$. Reuver.
 - » 7 a, b. *Carpolithes* sp. 27, p. 145. Nuts. $\frac{12}{1}$. Reuver.
 - » 8. *Carpolithes* sp. 28, p. 145. Fruit. $\frac{12}{1}$. Reuver.
 - » 9. *Carpolithes* sp. 29, p. 145. Seed. $\frac{12}{1}$. Reuver.
 - » 10 a, b. *Carpolithes* sp. 30 (abortive *Vitis*?), p. 145. Seed. $\frac{12}{1}$. Reuver.
 - » 11. *Carpolithes* sp. 31, 145. Fruit, interior. $\frac{12}{1}$. Reuver.
 - » 12, 13. *Carpolithes* sp. 31, p. 145. Fruits, exterior, showing hinged valve. $\frac{12}{1}$. Brunssum.
 - » 14. *Carpolithes* sp. 31, p. 145. Fruit, base. $\frac{12}{1}$. Brunssum.
 - » 15 a, b. *Carpolithes* sp. 32, p. 146. Endocarp. $\frac{6}{1}$. Reuver.
 - » 16. *Carpolithes* sp. 33, p. 146. Fruit. $\frac{12}{1}$. Reuver.
 - » 17. Solanaceae, p. 134. Seed. $\frac{12}{1}$. Swalmen.
 - » 18. *Carpolithes* sp. 34, p. 146. Berry. $\frac{12}{1}$. Reuver.
 - » 19. Palmae, p. 71. Endocarp, interior. $\frac{6}{1}$. Reuver.
 - » 20, 21. Palmae, p. 71. Endocarps and mesocarps. $\frac{6}{1}$. Swalmen.
 - » 22. *Carpolithes* sp. 35, p. 146. Bract. $\frac{6}{1}$. Brunssum.
 - » 23. *Carpolithes* sp. 36, p. 147. Seed. $\frac{12}{1}$. Reuver.
 - » 24 a, b. } *Carpolithes* sp. 37, p. 147. Fragments of hard bony fruits. $\frac{2}{1}$. Swalmen.
 - » 25 a, b. }
 - » 26 a, b. *Carpolithes* sp. 38 (*Vitis*?), p. 147. Seed. $\frac{12}{1}$. Brunssum.
 - » 27. *Carpolithes* sp. 39, p. 147. Seed. $\frac{6}{1}$. Reuver.
 - » 28 a, b. *Carpolithes* sp. 40, p. 147. Seed. $\frac{12}{1}$. Brunssum.

PLATE XX.

- Fig. 1. *Carpolithes?* sp. 41, p. 148. $\frac{6}{1}$. Reuver.
- » 2, 3. *Carpolithes* sp. 42, pp. 148, 151. $\frac{12}{1}$. Brunssum.
 - » 4 a, b. *Carpolithes* sp. 43 (*Palmae?*), pp. 71, 148. Rachis. $\frac{4}{1}$. Brunssum.
 - » 5, 6. *Carpolithes* sp. 44 (*Palmae?*), p. 148. Bracts. $\frac{6}{1}$. Swalmen.
 - » 7 a, b. *Carpolithes* sp. 45, p. 149. Bract. $\frac{6}{1}$. Swalmen.
 - » 8 a, b. *Carpolithes?* sp. 46, p. 149. $\frac{4}{1}$. Swalmen.
 - » 9 a, b. *Carpolithes* sp. 47, p. 149. Apex of fruit. $\frac{6}{1}$. Reuver.
 - » 10 a, b. *Carpolithes* sp. 48, p. 149. $\frac{12}{1}$. Swalmen.
 - » 11–13. *Carpolithes* sp. 49, p. 149. Bracts. $\frac{6}{1}$. Reuver.
 - » 14. *Carpolithes* sp. 50, p. 149. Bract. $\frac{12}{1}$. Brunssum.
 - » 15. Spirally coiled or striate organ, p. 150. $\frac{12}{1}$. Reuver.
 - » 16, 17. Leaf-galls?, pp. 150, 151. $\frac{6}{1}$. Reuver.
 - » 18. Unknown, p. 150. $\frac{12}{1}$. Swalmen.
 - » 19. Unknown, p. 150. $\frac{4}{1}$. Reuver.
 - » 20. Unknown, p. 150. $\frac{6}{1}$. Reuver.
 - » 21, 22. Galls?, p. 150. $\frac{6}{1}$. Swalmen.
 - » 23, 24. Galls?, p. 150. $\frac{12}{1}$. Brunssum.
 - » 25 a, b. Galls or buds (the small cap *a* was attached to the axis *b*), p. 150. $\frac{6}{1}$. Swalmen.
 - » 26. Internode?, laterally flattened, and constricted above and below, p. 150. $\frac{12}{1}$. Swalmen.
 - » 27. *Gnetum scandens*, p. 55. Part of male inflorescence. $\frac{4}{1}$. Reuver.

1

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b

4

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b

11

b

a

10

b

12

a

13

b

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