

*Citation:*

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from the diencephalon, from the lobi inferiores; these fibers end probably all or most of them in the walls of the bloodvessels of the saccus.

It would take us too far to describe here the details of these different tracts and fibers, the secondary connections of the nuclei with each other and with the other parts of the brain, and to enter into a discussion of the results of our investigations in connection with the facts, found by previous writers. It would be impossible to enter into these things without the aid of a great many figures and in the few pages these proceedings allow us. All these things will be discussed at proper length in the publication of the last-named of us two, mentioned above.<sup>1)</sup> Here we only wanted to show, that renewed investigations convinced us of the truth of the hypothesis, put forth several years ago, that the saccus vasculosus of the lower aquatic vertebrates is not a gland but a receptive nervous structure, bilateral in origin, finding its homologon in the infundibular organ of amphioxus.

*Leiden.* Anatomical Cabinet. April 1910.

**Palaeontology.** — "*A further investigation of the pliocene flora of Tegelen.*" By CLEMENT REID, F.R.S. and MRS. ELEANOR M. REID, B.Sc. (Communicated by Prof. G. A. F. MOLENGRAAFF).

The results obtained from our first examination of the Pliocene deposits of Tegelen<sup>2)</sup> pointed to so rich a flora, that we considered it advisable to make further researches. Accordingly in the summer of 1908 we asked Messrs. CANOY, HERFKENS and SMULDERS to send us a further quantity of the fossiliferous brick-earth from the bottom of their pit. They most kindly carried out our request, employing the same men who had assisted us to collect the samples in 1905. The amount of loam sent was nearly 300 Kilog., and we must thank Messrs. CANOY and Co. and their workmen for the great care taken in its collection. Recent seeds were quite absent, except for a few grass seeds, which fly everywhere and are almost impossible to exclude. This large quantity of material has taken us a long time to examine, and we have been interrupted by other work which could not wait; hence the delay in publishing our results.

The new material was not quite so prolific as our former gathering,

<sup>1)</sup> Appearing in the "Zeitschrift für wissensch. Zoologie."

<sup>2)</sup> Verhand. Kon. Akad. v. Wetensch. (Tweede Sectie). Deel XIII, No. 6 (1907); Proceedings Acad. Amsterdam 1908. Vol. X, p. 860.

for only a botanist can select on the spot the thin seams which contain most of the land-plants; but this new gathering yielded in profusion the aquatic species. The results are of great interest, both as confirming our previous conclusions, and as extending our knowledge of the Tegelen flora. The additions to the list number about 40, thus bringing the complete list to about 135. Most of the seeds found belong, as one would expect, to species we have already recorded; but in many cases we obtained much better specimens, enabling us to make more definite determinations.

Among the novelties less than half are now living in the Netherlands. Some we are unable to identify either specifically or generically. In a few cases we feel confident that our species are extinct, but the specimens we have are too few to permit us to make the necessary dissections before describing and naming them. Others belong to very large orders or genera, the seeds of which are not well represented in herbaria, e.g. *Labiatae* and *Hypericum*. Others again belong to genera which have their chief or only development at the present day in Eastern Asia. This is the case with such genera as *Staphylea*, *Prunus*, many genera of *Araliaceae* and *Cornaceae*, *Viburnum*, *Carpinus*, etc. In view of the fact that the fruits of many of these eastern species are quite unknown we again hesitate to describe our species belonging to these genera as new.

The newly discovered exotic forms are mainly related to species of Eastern Asia, a few are European. Thus we have, besides the Eastern species mentioned above, *Crataegus cuneata* now living in China and Japan and a species of *Hippomarathrum*, a genus now distributed round the shores of the Mediterranean and in Western and Central Asia. We have the Central and Southern European species *Valeriana tripteris*, *Physalis Alkekengi*, and *Equisetum ramosissimum*. It may be noted in passing that all point to somewhat warmer conditions than at present prevail in the Netherlands.

Our present investigation of the Tegelen flora brings out one fact very strikingly. We have already mentioned, both in this paper and our former, that the living species agreeing with, or most closely related to many Tegelen species are now living only in Eastern Asia. It would seem therefore that there is a close affinity between the Pliocene flora of Tegelen, and the existing flora of parts of Eastern Asia; and that the more we learn about the Tegelen flora, the more marked does this affinity become. It is at present too early to consider what this means; whether it implies that the flora of the Far East is a survival of one which originated in Western Europe but was driven eastward; or whether it may rather point

to a wide-spread Palaearctic flora, now exterminated in the West, but surviving in the East. It will require much laborious research both in East and West to settle this interesting point.

- In the Tegelen brick-earth we have discovered, mixed with the seeds, various remains of small vertebrates; these Mr. E. T. NEWTON, who has so carefully studied the similar remains of the Cromer Forest-bed, has now determined for us. It may be remarked that the specimens from Tegelen, like those from Cromer, are usually very fragmentary, but in neither case is there any reason to doubt that these small mammals and fishes were contemporaneous with the plants. Mr. NEWTON's determinations have already been published<sup>1)</sup>; and it will be seen that we have obtained since 1907 several novelties. The complete list is as follows:

Abramis brama LINN.  
Anguilla vulgaris LINN.  
Carpinus rutilus LINN.  
Esox lucius LINN.  
Gasterosteus aculeatus LINN.  
Leuciscus cephalus LINN.?  
" erythrophthalmus LINN.  
Perca fluviatilis LINN.  
Tinca vulgaris CUV.  
Cypridoid teeth (not determined).  
Minute curved spines (unknown).  
Rana sp.  
Talpa europaea LINN.?  
Microtus (Mimomys) pliocaenicus F. MAJOR.  
" " intermedius NEWTON.

*Gasterosteus* and *Anguilla* have not yet been found in the Cromer Forest-bed; *Microtus intermedius* is abundant in that deposit; *Microtus pliocaenicus* is found in the slightly older Weybourn Crag, in the Norwich Crag, and in the Pliocene deposits of the Val d'Arno.

*Notes on the Plants.*

*Clematis Vitalba* LINN. (Fig. 1).

Three well-preserved carpels undoubtedly belonging to this species.

*Ranunculus repens* LINN. (Fig. 2)

Two well-preserved achenes.

<sup>1)</sup> Bull. Soc. belge de Géologie. Mémoires XXI, 591 (1907); and Procès-Verbaux XXIV, 231 (1910).

*Magnolia Kobus* DC. (Figs. 3, 4).

The beautifully-preserved seed shown in fig. 3 has been photographed side by side with a recent seed (fig. 4) grown at Kew. For other specimens, grown near Tokyo, we have to thank Dr. TOKUTARO ITO. There seems no doubt as to the determination of this Japanese plant.

*Euryale limburgensis* C. and E. M. REID (Fig. 6).

This specimen shows the embryotega in place and is figured to show this curious organ, and its exact resemblance to the recent species (Fig. 5).

*Stellaria aquatica* SCOP. (Fig. 7).

Numerous seeds of this species were found in 1908, though none occurred in our former collection.

*Stellaria nemorum* LINN. (Fig. 8).

A single broken seed evidently belongs to this species. It shows the attachment, and the characteristic tubercles with their digitate sutures.

*Lychnis Flos-cuculi* LINN.

Three more small seeds agreeing exactly with this species, but rather small, were found in 1908. They are slightly stipitate; but on comparing them with good series of recent seeds this stalk is occasionally found; it would probably become more prominent in the fossil through shrinkage of the testa.

*Scleranthus annuus* LINN. (Fig. 127 of former paper).

We can now identify this fruit with *S. annuus*, which occurs also not uncommonly in the Cromer Forest-bed.

*Hypericum* sp. 6 (Fig. 9).

Two more species have been found. Fig. 9 shows a minute seed resembling *H. montanum* in size and shape, but the sculpture seems finer and more irregular.

*Hypericum* sp. 7 (Fig. 10).

A short thick seed evidently belongs to a seventh species; but the genus is so large, and our collection of recent seeds is still so incomplete, that we cannot match it.

*Staphylea* sp. (Figs. 11, 12, 13).

We have now found a few fragments of seeds of this genus. The piece figured shows the very characteristic base and attachment;

but it belongs to no living species with which we have been able to compare it. It is a larger seed than either *S. pinnata* or *S. colchica* and differs also in various details. The attachment is round or ovate with longer axis parallel to the flattened sides. In the recent *S. pinnata* the attachment is transversely ovate. It may be extinct; but several new species of *Staphylea* have been collected by Dr. AUGUSTINE HENRY in China, and of some of them no fruits are in the Kew herbarium.

*Prunus spinosa* LINN. (Fig. 14).

We have found only a single worn stone of this species, and it looks as if it might have travelled some distance.

*Prunus* cf. *lusitanica* LINN. (Figs. 15, 16).

Two fragments of thin-walled plum-stones, showing sharp apex, somewhat flattened. They seem to be close to *Prunus lusitanica*, but the endocarp is much smaller.

*Prunus Maximoviczii* RUPRECHT (Figs. 17, 18).

We have now several more specimens of these small globose plum-stones; but most of them seem to have been digested by birds, or have travelled far. One (fig. 18) shows the highly characteristic loops or folds belonging to *Prunus Maximoviczii*, and has been photographed side by side with a recent specimen (fig. 17, from a specimen sent to us from Yokohama), to show the exact correspondence. None of our European species show loops of this character.

*Rubus* sp. (Figs. 19, 20, 21).

Two or three broken and much decayed endocarps and a few imperfect prickles are all the remains of *Rubus* we have yet found. They are quite indeterminable; but the endocarps are unusually thin and of a different shape from any recent species we have seen. Unfortunately ripe fruits of *Rubus* are seldom to be found in herbaria, and there are many species fruits of which we have not yet examined.

*Crataegus cuneata* STEB & ZUCC. (Figs. 22, 23, 24, 25, 26).

A single bony carpel, the inner faces meeting at less than a right angle, agrees exactly with this Japanese 5-carpelled *Crataegus*. We have photographed the fossil and recent specimens side by side in two aspects.

*Hippomarathrum* n. sp.? (Fig. 32).

Two well-preserved but somewhat flattened inflated mericarps, showing 5 broad strong ribs and numerous small rugosities. They

are greatly rounded dorsally and hollowed ventrally, bringing the curious triangular base into close proximity to the large triangular beak. We find this same very curious form of mericarp accompanied by the same large triangular beak in two species of *Hippomarathrum*, *H. vaginatum*, and an unnamed species from Turkestan. We have no hesitation therefore in referring our species to this genus, though it does not agree with any living species. It has the shape and size of *H. vaginatum*, but this species is almost without ribs, whereas ours is strongly and broadly ribbed. Other species have ribs such as ours, but do not agree with it in shape or size or in having the large beak. We do not describe our species as new as we cannot make a section to show the vitteae; we require more specimens.

The genus *Hippomarathrum* inhabits the Mediterranean region. It extends in Asia as far east as Soungaria.

Cryptotaenia? (Fig. 33).

One specimen, somewhat crushed and torn, but otherwise in a fair state of preservation. Ribs 5, very strong, merging into a beak  $\frac{1}{6}$  the length of the fruit; vittae 3 between each pair of dorsal ribs, those nearest the ribs being in close contact with them; ventral face somewhat damaged. Length 2.5 mm., breadth 1.5 mm., length of beak 0.4 mm.

The only genus showing these characters appears to be the Japanese *Cryptotaenia*; but our fossil fruit does not agree with the living species, being much smaller.

Genus? (Fig. 34).

Possibly a large umbelliferous fruit, but not sufficiently well-preserved for determination.

Cornaceae or Araliaceae. (Figs. 27, 28, 29).

We have several minute fruits irregularly 5 or 6-angled and indehiscent. One cut transversely showed 2 complete cells and apparently 2 or 3 with abortive seeds. Indehiscent fruits of this character are found in the Cornaceae (cf *Toricellia*) and in the Araliaceae (cf *Heptapleurum*)

Viburnum sp. (Figs. 30, 31).

Two endocarps of *Viburnum* belong to no recent species we have been able to examine, but correspond exactly with an unknown *Viburnum* found by us in the Cromer Forest-bed (*Linnean Journal-Botany*, XXXVIII, pl. 13, figs. 75, 76, 77). Three species of *Viburnum* now live in Europe; but the fossil is quite unlike any of these. There are various species living in Asia, and of most of them we

can find no fruits in the herbaria; we therefore do not describe this fossil as an extinct form.

*Valeriana tripteris* Linn. (Fig. 35).

A single specimen seems to correspond exactly with this Mid-European species; but as the fruit is much flattened it is difficult to photograph.

*Bidens tripartita* LINN. (Fig. 36).

Several fragments evidently belong to this species; but we have found no good specimen.

*Carduus palustris* WILLD. (Fig. 37).

We have found three fruits, about two-thirds the length of our recent specimens, but otherwise agreeing. Fossil composite-fruits have always shrunk considerably, and it is therefore useless to lay much stress on difference of size.

*Physalis Alkekengi* LINN. (Fig. 38).

Three seeds show the very peculiar sculpture of this species. They are somewhat small and have probably shrunk in carbonising, as happens with all fossil seeds belonging to this order.

*Prunella vulgaris* LINN. (Fig. 41).

One well-preserved nutlet has been found.

*Stachys longiflora* BOISS. & BAL.? (Fig. 43).

Two small nutlets, oval, somewhat truncate, narrowed below with a small terminal attachment, surface rugose and pustulate. Strikingly like *S. longiflora*, but somewhat small.

Genus? (Fig. 42).

A finely-tubercled nutlet of a labiate, which we are unable to identify.

*Teucrium Botrys* LINN. (Figs. 39, 40).

We have only a single nutlet, which we have photographed from above and below. The irregular rugosity and large basal aperture are very characteristic of this species.

*Polygonum minus* HUDSON. (Fig. 44).

A few small nuts seem to represent this species.

*Polygonum Convolvulus* LINN. (Fig. 45).

A single somewhat damaged nut corresponds exactly and shows the very characteristic granulation of this species.

*Polygonum Bellardi* ALL.

Fig. 68 of our previous paper by mistake was only magnified  $\frac{1}{1}$ , not  $\frac{12}{1}$  as stated, like other species of the genus. The nut is large.

*Rumex* n. sp.? (Fig. 46).

Several nuts, often with remains of fruiting sepals, and one good fruit. This exceedingly minute *Rumex* shows short triangular fruiting sepals, one of which bears a longish-oval tubercle; sepals somewhat waved at margin with strong looped reticulation; nut small, broadly triangular, with rounded base, so that the greatest width is at one-third of the height, surface rugose. We can find no recent species at all like this; but we hesitate to give it a name, as we have only one good fruit.

*Carpinus* n. sp.? (Fig. 47).

Three minute nuts represent a second species of this genus; but they are much too small to be referred to the European forms. There are several small-fruited species of *Carpinus* in Japan and China; the one which corresponds most closely with our fossil is *C. laxiflora* Bl.; but the ribs in our fossil are more prominent.

*Potamogeton crispus* LINN. (Fig. 48).

Numerous fruits have now been found, though we saw none in our former gathering.

*Cyperus* sp. 1 (Fig. 49).

These minute nuts seem to belong to a species of *Cyperus*; they are very abundant.

*Cyperus* Sp. 2 (Fig. 50).

This form of *Cyperus* is almost as abundant as the last.

*Dulichium vespiforme* C. and E. M. REID.

This species has been found abundantly in our new collection from Tegelen, and one specimen distinctly shows 9 setae, though the usual number appears to be 7 or 8. In other respects the fruits show but little variation. A closely allied form was figured by Dr. J. STOLLER in 1909, from Friedrichshagen am Müggelsee and Lauenburg a. Elbe <sup>1)</sup>).

*Scirpus* 3 sp. (Figs. 51, 52, 53).

The three species of *Scirpus* we have not been able to identify. The setae are not preserved.

<sup>1)</sup> Jahrb. Königl. Preuss. Geol. Landesanstalt für 1909, bd. XXX, t. 1. heft. 1.

*Scirpus Tabernaemontani* GMEL. (Fig. 54).

We have only one nut of this species.

*Incerta sedes.*

Fig. 55 appears to be a minute hard seed or endocarp.

Figs. 56, 57 represent the inside of the split carpel, of which the outside was figured in 1907 (fig. 125). We are still unable to identify it.

Fig. 58 is a minute globular seed sculptured like *Papaver*; but we have been unable to refer it to any genus.

Fig. 59 is a hard endocarp with remains of succulent pericarp. It is probably unripe, but seems unlike anything else we have found.

More specimens have been found of the unknown seed fig. 124 of our former paper. The same species has also been sent to us by Baron GRÜNDL from Raevels; but we are still unable to suggest its botanical position. The seeds are small and hard, with thick bony testa, often faceted by mutual pressure, and an external curved "germination groove" along which the seed burst. The embryo was pendent, but has left no impression on the smooth interior of the testa.

*Equisetum ramosissimum* DESF. (Fig. 60).

A fragment of *Equisetum* showing a hexagonal stem with irregular transverse rugosity, a six-toothed sheath, each tooth with a central rib, and two opposite bnds. These characters are found combined in *E. ramosissimum* and we may refer our specimen to this species. It is probably a portion of a branch close to the rhizome. We have found such a branch on a specimen from the Canton Vaud, in Switzerland, which agrees in every detail with our fossil. The species is widely distributed throughout Southern Europe, Asia, and Africa, but does not now extend so far north as Tegelen.

DESCRIPTION OF THE PLATE.

- Fig. 1. *Clematis Vitalba* LINN. Achene.  $\frac{9}{1}$ .  
" 2. *Ranunculus repens* LINN. Achene.  $\frac{12}{1}$ .  
" 3. *Magnolia Kobus* DC. Seed (fossil).  $\frac{3}{1}$ .  
" 4. " " Seed (recent).  $\frac{3}{1}$ .  
" 5. *Euryale ferox* SALISB Seed (recent).  $\frac{3}{1}$ .  
" 6. " *limburgensis* C. and E. M. REID. Seed.  $\frac{3}{1}$ .  
" 7. *Stellaria aquatica* SCOP. Seed.  $\frac{12}{1}$ .

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Photo, C. & E. M. REID.

- Fig. 8. *Stellaria nemorum* LINN. Broken seed  $\frac{12}{1}$ .
- " 9. *Hypericum* sp. 6. Seed.  $\frac{24}{1}$ .
- " 10. " " 7. Seed.  $\frac{24}{1}$ .
- " 11. *Staphylea* sp. Interior of broken seed.  $\frac{3}{1}$ .
- " 12. " " Side view of attachment.  $\frac{3}{1}$ .
- " 13. " " Base of seed.  $\frac{3}{1}$ .
- " 14. *Prunus spinosa* LINN. Decayed stone.  $\frac{3}{1}$ .
- " 15, 16. *Prunus* cf. *lusitanica* LINN. Interior and exterior of broken stones.  $\frac{3}{1}$ .
- " 17. *Prunus Maximoviczii* RUPRECHT. Recent stone.  $\frac{3}{1}$ .
- " 18. " " " Fossil stone.  $\frac{3}{1}$ .
- " 19. *Rubus* sp. Exterior of endocarp.  $\frac{6}{1}$ .
- " 20. " " Interior of endocarp (another specimen).  $\frac{6}{1}$ .
- " 21. " " Prickle.  $\frac{6}{1}$ .
- " 22. *Crataegus cuneata* SIEB. & ZUCC. (fossil). Inner face of carpel.  $\frac{3}{1}$ .
- " 23. " " (fossil). Outer " " "  $\frac{3}{1}$ .
- " 24. " " (recent). " " " "  $\frac{3}{1}$ .
- " 25. " " (fossil). Side view " "  $\frac{3}{1}$ .
- " 26. " " (recent). " " " "  $\frac{3}{1}$ .
- " 27, 28, 29. Cornaceae or Araliaceae. Three specimens, showing interior, side view, and apex.  $\frac{6}{1}$ .
- " 30. *Viburnum* sp. Dorsal view of endocarp.  $\frac{6}{1}$ .
- " 31. " " Ventral " " " (another specimen).  $\frac{6}{1}$ .
- " 32. *Hippomarathrum* n. sp. ? Mericarp.  $\frac{6}{1}$ .
- " 33. *Cryptotaenia* ? Mericarp.  $\frac{12}{1}$ .
- " 34. Umbelliferous Mericarp. ?  $\frac{3}{1}$ .
- " 35. *Valeriana tripteris* LINN. Fruit.  $\frac{6}{1}$ .
- " 36. *Bidens tripartita* LINN. Damaged fruit.  $\frac{6}{1}$ .
- " 37. *Carduus palustris* WILLD. Fruit.  $\frac{6}{1}$ .
- " 38. *Physalis Alkekengi* LINN. Seed.  $\frac{12}{1}$ .
- " 39, 40. *Teucrium Botrys* LINN. Top and base of nutlet.  $\frac{12}{1}$ .
- " 41. *Prunella vulgaris* LINN. Ventral face of nutlet.  $\frac{12}{1}$ .
- " 42. Labiate, genus unknown.  $\frac{12}{1}$ .
- " 43. *Stachys longiflora* BOISS & BAL. ? Nutlet.  $\frac{12}{1}$ .
- " 44. *Polygonum minus* HUDS. Nut.  $\frac{6}{1}$ .
- " 45. " *convolvulus* LINN. Nut.  $\frac{6}{1}$ .
- " 46. *Rumex* n. sp. ? Fruit.  $\frac{6}{1}$ .
- " 47. *Carpinus* n. sp. ? Nut.  $\frac{6}{1}$ .
- " 48. *Potamogeton crispus* LINN. Fruit.  $\frac{6}{1}$ .
- " 49. *Cyperus* ? sp. 1. Nut.  $\frac{12}{1}$ .
- " 50. *Cyperus* ? sp. 2. Nut.  $\frac{12}{1}$ .
- " 51, 52, 53. *Scirpus* 3 sp. Nuts.  $\frac{12}{1}$ .
- " 54. *Scirpus Tabernaemontani* GMEL. Nut.  $\frac{12}{1}$ .
- " 55. Unknown.  $\frac{24}{1}$ .
- " 56, 57. Inside of unknown carpel.  $\frac{12}{1}$ .
- " 58. Papaveraceae ? Seed.  $\frac{24}{1}$ .
- " 59. Unknown endocarp with remains of pericarp.  $\frac{6}{1}$ .
- " 60. *Equisetum ramosissimum* DESR.  $\frac{3}{1}$ .