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THE SCORESBY SOUND COMMITTEE'S 2ND EAST GREENLAND
EXPEDITION IN 1932 TO KING CHRISTIAN IX.s LAND

LEADER: EJNAR MIKKELSEN

NEW INVESTIGATIONS
OF THE TERTIARY AT CAPE DALTON,
EAST GREENLAND

BY

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WITH 3 FIGURES IN THE TEXT

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One of the most important results obtained by the AMDRUP-HARTZ Expedition to East Greenland (1900) was the discovery of Tertiary sediments at Cape Dalton. Fossil plants and brackish as well as salt-water animals were collected in these deposits and brought back to Copenhagen, the finds of the fossil animals being particularly important, as they were the first of their kind which had been found in the Tertiary of East Greenland. The examination of this fossil fauna was entrusted to the author of the present article, and from his researches it appeared that these deposits were of Eocene age, their fauna showing a certain agreement, more particularly with London Clay and somewhat younger deposits in Western Europe¹).

A wing of a beetle was subsequently examined and described by KAI L. HENRIKSEN²) while i.a. the remains of plants found at Cape Dalton were described in a recently published article by FR. J. MATHIESEN³).

¹) J. P. J. RAVN: The Tertiary Fauna at Kap Dalton in East Greenland. Medd. om Grønl. Vol. XXIX, Copenhagen 1903, pp. 93—140. Also published by the University Mineralogical and Geological Museum as "Communications paléont. No. 4".

²) KAI L. HENRIKSEN: En Bemærkning om Tertiæret ved Kap Dalton i Øst-Grønland. Medd. om Grønl. Vol. LVI, pp. 203—206, København 1917.

³) FR. J. MATHIESEN: Notes on some Fossil Plants from East Greenland. Medd. om Grønl. Vol. LXXXV. Kbhvn. 1932. Also published by the University Mineralogical and Geological Museum as "Communications paléont. No. 40".

I. CONDITIONS AND AGE OF DEPOSITS

The greater part of the fossil material collected at Cape Dalton was in rather a poor state of preservation, so that a determination of the species was by no means possible in all cases, and even a determination of the genus was at times uncertain. A renewed geological investigation of the region round Cape Dalton must, therefore, be considered very desirable. However, the numerous Danish expeditions which were sent out after 1900, had other ends in view, viz. the examination of Scoresby Sound and the country to the north of it, and so great satisfaction was felt when, in 1932, the Scoresby Sound Committee's 2nd East Greenland Expedition was given an opportunity to call at Cape Dalton, partly to examine the previously known locality, partly to look for new localities with Tertiary deposits. The geological investigations were undertaken by the English geologist, L. R. WAGER (The University, Reading). The expedition unfortunately did not find new fossiliferous Tertiary localities, but from the already visited locality a number of fossil plants and animals were collected, which, on the return of the expedition, were handed over for further treatment to Professor FR. J. MATHIESEN and the present author, respectively.

After his return to England WAGER had to undertake a new expedition (to Mt. Everest), and that unfortunately before he had found time to work up the geological observations made in East Greenland. In a couple of letters from November last he gave, however, an account of geological conditions at Cape Dalton, and the information contained in these letters was of great importance, seeing that until then practically nothing was known on the subject. By arrangement with the leader of the expedition, Captain EJNAR MIKKELSEN, I shall in the following report what WAGER, in the said letters, has communicated as to the conditions of deposits.

The fossils collected in 1900 came from two different deposits: 1) a dark sandstone, which on account of its wealth of *Cyrena* shells I named "Cyrena Bed", and 2) a brown shale, containing numerous

nodules with remains of *Coeloma*, which I consequently designated as "Coeloma Bed". It did not appear, from the observations made in the course of the expedition¹⁾, what were the relative ages of these two deposits, neither did the fauna supply any information to this effect. But seeing that two of the gastropod species were common to both deposits, I was able to state that we may presumably be right in supposing that the two deposits do not differ much with regard to age. And as the *Cyrena* sandstone was, furthermore, found to contain bits of shale, which have some resemblance to the shale of the Coeloma Beds, I supposed that there was some probability of the latter being

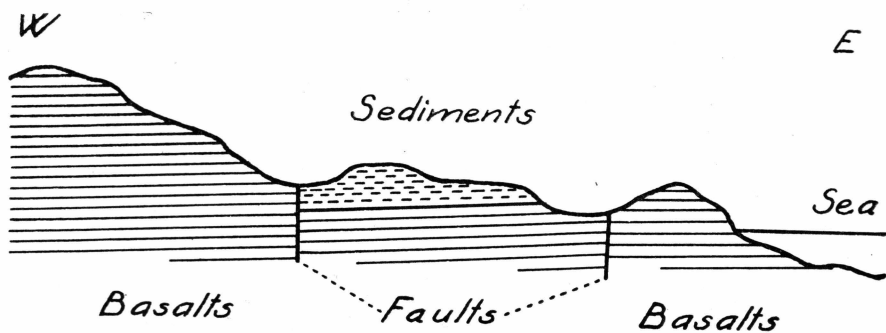


Fig. 1. Diagram showing the relations of the Tertiary deposits of Cape Dalton to the Basalts. After a sketch by Mr. WAGER.

older than the former. WAGER's observations have shown that this latter supposition is incorrect.

The following are the results arrived at by WAGER as to the conditions of the deposits within the Tertiary at Cape Dalton, this information being contained in the letters mentioned above.

The conditions for preservation of the beds seem to be due to faults, as shown in fig. 1, which is designed after a sketch by WAGER. Elsewhere to the south of Cape Dalton there is a steady dip to the east, and the sediments have been removed. Thus the Tertiary seems to be very limited in extent, but no information is at hand as to whether WAGER has had the opportunity to examine the considerable beds of sandstone, which in 1900 were seen in the basalt cliff farther to the northwest, and which HARTZ, presumably with good justice, considered Tertiary. WAGER only communicates that the Expedition did not succeed in finding any new locality for the Tertiary material.

From Cape Dalton WAGER gives the following section of the Tertiary:

¹⁾ OTTO NORDENSKJÖLD: On the Geology and Physical Geography of East-Greenland, p. 191—192. — Medd. om Grønland, Vol. 28, V. Kjøbenhavn 1907.

Upper series:	{	White baked shales..... (top not seen) 15'
		Calcareous shales with small nodules..... ?40'
		containing plant remains near top and the crab nodules and very large (3') lobster nodules below (Coeloma Beds).
		[?Black sandstone].
Middle series:		Yellow sandstone, unfossiliferous..... 50'
Lower series:	{	Black sandstone with fragments and..... 15'
		nodules containing plant remains.
		Thin brown sandstone..... 5'
		Black sandstone with bands rich in <i>Cyrena</i> (Cyrena Beds).
		Pebbly beach deposit..... 6'
		Basalt lava. (No angular unconformity and lava not exceptionally weathered).

WAGER suspects that there is no great age difference between the various horizons.

A petrographic examination of some of the deposits had already, on an earlier occasion, been made by N. V. USSING (see RAVN: l. c. pp. 100—103); further, Professor O. B. BØGGILD has kindly undertaken an examination of the samples brought home by the expedition of 1932, and so practically the whole of the series of sediments has now been made subject to examination from a petrographic point of view. The results of these examinations will be given in the following, the beginning being made with the lowest stratum.

1. Pebbly beach deposits: BØGGILD communicates that matrix consists of a sandstone like that described by USSING from "Cyrenabed, b". The cement is Calcite, and the grains almost exclusively consist of Augite and micro-crystalline basalt; besides these only a few Garnet grains were found. The pebbles are two kinds of basalt: a black Leucite-lava and a greyish, greatly metamorphosed basalt.

2. Black Sandstone (Cyrena Beds): USSING has given a detailed description of this sandstone, to which description the reader is referred.

3. Thin brown sandstone: Of this no samples are at hand.

4. Yellow sandstone, unfossiliferous: According to BØGGILD this is a very fragile yellow sandstone, the cement of which can not be accurately determined; the grains consist principally of Quartz and Felspar, with a few other easily recognizable minerals, such as Garnet and others. There are no distinctly basaltic constituents.

[5. Black sandstone: According to WAGER its place in the series of strata is uncertain. I have not been able to identify with certainty any of the samples at hand with this sandstone].

6. Calcareous shales (Coeloma Beds): For further details see USSING's description of these shales.

7. White baked shales: According to BØGGILD a rather highly metamorphosed volcanic tuff, the separate component parts of which it is very difficult to identify. The grains are almost exclusively Felspar, presumably different kinds of Plagioclase. The tuff is possibly of an andesitic nature.

These examinations show that in the course of the sedimentation a somewhat varying volcanic action has, almost incessantly, played a very important part.

In the collection of fossils brought home by the expedition of 1932, there are a few forms which have not formerly been found in the Tertiary of East Greenland, viz. two *Chlamys* species, one of which, however, cannot be defined as to species, as well as an entirely undefinable Bryozoan. The other 11 species are probably all known from the former material, and the relative proportion of the quantities in which they were found was about the same. Thus *Cyrena gravesii* and *Coeloma bicarinatum* constitute the greater part of the material, whereas other species have only been found in one or quite few specimens. The average state of preservation is unfortunately bad, and a preparation is in most cases practically excluded. As mentioned in the following it has, however, in a few cases been possible to correct former determinations by means of the new material collected. After these corrections have been undertaken, the complete list of the Tertiary fauna from Cape Dalton will be as given below. The species, which were not previously known from these deposits are marked *, whereas the species formerly known from there, but not identified in 1932, are given in parenthesis.

	Cyrena Beds	Coeloma Beds
*1. Bryozoan	—	+
2. <i>Nucula</i> cfr. <i>similis</i> J. Sow.	—	+
*3. <i>Chlamys</i> (<i>Pseudamusium</i>) <i>corneola</i> (WOOD)	—	+
*4. <i>Chlamys</i> sp.	+	—
5. <i>Mytilus affinis</i> J. Sow.	+	—
(6. <i>Modiola</i> cfr. <i>simplex</i> J. Sow.)	—	+
7. <i>Cyprina</i> sp.	+	+
(8. <i>Cyprina</i> sp.)	—	+
(9. <i>Astarte</i> cfr. <i>tenera</i> MORRIS)	+	—
10. <i>Cyrena gravesii</i> DESH.	+	—
(11. <i>Cryptodon</i> cfr. <i>unicarinatus</i> NYST.)	+	+
(12. <i>Erycina</i> sp.)	+	—
(13. <i>Tellina</i> sp.)	+	—

	Cyrena Beds	Coeloma Beds
14. <i>Psammobia</i> ? sp.....	+	—
(15. <i>Donax</i> sp.)	+	—
16. <i>Teredo</i> sp.....	—	+
17. <i>Natica</i> sp.....	+	—
18. <i>Aporrhais speciosa</i> (v. SCHLOTH.)	+	+
(19. <i>Fusus</i> sp.)	+	—
20. <i>Glandina</i> n. sp.	+	—
21. <i>Homarus groenlandicus</i> (RAVN)	—	+
22. <i>Coeloma bicarinatum</i> RAVN.....	—	+
(23. <i>Eugnamptus decemsatus</i> SCUDD.)	—	+

Already in my former article on the Tertiary at Cape Dalton (p. 133) I stated that Cyrena Beds and Coeloma Beds cannot differ much with regard to age, and this opinion is, as mentioned above, shared by WAGER. It is much to be regretted that the new material does not give such good information about the age of the two deposits as to enable us to determine it with much greater exactitude than formerly. It is certain that the whole of the series of strata must be referred to the Eocene, but I have shown, on a former occasion, that some of the species found suggest the lower, others the middle Eocene, and this may still be said to hold good after having gone over the new material. Only a single form has been added, which it was possible to determine with regard to species, viz. *Chlamys corneola*, which suggests the lower Eocene. But over against this stands the species determined by HENRIKSEN, viz. *Eugnamptus decemsatus*, which is said to be of middle-Eocene age, and so it is even now impossible to say anything definite as to age. In this place it must be added that MATHIESEN who examined the Tertiary plant remains from East Greenland, and among these also remains from Cape Dalton, arrived at the result that "all available facts point towards an Early Tertiary (Paleocene-Eocene) age of these deposits" (l. c. p. 61). — On the strength of the examinations undertaken by HENRIKSEN and the present author LAUGE KOCH refers the Tertiary at Cape Dalton to the Eocene¹⁾.

As mentioned above, the expedition did not succeed in finding new fossiliferous Tertiary localities. However, WAGER in the course of the British Arctic Air Route Expedition (1930—31) found fossiliferous strata much farther towards southwest, that is, at Cape Gustav Holm²⁾. In Peak Gustav Holm he found, on top of the Metamorphic complex

¹⁾ LAUGE KOCH: Stratigraphy of Greenland. — Medd. om Grøn. Vol. 73, II, København 1929, p. 262.

²⁾ See Geographical Journal, Vol. LXXIX, No. 6, 1932, p. 485.

“a thin series of sandstones, limestones, and shales, baked by the numerous dykes cutting through them”. The sediments lie in greatly inclined strata and are covered by Plateau basalt. The limestones contain several poorly preserved fossils and must, according to WAGER, be ascribed to the Tertiary and compared with the Cyrena Beds of Cape Dalton, as Professor H. L. HAWKINS suggests the possibility of the greater part of the shells belonging to *Cyrena gravesii* DESH. Professor HAWKINS has been kind enough, on my request, to send me a block of the fossiliferous sediment for further examination, and an examination which was kindly undertaken by Professor BØGGILD proves that it is not a limestone, but a volcanic tuff with numerous grains of Augite cemented by Chalcedone. It contains a number of poorly preserved and greatly silicified shells. A preparation of these shells is unfortunately impossible, and they are consequently not to be determined. The possibility that some of them may belong to the said species of *Cyrena* is presumably not excluded, but it seems to me equally possible that at any rate a number of them may be Brachiopoda shells, and I am inclined to think that we are here dealing with sediments which are much older than the Tertiary.

II. THE FAUNA

1. *Bryozoorum* sp. indet.

In the surface of a nodule the skeleton of a Bryozoan is visible. It is in such an imperfect state of preservation that a more detailed determination is impossible.

Coeloma Beds: 2 specimens.

2. *Nucula* cfr. *similis* J. Sow.

1903. *Nucula similis* J. Sow.; RAVN: l. c. p. 104; pl. III, fig. 1.

As to the older material I have, though with some hesitation, referred two connected valves of a *Nucula* to this species. The whole shape seems to be in accordance with it, but the surface is covered by concentric folds and fine radiating striae, whereas *N. similis* has a smooth or almost smooth surface. It is, however, conceivable that the deviating surface ornamentation of the Greenland specimen may be due to weathering in the present day, as we are here dealing with a loose-lying specimen. On the other hand, the recent finds comprise a fragment of a shell which shows the same ornamentation, and is enclosed in a nodule, and the surface of this shell does not seem to have undergone a weathering process, so that its ornamentation must be regarded as primary. It is, consequently, uncertain whether the specimens at hand can be referred to *N. similis*. Two very incomplete connected valves from an undefined horizon, though probably from Coeloma Beds, are somewhat more elongated than the one previously described, but still beyond a doubt belong to the same species.

Coeloma Beds: 2 specimens (+ 1 or 2)¹).

¹) The figures given in parenthesis here and in the following refer to the specimens found in 1900.

3. *Chlamys (Pseudamusium) corneola* (WOOD).

1861. *Pecten corneus* J. Sow.; WOOD, Eocene Bivalves. I. p. 39; pl. 9, fig. 7d.
 1887. *Chlamys (Pseudamusium) corneola* (WOOD); COSSMANN, Cat. illustr. II. p. 182; pl. 8, figs. 26 and 31.

There can hardly be any doubt that an impression of the inner side of a right shell must be referred to this species. The shell has been very thin, almost circular (16 mm high and 15 mm long) and only slightly convex. Fragments of the shell show that it has been smooth (or very nearly smooth). Impressions are seen of the ridges along the hinge margin and at the base of the ears.

The species is reported from London Clay in England (Highgate) and from contemporaneous deposits (Yprésien) in France (Cuise).

Coeloma Beds: 1 shell in one of the large nodules.

4. *Chlamys* sp.

In a nodule a fragment of a shell was found, seen from inside; it must be referred to the *Chlamys* genus, but is too incomplete to permit of a definition as to species. The shell is thin, only slightly convex and provided with rather narrow radial ribs. It dates from a black sandstone at the extreme western end of the complex. This sandstone now either lies uppermost in Cyrena Beds, or it forms a special band above the yellow unfossiliferous sandstone.

5. *Mytilus affinis* J. Sow.

1903. *Mytilus affinis* J. Sow.; RAVN: l. c. p. 105; pl. III, figs. 2—3.

Of this species a number of specimens were collected, which in every respect agree with those found in 1900.

Cyrena Beds: 15 specimens (+ 15).

7. *Cyprina* sp.

1903. *Cyprina* sp., RAVN: l. c. p. 106.

A fairly large fragment of an otherwise well-preserved shell may have belonged to the same species as the two shells of this genus found in 1900 in Cyrena Beds.

Coeloma Beds: 1 shell (? + 2 shells in Cyrena Beds).

10. *Cyrena gravesii* DESH.

1903. *Cyrena Gravesii* DESH.; RAVN: l. c. p. 107; pl. III, figs. 6—9.

A large number of *Cyrena* shells were collected. They are somewhat fragmentary, but it seems that they can all be referred to *C. gravesii*, of which species a very large material was already at hand from the former collection.

Cyrena Beds: Numerous specimens.

14. *Psammobia* sp.?

1903. *Psammobia* sp.? RAVN: l. c. p. 111.

Under this designation I have, as quoted above, made mention of a few poorly preserved shells. The new material includes the impression of the inner sides of two connected valves, as well as a fragment of the shell itself. From this specimen it is unfortunately not possible, any more than from the preceding ones, to conclude anything as to the hinge and the course of the pallial line, an exact determination of it being thus even now impossible.

Cyrena Beds: 1 specimen (+ 4 specimens).

16. *Teredo* sp.

1903. *Teredo* sp.; RAVN: l. c. p. 111.

The finds of 1932, like those of 1900, comprise a few fragments of fossil wood, which are filled with borings of an indeterminable species of *Teredo*.

Coeloma Beds (from about top): 3 fragments of wood with numerous borings.

17. *Natica* sp.

A single specimen of a *Natica* can, no more than those found in 1900, be determined as to species.

Cyrena Beds: 1 specimen.

18. *Aporrhais speciosa* (v. SCHLOTH).

1903. *Aporrhais speciosa* (v. SCHLOTH.); RAVN: l. c. p. 112; pl. IV; figs. 4—5.

Two specimens of *Aporrhais* are, it is true, not so completely preserved that it is possible to determine them exactly as to species, but seeing that they, as far as it is possible to judge, agree completely with the specimens of *A. speciosa* found in 1900, there can hardly be any doubt that they belong to this species.

Coeloma Beds: (1 specimen).

Cyrena Beds: 2 specimens (+ 4 spec.).

20. *Glandina* n. sp.

1903. *Bulimulus* sp.? RAVN: l. c. p. 114.

I have, on a former occasion, defined a number of very incomplete fragments as *Bulimulus* sp.?, adding at the same time that the surface is covered by rather thick transverse striae, almost as in *Glandina costellata* (Sow.). The finds of 1932 comprise a shell which shows that the agreement with the *Glandina* SCHUM. genus is so great that the present specimens must be referred to this genus.

The new shell, which I have not been able to refer to any previously described species, must have been about 22 mm high and 11,5 mm

thick. Thus, it is somewhat smaller than the young shells of *Gl. costellata* (Sow.)¹⁾, described and pictured by EDWARDS, and its outline agrees very well with this species, though its spire is shorter and its last whorl higher. In the same respects it is distinguished from most of the species described from the Paris Basin, only showing some resemblance with *Gl. electa* DESH.²⁾, but this species is somewhat thicker and has more strongly convex whorls and, consequently, deeper sutures. Furthermore, the species under discussion, as opposed to the French one, has a distinct, broad depression below the suture. In this respect it agrees with the said English species and a few of the French species

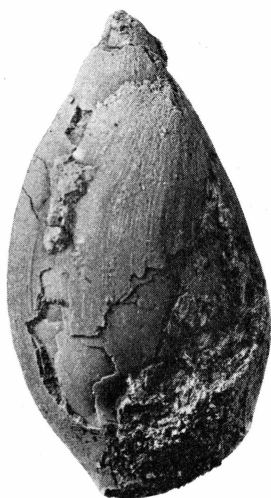


Fig. 2.

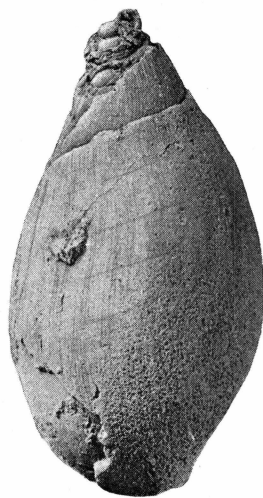


Fig. 3.

Glandina n. sp. 3 : 1.

from the Eocene. On the surface rather coarse transverse striae are seen, which below the depression bend slightly forwards. Further, faint traces are visible of a longitudinal striation.

Cyrena Beds: 8 specimens (+ 11).

As in the finds of 1900 a number of gastropods are now found in Cyrena Beds, but unfortunately it has not been possible to prepare them, and so they are still undeterminable. There is no doubt that they belong to different genera, their form varying greatly, and some of them have a smooth (or nearly smooth) surface, whereas others are provided with ornamentation.

¹⁾ FR. E. EDWARDS: A Monograph of the Eocene Mollusca. II. Pulmonata. (The Paleont. Soc.), 1852, p. 75; pl. 12, figs. 1a—k.

²⁾ G. P. DESHAYES: Description des animaux sans vertèbres découverts dans le bassin de Paris. II. Paris 1864, p. 838; pl. 53, figs. 10—12.

21. *Homarus groenlandicus* (RAVN).

1903. *Hoploparia groenlandica* RAVN: l. c. p. 115; pl. IV, figs. 1—2.

In his "Monograph of the Fossil Macrurous Crustacea of England" HENRY WOODS¹⁾ agrees with the opinion, which was first set forth by J. E. V. BOAS²⁾, viz. that *Hoploparia* cannot be maintained as an independent genus, but that some of its species, as for instance *H. gammaroides*, must be referred to the genus of *Homarus*. Therefore, also the Greenland species must be referred to this genus. Other species are referred by BOAS to the genus of *Nephrops*.

WAGER has succeeded in increasing the material of this species rather considerably, having found a fair amount of species in the great nodules from the lower part of Coeloma Beds. As compared with the specimen reproduced in my figure, which was quoted above, they are not in a good state of preservation, being, for instance, all very highly compressed; and there is consequently very little which can be added to my previously made description.

In one specimen the shape of the second somite is visible. It shows a rather good agreement with Woods' illustration, pl. XXVI, fig. 5. As mentioned in my formerly quoted description, the species is very closely related to *H. gammaroides* (McCOY). To the differences mentioned may here be added that pleura of the third and following somites are broader downwards and their point not so strongly bent back.

Coeloma Beds: 4 specimens of Cephalothorax with attached abdomens. 4 specimens of isolated Cephalothorax. 1 isolated abdomen. 3 isolated chelæ (the one in one of the small nodules). The finds made in 1900 only comprised 4 specimens.

22. *Coeloma bicarinatum* RAVN.

1903. *Coeloma bicarinatum* RAVN: l. c. p. 120; pl. IV, fig. 6 and pl. V, figs. 1—6.

The present finds, like those of the AMDRUP-HARTZ Expedition, comprise a very large number of nodules collected in Coeloma Beds, practically all of which contain well preserved specimens of that species. In the nodules there are, besides, rather frequently fragments of wood as well as leaves of Dicotyledons, in all probability from foliferous trees.

Nearly all nodules contain practically complete specimens of *Coeloma*; in a few cases only the chelæ are found, and then always chelæ of very large individuals.

¹⁾ The Palæont. Soc. Vol. for 1929. London 1925—31, p. 86.

²⁾ J. E. V. BOAS: Studier over Decapodernes Slægtskabsforhold. — Det Kgl. Danske Vidensk. Selskabs Skrifter. VI. Række. Naturvid. og Mathem. Afd. 1. Bd Kbhvn. 1880, pp. 73 and 176.

According to WAGER the crab-nodules are to be found in the lower part of Coeloma Beds, whereas in the upper part of these layers (near top) small nodules containing plant remains are said to occur. Together with the ordinary crab-nodules some large nodules have been found, about 1 m in diameter and containing remains of *Homarus*. In these nodules also five specimens of *Coeloma* have been found, some smaller nodules having been included in the great ones.
