

**TURBANELLA VARIANS N. SP.,
A MARINE GASTROTRICH
WITH LOCAL MORPHOLOGICAL VARIANTS.**

by

Catherine Maguire

(Queen's University, Marine Biology Station, Portaferry, Co. Down, Northern Ireland.

Résumé

Cinq variétés d'une espèce nouvelle de *Turbanella* de la surface du sable du County Down, Irlande du Nord, sont décrites. Les particularités de leur appareil reproducteur et les mécanismes possibles du transport et du stockage des spermatozoïdes sont discutées.

Introduction

A new species of *Turbanella*, which has close similarities with *T. cornuta* Remane 1925 and *T. hyalina* Schultze 1853, was found on several beaches in the area around Strangford Lough (Fig. 1). The overall appearance is probably closed to *T. cornuta* described by Wieser (1957), who suggested that two sub-species should be created to distinguish this American form from the original European type (Remane, 1925). The *Turbanella* now described differs somewhat in the reproductive System, as well as showing a gradation of characteristics throughout the five different forms, none of which corresponds exactly to any previously described species ; therefore it is given the status of a new species.

Turbanella populations from five beaches, of varying physical conditions, were examined. The holotypic form from Hanna's Mill Bay will be described in detail and differences between this and the other races will be outlined.

Type locality

Surface sand 0-5 cm section, fine moderately sorted sand; mid-low tide region, Hanna's Mill, Millquarter Bay, Co. Down Northern Ireland.



FIG. 1

Map to show locations of beaches around Strangford Lough. a: Hanna's Mill; b: Kilclif; c: Doctor's Bay; d: Millin Bay; e: South Bay.

Description

The animal has a flat, ribbon-like shape with convex dorsal surface. Length of adult 0.55-0.8 mm, in relaxed state; but can extend to over 1.0 mm when stretching (Plate I,2). The body is very contractile. The head is delineated from the body by small indentations and is conical in shape, but without distinct lateral projections (Fig. II, e). Head length 48-60 μm ; width 65 - 85 μm at widest part. Body width varies from approximately 80 μm in pharynx area, tapering slightly to approximately 68 μm at U 70 in animals not carrying mature eggs; those with eggs often bulge to 90 or 100 μm width in this region. The body just anterior to the caudal lobes narrows to

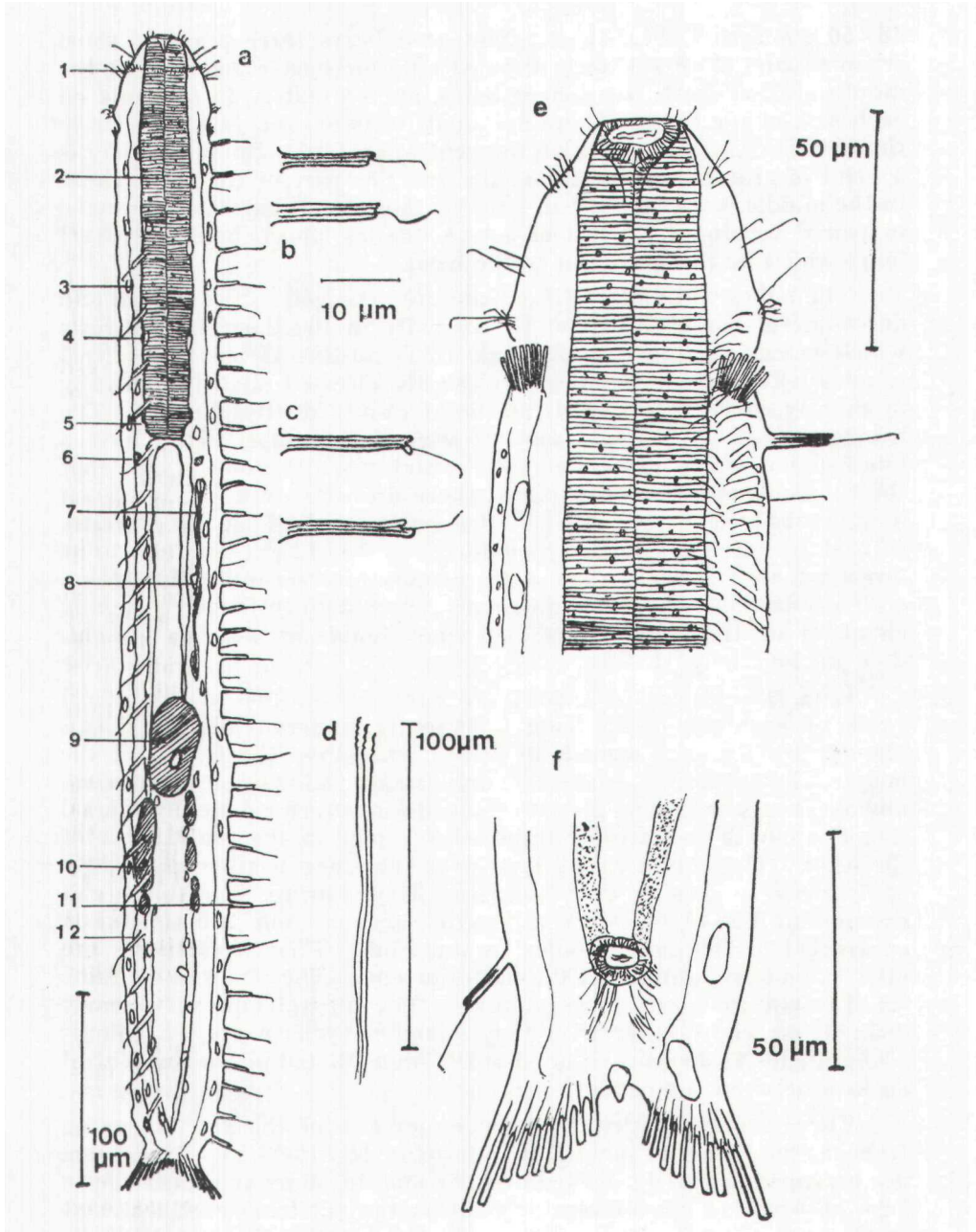


FIG. II
Hanna's Mill form *Turbanella varians*

a: dorsal view. 1: dorsal band of cilia; 2: pharynx; 3: epidermal gland; 4: dorsal gland; 5: pharyngeal pores; 6: green-orange glands; 7: sperm in testes; 8: "spermatophore;" 9: mature oocyte; 10: developing oocyte; 11: lateral tubule; 12: dorso-lateral tubule.

b: lateral tubules.

c: lateral tubules of South Bay form.

d: sperm.

e: ventral view of head.

f: ventral view of tail.

48-50 μm across (Fig. II, a). The head bears three pairs of short sensory hairs, 5 - 6 μm long, directed anteriorly on either side of the mouth and, at least, five longer hairs, approximately 12 μm long on each side of the head. There are small tufts of cilia just anterior to the indentations of the neck, on the ventral surface. Dorsally, there is a band of cilia extending across the anterior part of the head, those in the middle being shortest in length. Anterior tubules are arranged in paired ventro-lateral feet of 5 to 8 tubules, approximately 9 μm long; which lie just posterior to the head.

The adhesive tubules of the body are arranged in two lateral and dorso-lateral rows; there are 15-19 pairs in the dorso-lateral rows which extend up into the pharynx area and 28 - 32 pairs of lateral tubules. The lateral tubules are usually directed slightly ventrally or slightly dorsally, so they do not lie in a uniform straight row. The tubules are 12 - 16 μm long and are variable in shape. They have a fine canal running down the centre which gives the appearance that the tubule is split into two parts; there are sensory hairs, 9 - 12 μm long, embedded in the tip of the posterior half of the tubules (Fig. II, b). Sensory hairs approximately 10-12 μm long also arise directly from the body. There are usually nine posterior tubules on each caudal lobe, the two outer ones being slightly longer, reaching about 10 μm in length. A median short tubule or gland is present, 2-3 μm long (Fig. II, f).

Cilia, 10-11 μm in length, are arranged in two ventro-lateral bands on each side of the body. There are numerous distinct dorsal glands, usually greygreenish in colour, extending the length of the body. The epidermis contains many small yellow-green inclusions and also bears epidermal glands of a yellowish green colour (Fig. II, a).

The mouth is not quite terminal, opening on the ventral side of the head. The mouth cavity is very variable and flexible, constantly contracting in free moving animals. The pharynx is distinct and extends to U28 - U40; with a length varying from 250 μm when contracted to 290 μm expanded in the adult. Pharyngeal pores are distinct and are situated at the posterior end. The pharynx contains small bright green refractive granules. The gut walls are very clearly defined, especially anteriorly; they usually appear a greyish colour. The gut ends in an anus situated at U97 in a ciliated pit on the ventral surface between the caudal lobes.

There are two testes, lying on either side of the gut, extending from the gut/pharynx junction to approximately U50 - 53. The sperm are arranged in closely packed bundles and, in many specimens, have been observed to extend ventrally across the gut from each testes at approximately U45. There appears to be a male pore situated ventrally in the mid-line in this area, although this has never been clearly observed. The sperm do not have a distinct head, but bear a spiral pattern at the head end; approximate length is 115 μm (Fig. II, d). There are two bright round granular bodies, green to orange in colour, lying just anterior to the testes; these are distinct from the dorsal glands and lie more towards the mid-line. They possibly have some glandular function. In the mid-region of the testes, lying dorsally to the sperm, are two grey patches of glandular type tissue.

In several specimens, a small green object of variable shape,

1

2

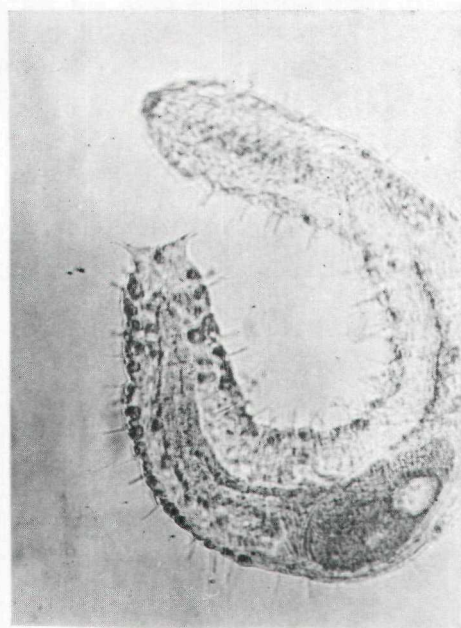
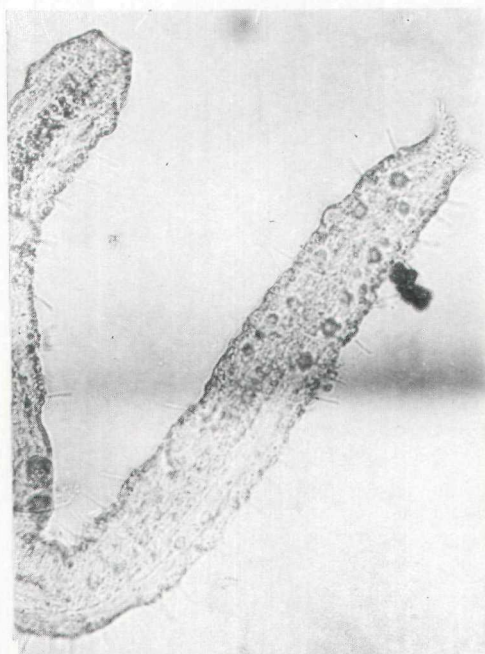
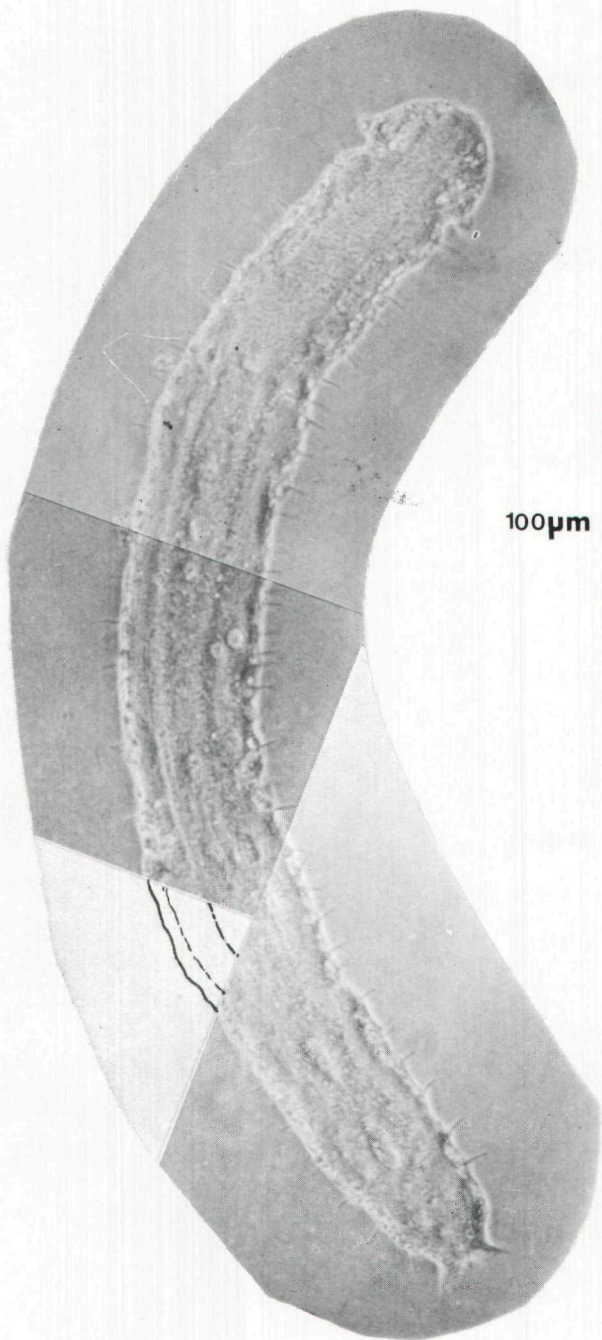
100 μ m

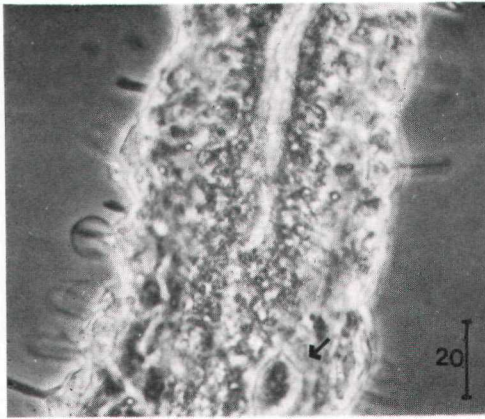
3

PLATE I

T. varians

1: South Bay form; 2: Hanna's Mill form; 3: Doctor's Bay form.

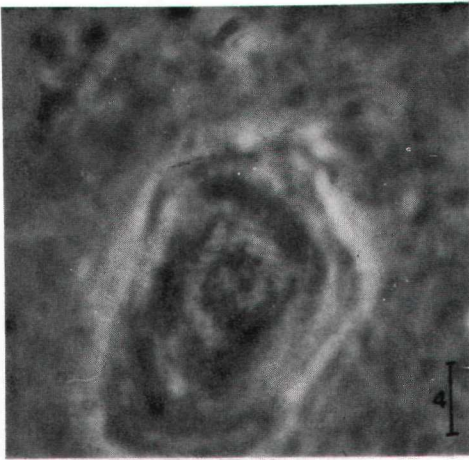




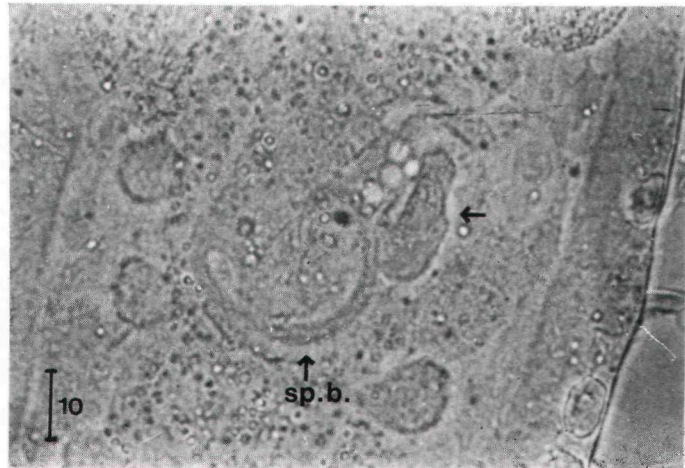
1



2



3



4

PLATE II

1: "spermatophore" of Hanna's Mill *T. varians*, in testes region; 2: "spermatophore" of Doctor's Bay form near mature egg; 3: "spermatophore" of Doctor's Bay form, under oil immersion; 4: bursa, containing "spermatophore" and sperm bundle (sp. b); Kilclief *T. varians*. (Scales show length in μm).

which may be cuticular, was observed (Fig. III). This is roughly vase shaped and usually found towards the posterior end of one or both of the testes (Plate II, 1). It was not present in all mature specimens and its function is not definitely known but, in some specimens, a similar green structure was observed together with sperm

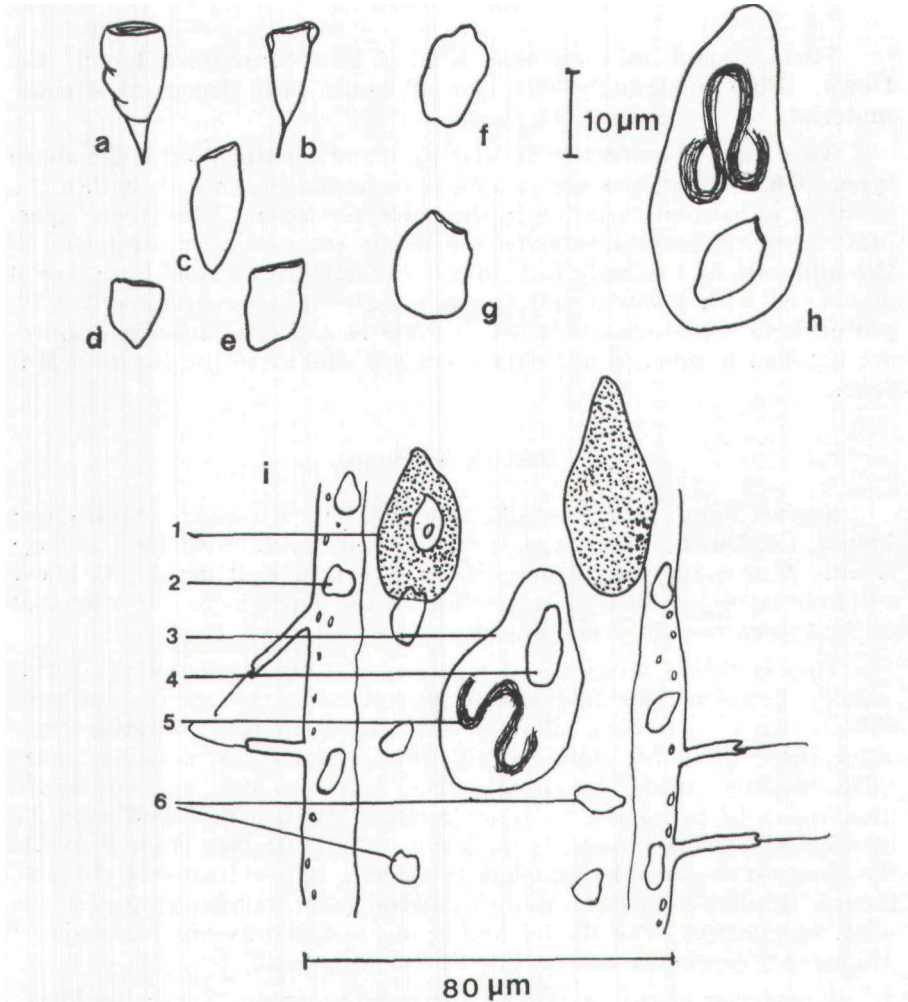


FIG. III

a, b, c, d, e: variations in shape of "spermatophores" observed in Hanna's Mill form; f: Doctor's Bay form; g: Kilclief form; h: "bursa" of Millin Bay form to show "spermatophore" and sperm bundle; i: Kilclief form; 1. oocyte; 2. epidermal gland; 3. "bursa"; 4. "spermatophore"; 5: sperm bundle; 6. dorsal glands.

inside a sac, lying just posterior to maturing oocytes; so it seems likely that it is involved with sperm transfer. This sac, which has a ventral opening at the anterior tip, is considered to be a bursa (Fig. III, h, i; Plate II, 4) and the green object is tentatively described as a "spermatophore".

The ovaries are paired and extend from U60 - U85. They lie

slightly dorsally on either side of the gut track, the most developed oocytes towards the anterior. Mature eggs are 60 - 80 μm in length and lie in the mid-line, dorsal to the gut.

Kilclief form

Surface sand, mid-low tide, Kilclief Bay, Strangford Lough, Co. Down. Fine moderately well sorted sand, with flocculent organic material.

This form is extremely similar to, if not identical with, the above type. On average, specimens appear to be longer, though within the range of individual variation in the holotypic form. The green "spermatophore" is present in some specimens situated near the testes in the mid-part of the body but, in several individuals, has been found associated with a bursa and sperm bundles at approximately U70, posterior to the ovaries (Fig. III, i; Plate II, 4). The anterior tubules are eight in number, other characters are similar to the Hanna's Mill form.

Doctor's Bay form

Surface sand, near low tide, Doctor's Bay, Kircubbin, Strangford Lough, Co. Down. This is a very polluted beach, with high sewage input. Fine sand with some silt. There is a well developed black sulphide layer just below the surface, so the *Turbanella* are restricted to the top two or three centimetres.

This is rather shorter and more squat than the holotypic form, usually between 500 - 580 μm long, extending to approximately 680 μm when stretching (Plate I, 3). The head is a rounded triangular shape as in the Hanna's Mill form, though the "neck" is generally slightly more indented. The anterior tubules are more numerous; 10 being the common number, though 8, 9 and even 13 tubules have been observed; posterior tubules ranges from 8 to 11, the two outer ones being slightly larger, approximately 10 μm . Lateral tubules tend to be more numerous also, reaching up to 44 in some specimens. The dorsal and epidermal glands are particularly prominent, especially in the tail region.

A posterior bursa containing sperm and a green "spermatophore" was present in some mature individuals; in others, "spermatophores" were paired and were generally found in the region of the mature eggs, at the posterior ends of the testes (Plate II, 2). In one specimen, both paired "spermatophores" in the testes region, as well as a bursa containing sperm and a larger "spermatophore" occurred together.

Millin Bay form

Surface sand, mid tide level, Millin Bay, Tara, Co. Down. Generally fine, poorly sorted shell sand, containing much fine plant debris.

The most obvious difference is in the head shape which is longer,

with more conical projections, and in the narrowing of the body to approximately 35 μm just anterior to the forked tail. There are 7 or 8 tubules on each caudal lobe, the outer one only being distinctly longer. The lateral and dorso-lateral tubules are longer, 14 -18 μm , and the tips are more clearly divided.

South Bay form

Surface sand, mid-low tide level, South Bay, Tara, Co. Down. Coarse, poorly sorted shell sand containing plant debris.

This form is the most distinctly different from the holotypic form; it is larger, varying between 650 μm and 950 μm length and 75 - 95 μm width and has much more distinct conical head projections, giving a head width of between 80-95 μm (Plate III,2). The lateral and dorso-lateral tubules are long, as in the Millin Bay form, and can be from 10-18 μm , with distinctly split ends. The caudal lobes bear 10 - 12 tubules each, the outer one only being distinctly longer, approximately 11.5 μm . The tubules give the lobes of the tail a straight edge, rather than the curved outline of the other types (Plate III, 4, 5). There is a very distinct median lobe, up to 8 μm long. Anterior tubules number between 9 and 12, and are longer at $\sim 12 \mu\text{m}$. Other details of ciliation, sensory hairs, reproductive system, appearance of gut and pharynx are very similar to the holotypic form.

Within the South Bay population itself, there appear to be two types which differ mainly in head shape. One form has distinct lateral projections on the sides of the head and is similar in outline to *T. cornuta*; the other is much closer to the Millin Bay form, having a very conical head shape, but without the distinct lateral extensions (Plate III,2,3). The larger size of the South Bay form may be a result of living in a coarser sediment. It appears that there is a gradation of characters throughout the South Bay/Millin Bay populations, and that these form a race isolated from the Doctor's Bay population and the Hanna's Mill/Kilclief population. The main differences between forms are summarized in Table I.

DISCUSSION

In my opinion, this group of *Turbanella* forms a single species, in which semi-isolated populations have diverged into several slightly different races. The distribution of *Turbanella* subtidally is unknown, so it is impossible to say whether these are completely isolated separate populations.

They are obviously closely related to *T. hyalina* Schultze 1853, but all forms are more elongate and bear many more dorso-lateral tubules; Schultze only describes 6-8 dorso-lateral tubules in *T. hyalina*. The terminal lateral tubule bears a sensory hair whereas this is absent in *T. hyalina* and there are no sensory hairs between the outer two tubules of the caudal lobes as in Karling's description

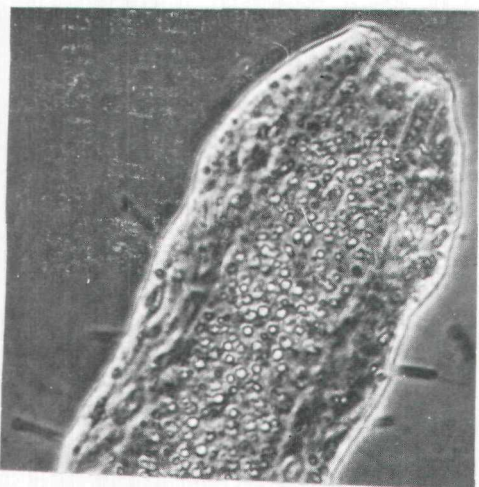
(Karling, 1954). Sensory hairs, arising directly from the body, are not mentioned in the original description.

The South Bay form, which has the most distinct lateral head projections (Plate III, 2), is very like *T. cornuta* Remane 1926 in overall appearance, but closer examination shows considerable differences between this form and Remane's described species. The lateral projections of the head are smaller; there are more anterior tubules, between 10 and 12, instead of five and the posterior tubules are more numerous, the outer one of each caudal lobe being the longest. The sensory hairs arising from the dorso-lateral tubules are much shorter than those of Remane's drawing. In later descriptions of *T. cornuta* (Remane, 1929; 1936), Remane shows a *receptaculum seminis*, containing sperm, immediately behind the mature eggs, which is obviously very similar to the bursa in this species, though no enclosed structures corresponding to the green "spermatophore" inside the bursa are drawn. The South Bay form, however, does correspond closely to Wieser's (1954) description of *T. cornuta* from Puget Sound though in general, *T. varians* is rather larger. He noted almost the same differences from Remane's original type, concluded that these were not sufficient to establish a new species, but suggested that the original "European" form and the West American form might be subspecies. Wieser gives little description of the reproductive system but shows no indication of "spermatophores" or "bursa" in his drawing of *T. cornuta*; apart from this, the only difference between the South Bay form and Wieser's drawing of the West American form is in the size and number of the posterior tubules and the median caudal lobe which are considerably smaller in the latter.

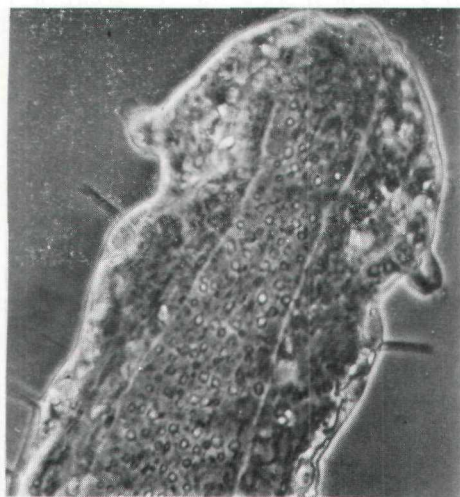
The South Bay *Turbanella*, with the reduced lateral head appendages (Plate III, 3), and the Millin Bay form appear to be intermediate between the above type and the holotypic form in head shape and in the form of the caudal lobes; also, both have the "split" lateral tubules (Fig. II c) like the typical South Bay form. It appears that

TABLE I

	Length µm	Shape	Head tubules	Anterior tubules	Posterior tubules	Lateral tubules	Dorso- lateral tubules	"Sperma- phore"	Bursa
Manna's Mill (Holotype)	560-800		Rounded conical	5-8	6-9 Two long	29-32	19-20	Yes	Present
Kilclief	600-875		Rounded conical	Generally 8	8 Two long	28-36	16-20	Yes	Present with sperm
Doctor's Bay	560-680		Rounded conical indented neck	8-13	8-11 Two long	36-44	17-22	Yes often paired	Present with sperm
Millin Bay	650-740		Distinctively conical with sharp corners	7	7-8 One long	25-30	18	Yes	Present with sperm
South Bay	650-950		Distinctly conical with lateral projections	9-12	8-11 One long	29-33	16-21	Yes	—



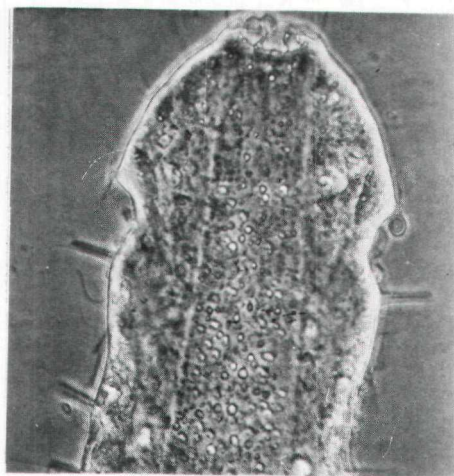
1



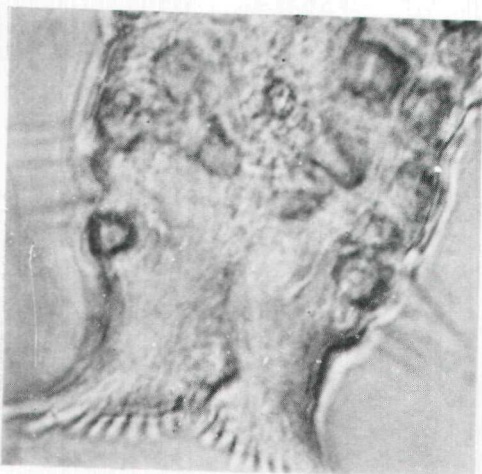
2

50 μ m

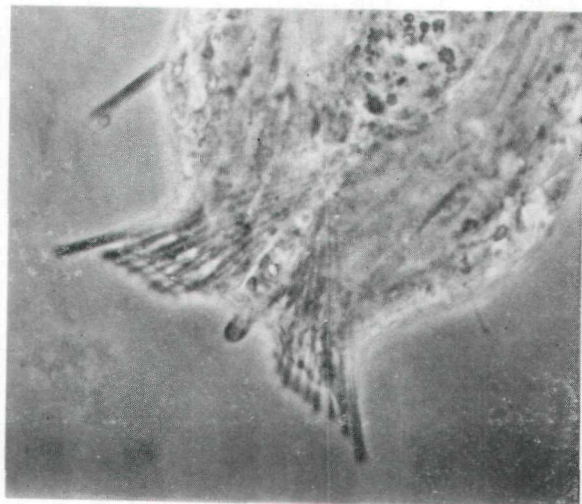
25 μ m



3



4



5

PLATE III

T. various

1: head of Hanna's Mill form; 2: head of typical South Bay form; 3: head of second form of South Bay *T. various*; 4: caudal lobes of Doctor's Bay form; 5: caudal lobes of South Bay form.

these variants show a gradation of characters within the two beaches (see Table I), and so cannot strictly be designated as sub-species or as identical with Wieser's "*T. cornuta*". These variations pose considerable problems in deciding what constitutes a new species. However the differences from Remane's descriptions, especially in the reproductive system, warrant at least, on present knowledge of *T. cornuta*, the designation of a new species.

Turbanella varians also shows certain resemblances to *T. reducta* Boaden 1974 and *T. otti* Schrom 1973 and is presumably fairly closely related; all have similar adhesive tubules arranged in lateral and dorso-lateral rows, with the latter extending into the pharynx region. General body organization is similar, but both species are smaller, only 420 and 400 μm respectively, both have a more distinctly conical head shape and *T. otti* is much broader in relation to its length. *T. otti* has fewer anterior and posterior tubules and the numbers in the lateral and dorso-lateral rows are considerably less. *T. reducta* only bears five posterior tubules and both species show a distinct median tubule. *T. reducta* has longer and fewer sensory hairs on the head and those borne on the adhesive tubules are much longer.

The presence of "spermatophores" and "bursae" cannot be used as an identifying characteristic since they were not observed in all mature individuals. The position of the "spermatophore" in the testes region in some individuals, but associated with a posterior bursa in others, is problematic and raises some interesting queries regarding its reproductive function. It is possible that the bursa occurs in all forms at a particular period of the life-span only and, thus, it could have been missed in some individuals. Although the "green objects" are variable in shape, all appear to have an opening at one end and it is possible that this could serve to hold one end of a sperm bundle during sperm transference and act as an aid to penetration and transfer into the bursa (i.e. it could serve the function of a penis).

Christiane Schoepfer-Sterrer's paper (1974) shows how little we know about the methods of sperm transfer and storage in Gastrotricha or even about the functions of long observed reproductive structures. No details of sperm transfer have been given for other *Turbanella*, and no previous descriptions of species record the presence of a bursa, except for Remane's "receptaculum seminis" of *T. cornuta*. The structure designated as "bursa" in this *Turbanella* is in a similar position behind the ripe oocytes to the muscular sacs found in *Urodasys* and *Macrodasys* species, previously called penises, but considered to be bursae by Schoepfer-Sterrer. Thus, it is possible that the sperm could be transferred in bundles from the testes via a ventral median pore with the aid of the "spermatophore" to the bursa, from which they could be released gradually to fertilize the mature eggs lying slightly anteriorly.

Summary

Five variants of a new surface sand dwelling species of *Turbanella* from Co. Down, Northern Ireland, are described. The peculiarities of their reproductive system and the possible mechanisms of sperm transfer and storage are discussed.

Acknowledgements

I would like to thank the staff of the Marine Station, Portaferry for help with collecting samples, Dr. P.J.S. Boaden for advice and criticism of the manuscript, and Bernadette Byers for typing it.

REFERENCES

- BOADEN, P.J.S., 1974. — Three new thiobiotic Gastrotricha. *Cah. Biol. Mar.*, 15, pp. 367-378.
- HULINGS, N.C. and GRAY, J.S., 1971. — A manual for the study of meiofauna. *Smithson. cont. zool.*, 78, pp. 1-83.
- KARLING, T.G., 1954. — Über einige Kleintiere des Meeresandes des Nordsee-Ostsee-Gebietes. *Ark. Zool.*, 7, pp. 241-249.
- REMANE, A., 1925. — Neue aberrante Gastrotricha II. *Turbanella cornuta* n. sp. und *Turbanella hyalina* M. Schultze 1853. *Zool. Anz.*, 64, pp. 309-314.
- REMANE, A., 1929. — Gastrotricha. *Handb. Zool.*, 2, pp. 121-186.
- REMANE, A., 1936. — Gastrotricha und Kinorhyncha. *Bronn's Klassen*, 4, 2, Buch. 1, 2, pp. 1-242.
- SCHOEPFER-STERRER, C., 1974. — Five new species of *Urodasys* and remarks on the terminology of the genital organs in Macrodasyidae (Gastrotricha). *Cah. Biol. Mar.*, 15, p. 229-254.
- SCHROM, H., 1972. — Noradriatische Gastrotrichen. *Helgolander wiss. Meeresunters.*, 23, pp. 286-351.
- SCHULTZE, M., 1853. — Ueber *Chaetonotus* und *Ichthydium* Ehrbg. und eine neue verwandte Gattung *Turbanella*. *Meier Arch. Anat. Physiol.*, 61, pp. 241-254.
- WIESER, W., 1957. — Gastrotricha Macrodasyoidea from the intertidal of Puget Sound. *Trans. Am. Micr. Soc.*, 76 (4), pp. 372-381.