shortest of all forms encountered.) These organisms remain alive for 10 to 15 minutes in the sugar solution, and this increases the flotation time to approximately 20 minutes.

In one test, a sample in which annelids were abundant was floated-out alive. The organisms were counted, then put back with the debris, and the sample was preserved and floated-out again. The sample was soaked in water for 20 minutes between each flotation period. During the first live flotation, approximately 99 per cent of the annelids present in the sample were recovered (Table 2). After the sample was preserved, only 85 per cent of the worms could be recovered in three flotation periods. The shorter flotation time after preservation made efficient recovery difficult.

Efficiency of flotation.—In order to compare the efficiency of hand-sorting and flotation, two preserved samples were first floated-out, the organisms, were counted, then put back with the debris. The samples were then sorted without the aid of flotation. In the two samples the total number of organisms recovered by hand-sorting amounted to 86 per cent and 64 per cent of the number removed during two flotation periods (Table 3). Each sample was sorted by flotation in less than one-fifth the time required for hand-sorting.

Flotation procedure adopted.—The following procedure has been adopted for sorting benthic samples. A sugar solution with a specific gravity of 1.12 is prepared (approximately 2.5 pounds of granulated sugar per gallon of solution). The specific gravity is determined with a hydrometer. The sample is drained as completely as possible through a sieve and placed in a 12- by 17-inch, white enamel dissecting pan. One-fourth of a quart to one quart of debris can be sorted at one time depending on the nature of the debris and the type and size of organisms in the sample. The material is flooded with 3 to 4 quarts of sugar solution and the debris is then stirred and distributed evenly over the bottom of the pan. Organisms are removed from the surface with a fine-mesh wire scoop. When no more organisms can be found, the sample is stirred and all additional organisms which come to the surface are removed. The sugar solution is then decanted off through the sieve and the sample is covered with water. While the sample is in water, the material is carefully examined for molluscs, insects in cases, and individuals entangled in vegetation. A careful examination will ordinarily take at least 20 minutes. After this period the water is poured off through the sieve, the sugar solution is again added, and all additional organisms are removed. If a large number of organisms are found during the second flotation period, the sample is soaked and floated-out again.

REFERENCES

BEAK, T. W. 1938. Methods of making and sorting collections for an ecological study of a stream. Progress Report III, Avon Biological Research, Annual Rept. 1936–1937, **5:** 42–46.

BIRKETT, LEON. 1957. Flotation technique for sorting grab samples. J. Cons. Int. Explor. Mer, **22**(3): 289–292.

CAVENESS, FIELDS E., AND HAROLD J. JENSEN. 1955. Modification of the centrifugal-flotation technique for the isolation and concentration of nematodes and their eggs from soil and plant tissue. Proc. Helm. Soc. Washington, **22**(2): 87–89.

HUNT, BURTON P. 1953. The life history and economic importance of a burrowing mayfly, *Hexagenia limbata*, in southern Michigan lakes. Bull. Inst. Fish. Res., No. 4: 151 pp.

LADELL, W. R. S. 1936. A new apparatus for separating insects and other arthropods from the soil. Ann. Appl. Biol., **23:** 862–879.

LYMAN, F. EARLE. 1943. A pre-impoundment bottom-fauna study of Watts Bar Reservoir area (Tennessee). Trans. Amer. Fish. Soc., **72**(1942): 52–62.

MOFFETT, JAMES W. 1943. A limnological investigation of the dynamics of a sandy, wave-swept shoal in Douglas Lake, Michigan. Trans. Amer. Micros. Soc., **62**(1): 1–23.

RICHARD O. ANDERSON

Institute for Fisheries Research
Ann Arbor, Michigan

A Note on Subterranean Nematodes from Chesapeake Bay, Md.

The subterranean water on marine beaches has been found to harbor a specialized and highly interesting fauna. The habitat was more or less discovered by Remane and Schulz (1934) and since then has been intensively studied by Remane and his co-workers, particularly by Gerlach (cf. Gerlach 1953), by Delamare-Deboutteville and co-workers (*e.g.* Delamare-Deboutteville 1954), and by some others (cf. Brinck *et al.* 1955). As a result the habitat is fairly well known along the German coast, parts of the Mediterranean coast, and parts of the West-European Atlantic coast. Other data have been published concerning such widely scattered localities as Madagascar, Southwest Africa, various points on the coasts of Brazil, Chile, Peru, and San Salvador. In North America the habitat has not been studied yet. Such an investigation, however, would be of interest, not least in order to test the thesis put forward recently (Gerlach 1954, 1955) that the marine subterranean fauna is not only specialized, but also of world-wide distribution.

As a beginning a small scale investigation was undertaken of the subterranean fauna on Chesapeake Beach, Md.[1] The study focussed on the nematodes as the dominant group of the subterranean fauna (closely followed by the harpacticoid copepods) and also the best known one, largely due to Gerlach's work.

Collections were made on two points of Chesapeake Beach, *i.e.* a fine sand locality on South Beach and a coarse sand locality on North Beach, the two being about 1 km apart. Both beaches are flat. South Beach is protected by piers, but the sand is fairly clean. North Beach is unprotected and consequently more exposed to wave action. The salinity in this area of Chesapeake Bay according to Cowles (1930) varies between 9 and 13‰, according to Timm (1952) is 10.5‰. The sampling procedure was very simple. A hole was dug into the beach until water began to seep in from below. The water was scooped up and strained through a very fine piece of bolting silk. The material retained by the latter was examined under a dissecting microscope.

The specification of the samples taken is the following:

Sample No.	Distance from high water's edge (cm)	Depth (cm)	Date	Remarks
South Beach				
F-1	50	20	10/ 8/54	little detritus
F-2	50	20	10/21/54	in the vicinity black mud under
F-3	50	20	10/21/54	the surface
F-4	250	45	10/21/54	above a layer of black mud
North Beach				
C-1	50	20	10/ 8/54	little detritus
C-2	120	30	10/ 8/54	
C-3	500	50	10/ 8/54	sand somewhat finer, less shells
C-4	100	10	6/15/55	more detritus
C-5	300	30	6/15/55	

The mechanical analysis of the beach sand in the two localities yielded the following results (in % of the total weight of each sample):

Grain size (in μ)	South Beach	North Beach	
		Sample 1	Sample 2
>810	—	65.0	52.7
810–297	—	32.9	41.5
297–149	42.4	1.8	5.3
149–74	45.6	0.3	0.1
74–52	12.0	+	0.4

The accompanying fauna consisted mainly of copepods, turbellarians, collemboles, mites, and a few oligochaetes, polychaetes, ostracods, gastrotrichs, rotifers, and one tardigrade (*Batillipes mirus* or n.sp.).

The nematodes will be described separately (Wieser ms.). Their distribution is set out in Table 1.

As can be seen, both aspects of the subterranean habitat, the coarse sand and the fine sand, are characterized by a number of species. Whether this distinction holds for sands of similar composition on all beaches of Chesapeake Bay has to await further investigation.

The nematodes found may be divided into several ecological and geographical groups.

Ecological groups:

Species restricted to subterranean water and exposed parts of the beach: *Enoplus schulzi*, *Enoploides brunettii* var. *vectis*, *Enoplolaimus litoralis*, *Dolicholaimus benepapillosus*, *Anoplostoma exceptum*, *Hypodontolaimus schuurmansstekhoveni* *Theristus otoplanobius*, *Monhystera dahli*.

More eurytopic species, also occurring on mud or (though rarely) on algae: *Dorylaimus aestuarii*, *Oncholaimium oxure* var. *domesticum*, *Paracanthonchus caecus* (most eurytopic of all species), *Graphonema tentabunda*, *Ascolaimus elongatus*, *Odontophora axonolaimoides*, *Tripyloides gracilis*, *Theristus alternus*, *Theristus oistospiculum*, *Rhabditis marina*.

Both these ecological groups are about equally abundant in the coarse sand and in the fine sand localities.

Geographical groups:

Species restricted to Chesapeake Bay (cf. Timm 1952): *Odontophora axonolaimoides*, *Dorylaimus aestuarii*, and the five new species.

Species occurring on the east coast of both

[1] The investigation was carried out while the author held a fellowship of the International Cooperation Administration. The hospitality of Dr. G. Steiner, Nematology Division, Plant Industry Station, Beltsville, Md., in whose laboratory the material was worked up, is greatly appreciated.

TABLE 1. *Numerical distribution of nematodes in the subterranean water of two localities on Chesapeake Beach, Md.*

	South Beach				North Beach				
	F-1	F-2	F-3	F-4	C-1	C-2	C-3	C-4	C-5
Theristus otoplanobius Gerlach	9	12	1						
Tripyloides gracilis (Ditlevsen)	3	1	1						
Theristus alternus Wieser		5	3						
Metoncholaimus unguentarius n. sp.		7	2						
Odontophora axonolaimoides Timm	1		2						
Enoploides brunettii var. *vectis* Gerlach			1						
Dolicholaimus benepapillosus Schulz			1						
Hypodontolaimus schuurmans-stekhoveni Gerlach	7	15	37	3	1	2		6	
Dorylaimus aestuarii Timm		1	3		1				
Paracanthonchus caecus (Bastian)	5							5	3
Graphonema tentabunda (de Man)	1				1	1			
Rhabditis marina Bastian	1	1			2	1			
Enoplolaimus litoralis Schulz	1		1		3			24	40
Oncholaimium oxyure var. *domesticum* Chitwood			6		6			14	14
Theristus camelopardalis n. sp.					1	1		30	
Graphonema biserialis n. sp.					2	9	1		1
Theristus oistospiculum Allgén					6			1	
Anoplostoma exceptum Schulz					1			2	
Spilophorella simplex n. sp.						1	1		
Ascolaimus elongatus (Bütschli)								2	
Enoplus schulzi Gerlach						1			1
Oncholaimium priapulus n. sp.							1		
Monhystera dahli Wieser						7			

Americas: the above seven species plus *Enoploides brunettii* var. *vectis* and *Oncholaimium oxyure* var. *domesticum*.

Species occurring also in northern Europe (Baltic, North Sea): *Hypodontolaimus schuurmans-stekhoveni*, *Graphonema tentabunda*, *Theristus otoplanobius*.

Species occurring also in northern Europe and in the Mediterranean: *Dolicholaimus benepapillosus*, *Enoplolaimus litoralis*, *Anoplostoma exceptum*, *Ascolaimus elongatus*.

Species occurring on both sides of the Americas: *Theristus alternus*.

Species of probably worldwide distribution: *Enoplus schulzi*, *Paracanthonchus caecus*, *Tripyloides gracilis*, *Theristus oistospiculum*, *Rhabditis marina*.

REFERENCES

BRINCK, P., E. DAHL, AND W. WIESER. 1955. On the littoral subsoil fauna of the Simrishamn Beach in Eastern Scania. Kungl. Fysiogr. Sällsk. Lund Förh., **25**(14): 1–21.

COWLES, R. R. 1930. A biological study of the offshore waters of Chesapeake Bay. Bull. U. S. Bur. Fish., **46**: 277–381.

GERLACH, S. A. 1953. Die Biozönotische Gliederung der Nematodenfauna an den deutschen Küsten. Z. Morphol. Okol. Tiere, **41**: 411–512.

——— 1954. Die Nematodenbesiedlung des Sandstrandes und des Küstengrundwassers an der italienischen Küste. II. Ökologischer Teil. Arch. Zool. Italiano, **39**: 311–359.

——— 1955. Zur Kenntnis der freilebenden marinen Nematoden von San Salvador. Z. wiss. Zool., **158**: 249–303.

DELAMARE - DEBOUTTEVILLE, CL. 1954. Eaux souterraines littorales de la cote catalane française. Vie et Milieu, **5**: 408–451.

REMANE, A., AND E. SCHULZ. 1934. Die Tierwelt des Küstengrundwassers bei Schilksee (Kieler Bucht). I. Das Küstengrundwasser als Lebensraum. Schr. nat. wiss. Ver. Schleswig Holstein, **20**: 399–408.

TIMM, W. 1952. A survey of the marine nematodes of Chesapeake Bay, Maryland. Chesapeake Biol. Lab., Solomons Isl., Md., Publ. no. **95**: 1–70.

WIESER, W. Nematodes from the east coast of North America (Manuscript).

WOLFGANG WIESER

Dept. of Zoology,
University of Vienna, Austria