A VORACIOUS STARFISH

GILBERT W. TUCKER, of Sarasota, Fla., recently sent in to the Biological Survey, Department of Agriculture, a starfish (*Luidia clathrata*) picked up on the beach, with the rays 145 mm long from the center of the disk. It had swallowed a sand-dollar or keyhole urchin (*Mellita quinquiesperforata*) 60 mm in diameter, and apparently had died as a result of the operation.

The sand-dollar has been completely digested, but the rigid test, though cracked and partly broken, still retains its shape, so that the starfish seems to have a large circular disk.

Most starfishes are very voracious, eating almost anything they can capture and swallow, especially mollusks, echinoderms and worms, sometimes of surprising size. Those with extensible stomachs feed on large bivalves, such as oysters and mussels, and also on fish that have been disabled, especially those caught in gill nets. But it is seldom that a starfish permits its voracity to overreach itself.

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ON THE COURAGE OF SCIENTISTS

IN the current number of SCIENCE (April 27), under the caption, "Disgrace of German Science," "A correspondent" asks the question, "Is there no courage left among the men of science . . .?" Well, at least your courageous correspondent, who I infer is also a scientist and, at least, a resident of this country, while basking in the sunshine of American freedom, nevertheless, one observes, finds it very convenient for himself to hide behind a pseudonym.

Of course it has not been so long ago when scholars and even public officials in this country lost their jobs for saying what they thought was right and signing their names thereto, and many of them no doubt are still kept from advancement and recognition for having done no more than that. But those men then were in the minority. Judging, however, from the many articles printed in our "big" magazine and newspapers (whose profit incidentally derives largely from lavish advertisements) your correspondent, in the game of berating our neighbors overseas and obfuscating their issues, has the majority on his side. But if he, so favorably placed, exhibits such a degree of funk what does he expect from his German colleagues who have been broken and torn by economic, political and social upheavals and cyclones without end these two decades past?

"Ah, Consistency, what a jewel thou art!"

CHARLES D. SNYDER

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ENDOSPORE FORMATION BY BACILLUS SUBTILIS IN A SYNTHETIC MEDIUM

A NUMBER of papers have appeared within recent years dealing with the old question of endospore formation by bacteria, but few of the workers have utilized synthetic media as a tool for the study of their respective problems. The absence of sporulation in synthetic media was noted by Williams,[1] who was unable to secure satisfactory spore yields with *Bacillus subtilis* in several simple media of known chemical composition. Tarr,[2] however, succeeded in obtaining good sporulation by several aerobic spore-forming bacteria after seven days' incubation in a medium containing mineral salts with a low percentage of sucrose and of secondary ammonium phosphate.

The use of a simple synthetic medium in which a high percentage of spores will be produced within a short period of incubation is very desirable, particularly in the study of physiological conditions influencing sporulation. The effect of various ion combinations on sporulation, and on the resistance to adverse environmental conditions of the spores produced, can be much more satisfactorily determined when a relatively simple synthetic medium is used than is the case when a complex organic medium is employed as a base. Also, where synthetic media are used the matter of confirmation of results is greatly simplified.

In an effort to derive a medium of simple formula suitable for the production of appreciable sporulation by *Bacillus subtilis* some sixty combinations of nutrients have been tested. In every medium except one, sporulation has been either absent or much belated. The sole satisfactory medium is of the following composition:

K_2HPO_4	.31 per cent.
KH_2PO_4	.08 " "
$MgSO_4$	.02 " "
KCl	.02 " "
asparagine	.5 " "
$(NH_4)H_2PO_4$	.1 " "
levulose	.5 " "

The salts and amino-acid are adjusted to pH 7.2, sterilized, and the levulose in sterile distilled water solution is added under aseptic conditions.

[1] O. B. Williams, *Jour. Inf. Dis.*, 44: 421–465, 1929.
[2] H. L. A. Tarr, *Jour. Hyg.*, 32: 535–543, 1932.

Bacillus subtilis grows luxuriantly in this medium, there being approximately 200,000,000 cells present per cubic centimeter of the culture after 48 hours' incubation at 37 degrees Centigrade. Sixty to 70 per cent. spores are regularly present within five days (100 per cent. in the pellicle). With Parke-Davis peptone in a 1 per cent. solution as a control, there were 370,000,000 cells, but less than 30 per cent. of these were as spores.

The simplicity of the medium and its capacity for supporting good growth and the rapid production of a high percentage of spores by *B. subtilis* justifies its use in future spore studies with this organism.

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A SIMPLIFIED TECHNIQUE FOR MOUNTING GROUND BONE SECTIONS TO SHOW AIR-INJECTED LACUNAE AND CANALICULI

THE usual method for such sections is to place a small lump of solid balsam or solidified 10 per cent. gelatine on both slide and cover-glass. Apply enough heat to dissolve the mounting medium, place bone section in liquefied balsam or gelatine, cover and cool rapidly.

Better results are obtained by mounting the dry bone section in either thin or medium thick damar balsam and permitting the balsam to dry in air. No cover-glass should be used. The specimen may be examined while the balsam is drying, for the canaliculi and lacunae become evident immediately and are much more outstanding than specimens in which the bone spaces are filled with débris.

Bone sections so prepared keep indefinitely and are much more satisfactory than those in which heat and cover-glass are necessary. By employing the technique for grinding bone already described in SCIENCE, Vol. 75, No. 1945, "Aloxite as an Abrasive for Grinding Bone Sections for Histology," in conjunction with this simplified mounting technique, an ideal method for preparation of bone sections for classroom use is achieved.

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SPECIAL ARTICLES

X-RAY DIFFRACTION STUDIES OF THE BUREAU OF STANDARDS RUBBER FRACTIONS

AT the request of Dr. Washburn, a careful preliminary x-ray diffraction study has been completed on various samples of rubber fractions prepared at the Bureau of Standards by the methods already described.[1] The results are so interesting, especially in structural differentiation between the ether-soluble (sol-rubber) and the ether-insoluble (gel-rubber) hydrocarbons, and in producing new data bearing upon the several theories of the structure of whole rubber, that it has seemed desirable to record very briefly some of the more important observations. It will be recalled that native rubber, raw, purified or vulcanized, gives a typical liquid halo or "amorphous" type of diffraction pattern in the unstretched condition, which changes to the characteristic crystal fiber pattern when the rubber specimen is stretched. Upon the basis of these facts several theories of the structure of the rubber hydrocarbon have been proposed: the folded or spiral molecules model; the fringe model (bundles of molecular chains with frayed ends); the flexible chain model and the very familiar two-phase model.

The important new observations on the fractions are as follows: (1) The purified total hydrocarbon behaves on stretching exactly as previously found for rubber.

(2) *The sol-rubber fraction produces no evidence whatever of the characteristic crystal fiber pattern upon stretching even up to 1000 per cent.* The liquid halo is retained under all conditions, but it becomes *broader* in proportion as the percentage of stretch increases (which may be due to decreasing particle size). The same results are observed in the presence or absence of antioxidants.

(3) The gel-rubber fraction produces easily, above 100 per cent. elongation, the crystal fiber pattern, which is quite sharp and intense for 200 per cent. stretch. The liquid halo remains unchanged in width and decreases in intensity as the crystal interferences increase in intensity. When, however, antioxidants are removed and the sheet allowed to stand without vulcanization, it is difficult to find crystal interferences even at 400 per cent. elongation.

(4) The sol-rubber *when vulcanized* begins to show faint evidence of crystal interferences when stretched above 400 per cent., showing that sulfur has produced a profound structural effect. Vulcanization was accomplished by the Peachey (vapor cure) method.

(5) The gel-rubber, vulcanized, gives a fiber pattern at 250 per cent. elongation.

In a detailed paper there will be presented:

Quantitative measurements on 50 or more diffraction films, correlation of these structural observations

[1] Washburn, *Phys. Rev.*, 38, 1790 (1931); Smith, Saylor and Wing, *Bureau of Standards Journal of Research*, 10, 479 (1933).