thin walls allow a rapid uptake of oxygen, and the rhythmic muscular contractions bring oxygenated cœlomic fluid into the body cavity. The presence of a respiratory pigment in the cœlomocytes[5,6] makes the cœlomic fluid well suited for transport of oxygen. That the pigment is a hæmerythrin, as stated previously[5,6], was confirmed by a spectrophotometric examination of a hæmolysate with distilled water. The appearance of an absorption maximum at 4900 Å. agrees well with observations on *Sipunculus*[7,8].

In spite of its content of a respiratory pigment the oxygen capacity of the cœlomic fluid is rather small. By measurements with a van Slyke apparatus the value of 0·014 ml. oxygen per ml. fluid was obtained. For sea-water the value 0·006–0·007 was found. The oxygen dissociation properties of cœlomic fluid was studied by a crude colorimetric method. Half saturation was obtained at an oxygen tension of 60 mm. mercury, which indicates a slowly sloping dissociation curve. However, the measurements were made at 19° C., which is above the temperature of the natural environment of *Priapulus caudatus*.

It is an unsolved problem how respiratory movements of the caudal appendage can be triggered by an increase of oxygen tension in the surrounding sea-water. Probably, the movements are initiated from the nervous system, because the muscles of the appendage are innervated from the abdominal nerve trunk[1].

We are grateful to Dr. Knut Schmidt-Nielsen of Duke University, Durham, North Carolina, who made the van Slyke analyses.

RAGNAR FÄNGE*
ARTUR MATTISSON†

The Zoological Station,
Kristineberg, Sweden.

* Institute of Zoophysiology, University of Oslo, Norway.
† Zoophysiological Institute, University of Lund, Sweden.

1 Molcanov, L. A., *Bull. Acad. Imp. Sci. St.-Pétersbourg*, 957 (1908).
2 Hammarsten, O. D., and Runnström, J., *Bergens Museums Aarbok, Naturv. raekke nr.* **13**, 1 (1918).
3 Menzies, R. J., *Nature*, **184**, 1585 (1959).
4 Lang, K., *Arkiv. Zool.*, **41** *A*, 5 (1948).
5 Fänge, R., *Nature*, **165**, 613 (1950).
6 Fänge, R., and Åkesson, B., *Arkiv. Zool.*, **3**, 25 (1951).
7 Florkin, M., *Arch. Int. Physiol.*, **36**, 247 (1933).
8 Roche, J., *Bull. Soc. Chim. Biol., Paris*, **15**, 1415 (1933).

ANATOMY

Properties of Stressed Bone

PROF. DREYER's communication[1] raises a matter of considerable interest and importance. Engineers know that all materials react similarly on broad principles. That is, they obey Hooke's law, within wide ranges, of course, and conform to other physical changes under stress such as Poisson's ratio.

There is no reason to doubt that bone material differs in principle from other created material. As such it should be, and probably is, elastic up to a yield point. Experiments on living bone may be difficult, but if Young's modulus for bone tissue, or the range of elastic limit, could be determined it would be most helpful. Moreover, its subsequent behaviour beyond that point up to fracture should be established, and would then provide an answer to the problem under investigation by Prof. Dreyer.

Moreover, the amount of compression and extension under stress, as well as the degree of bending under torque, or eccentric loading, are clearly forms of bone characteristics that ought to be known. Naturally the reactions on colour referred to by Prof. Dreyer are a measure of the reaction set up to applied stresses, and are familiar to every engineer. 'Perspex' and celluloid, in the form of full-size models, indicate changes in colour under stress, and show the pattern and distribution of stresses set up under applied loads. They can also be used to reveal the effects and redistribution of stress under fatigue due to repetitive loading. A breakdown then occurs of normal strength leading to failure at a much lower stress. This, of course, is of considerable importance with a lowering of the elastic limit by age.

H. M. PEARSON

British Transport Commission,
British Railways Division,
222 Marylebone Road,
London, N.W.1.

1 *Nature*, **189**, 594 (1961).

THE problem that needs elucidation is to determine the nature and origin of the osteoblastic and osteoclastic stimuli which, when associated with a normal metabolism, will influence the deposition or removal of bone.

These stimuli may originate as a result of function or non-function of a bone. It is therefore tempting to suggest that stress produces some change in the inorganic or organic portion of the bone. The stress is then converted to a stimulus which affects the neighbouring osteogenic tissue.

The crystalline structure of bone had led us to believe that these stimuli may be electrical. The piezoelectric properties of bone have been investigated, but so far my results have not been encouraging. Thus when I found the alteration in staining properties and birefringence of bone as a result of stress I felt that these changes may well be related to the origin of locally produced osteoblastic and osteoclastic stimuli in bone.

I am not sure that the phenomenon that I have described is quite comparable with the changes seen in colour in stressed 'Perspex', celluloid, transparent 'Balelite' and 'Araldite' (Ciba).

When these materials are stressed with mild forces the changes in colour occur almost immediately and conversely disappear as soon as the force is released. My *in vitro* experiments show that the birefringent portion of the bone does not, even after 24 hr., revert to its unstressed state when the stress is removed; yet *in vivo* this must be a reversible process. Of course, the picture with massive forces and the influence of temperature is an entirely different matter.

C. J. DREYER

University of the Witwatersrand,
Milner Park,
Johannesburg.

Influence of Large Doses of Œstrogens on the Structure of the Bones of Some Reptiles

IT was first shown by Kyes and Potter[1] that, during reproductive activity, the marrow cavities of the bones of female pigeons become filled with endosteal bone. It is thought that this medullary bone is formed under the synergistic action of the androgens and œstrogens[2] which are produced in the female bird during the breeding season. Similarly, injections of œstrogens induce the formation of medullary bone in