The order of hardness is:—Diamond, iridium, platinum, iron, arsenic, antimony, gold-copper-silver, aluminium, tin, bismuth, and lead-sulphur. (It is probable that arsenic and antimony were tested in a crystalline state, in that respect differing from the three metals above and the four below them.)

The order of ascending coefficients of expansion is:—Diamond, arsenic, iridium, platinum, antimony, iron, bismuth, gold, copper, silver, tin, aluminium, lead, and sulphur. Here the agreement is not so close as before.

Doubtless coefficients of expansion themselves depend partly on how far the mean range of temperature from which they are calculated is removed from the melting point. For strict comparison, what are known as "corresponding temperatures" should be taken. If this is done for coefficients of expansion of gases, then the values become identical; with solids (or liquids) the coefficients would approach, but never reach, uniformity.

In practice engineers are bound to consider arbitrary temperatures which will affect their mixed materials, but a knowledge derived from comparison of physical properties at corresponding temperatures would enable them to predict special changes among the mixed material which would occur when temperatures rise or fall. REGINALD G. DURRANT.

University College, Reading.

The Hardening of Metals under Mechanical Treatment.

IT appears from an article by Mr. Ernest A. Smith in NATURE of November 18, p. 381, that the cause of the hardening of metals under mechanical treatment is still regarded as obscure.

May I suggest, for the consideration of research associations and others concerned, that all the phenomena of plastic deformation, including hardening by distortion, are aspects of what Osborne Reynolds has called "dilatancy," and that this twentieth century is no time for random empirical experiments conducted without either guiding principles or clearly defined objectives?

Reynolds has shown that the density of a granular solid must change when the solid is distorted. There is ample evidence that distortion alters the density of metals, and no very valid reason for assigning the accompanying alteration of "hardness" (and other properties) to anything but a change in the pattern of the grains, *i.e.* to dilatancy.

Systematic experimental investigation can scarcely fail to have far-reaching results, and may even bridge the gulf between mechanics and the more exact sciences. J. INNES.

12 Edward's Road, Whitley Bay,
Northumberland, November 22.

Tube-dwelling Phase in the Development of the Lobster.

WHILST the development of the lobster from the Schizopod stage onward to an inch or a little more is fairly well known, the great rarity of the stages between that and 3 in. or 4 in. (second year) has often puzzled marine zoologists. For instance, only once in many years has a small lobster of about 4 in. been seen at St. Andrews, and this example was tossed amidst a vast quantity of débris on shore after a violent storm. Prof. Prince, Dominion Commissioner of Fisheries for Canada, and president-elect of the American Fisheries Society, who has inaugurated many important advances in scientific fisheries work, tells me that Prof. Knight, who has been investigating the subject, finds that "after the pelagic stage the young lobster appears to frequent shallow bays and make a definite burrow with two entrances, and it sits on guard at one, but if in danger escapes by the other. It is very quick in emerging, but Prof. Knight and his assistant got 200 to 300 in a bay in Prince Edward Island. Now we know the reason of our failing to capture these very small lobsters from 1½ in. to 3 in. long. The dredge cannot secure them, yet they must occur in countless millions in our Canadian bays, since many more than 100,000,000 adults are taken in our waters for canning and the live-lobster trade in good years." Thus the rarity of the little lobsters of the stage indicated is explained.

It is interesting that the adult, as shown by Dr. H. C. Williamson, of the Scottish Fishery Board's staff, has a similar fondness for cavities, which it searches for with its antennæ, and will even turn out a weaker neighbour and seize its shelter.

W. C. McINTOSH.

Contractile Vacuoles.

I HAVE just read W. Stempel's paper, "Ueber die Funktion der pulsierenden Vacuole," to which Prof. Bayliss kindly directed my attention in NATURE of November 18, p. 376. Stempel's idea as to how the contractile vacuole works appears to differ fundamentally from my conception of its mechanism. He regards it as a preformed organ of the cell, developed to eliminate the waste products of metabolism, these products being introduced into the vacuole by the radiating canals which he endows with peristaltic action. He further postulates the existence of non-return valves between these radiating canals and the vacuole, and also of one at the point of exit of the fluid to the exterior. He considers that the evacuation of the contents is effected by the osmotic pressure in the vacuole, opening the valve and thrusting out the fluid, by the surface tension of the extruded drop, and by the pressure of the protoplasm. He does not indicate that the elasticity of the protoplasm or its tenacity enters into the mechanism. My suggestion may be summed up in the much simpler statement that the contractile vacuole is a necessary development in the protoplasmic semi-permeable gel wherever sufficient soluble material accumulates, the radiating canals being formed by the elastic recovery of the gel after rupture. HENRY H. DIXON.

School of Botany, Trinity College, Dublin,
November 20.

Leptocephalus of Conger in the Firth of Clyde.

IN a recent issue (vol. xii., No. 2, July, 1920) of the Journ. Mar. Biol. Assoc. Mr. E. Ford, in a "Note on a Leptocephalus Stage of the Conger," gives a "summary of captures around the British Isles." To the records there given, may I add two from the Firth of Clyde?

(1) July, 1907; off Keppel Pier; 3 fms.; length, 120 mm.; depth, excluding fins, 8 mm.; a distinct row of black spots along the lateral line. Taken from the stomach of a saithe (*Gadus virens*).

(2) March, 1908; Ardneil Bay, 10 fms.; taken from the stomach of a cod (*G. callarius*); too much digested to give any details. RICHARD ELMHIRST.

Marine Biological Station, Keppel, Millport.

Spiranthes autumnalis.

SIR HERBERT MAXWELL will, I am sure, allow me to make a little correction in his statement on p. 409 of NATURE of November 25; it was not Sir Joseph Hooker, but Sir William who in 1843 doubtfully described a solitary specimen of *Veronica tetragona* as a species of the coniferous genus Podocarpus. Oddly enough, the plant was correctly described from a flowering specimen in the same volume of Hooker's "Icones" on a later plate.

B. DAYDON JACKSON.

Linnean Society, Burlington House,
London, W.1, November 26.