some particular organ only of B may be supplied from A, this organ being cut off from the circulation of B. The details of the procedure cannot be described here, but some recent improvements in the technique may be referred to. The chief difficulty lies in the fact that when the blood comes into contact with any foreign surface that is wetted by it, such as the glass or india-rubber tubes connecting the two animals, clotting occurs. This may be obviated by making the blood incapable of clotting. A substance extracted from the heads of leeches will do this, but it is at the present time almost impossible to obtain it. Other substances having the same effect are too poisonous. Since the blood does not clot in the uninjured blood-vessels themselves, Hédon in France and Dale and Laidlaw in this country have made use of pieces of vein to connect the blood-vessels required. The latter workers desired only to divert the blood from one vein of an animal into another of the same animal, so that no great internal pressure was present, and it was sufficient to pass a short metallic tube (Crile's canula) over each end of the piece of vein, reflecting the ends over the tube and tying them. When this is done, and the tube is introduced into a blood-vessel, the blood comes into contact only with the lining of a normal blood-vessel. Hédon, wishing to connect the artery of one animal with that of another, took a metallic tube long enough to enclose nearly the whole length of the piece of vein and reflected the ends over this. The vein was thus adequately supported against the pressure of the blood in the arteries.

Bazett and Quinby, in the current issue of the *Quarterly Journal of Experimental Physiology* (vol. xii., No. 3), describe a method in which the fact is made use of that if blood is in contact only with a foreign surface not wetted by it, clotting is absent for a long time. They coated the interior of the glass and rubber tubes used with a mixture of paraffin and vaseline, and by interposing a specially constructed stopcock were able to connect the circulation of the two animals or return to normal at will.

These improvements in the technique of cross-circulation should render it possible to investigate problems hitherto difficult to solve. There is one disadvantage in it which must not be overlooked. This is the fact that a fall in the blood-pressure in one animal causes an inflow from the other when there is complete intercommunication between the two. Thus one of the animals may be seriously depleted if the low pressure lasts for any length of time. For this reason the production of wound-shock in one animal by the products of tissue-injury of another seems impossible, because the fall of blood-pressure, which is the most marked symptom of the state, would in itself drain blood from the normal animal and produce a similar state merely by loss of blood, apart from the action of a chemical substance. W. M. BAYLISS.

NICKEL-CHROMIUM STEEL FORGINGS.

DURING the war there was a considerable development of the use of alloy steels, in particular of those containing nickel and chromium. These uses were of the most varied kinds, not the least important being in the construction of internal-combustion engines used in aircraft, where service conditions are very severe. It is not surprising, therefore, that difficulty in complying with the specifications was encountered in manufacture, and much novel experience has been accumulated by technical workers in this field of steel metallurgy.

At the autumn meeting of the Iron and Steel Institute two important papers relating to this class of steel were presented: one was by Messrs. Andrew, Greenwood, and Green, of the metallurgical research department of Sir W. G. Armstrong, Whitworth, and Co.; the other by Mr. R. H. Greaves, of the research department, Woolwich Arsenal. It is interesting and significant to note that the latter paper is entitled "Metallurgical Communication No. 1, from the Research Department, Woolwich."

Messrs. Andrew, Greenwood, and Green, who took up the investigation of defects in the final tests of nickel-chromium forgings, have carried out their work in a most thorough and exhaustive way, following up the manufacture of these from the original casting to the finished article. It needs considerable courage for the investigators in a works to publish evidence showing manifest defects in the products of the firm's work, and the authors are to be commended for their honesty in taking this step. It is but rarely that such cases are met with.

The manufacture of a hollow forging may be divided broadly into three distinct sets of operations: casting, forging, and heat treatment. The authors emphasise the operation of casting as the most important of all, because any defects present in the ingot, generally speaking, persist throughout up to the final treatment. It is essential that not only the metal but also the mould-walls should be clean, and that all loose sand must be prevented from getting into the mould. As a method of assisting in the achievement of these results, the authors suggest the use of a tundish with sloping walls lined with basic material. They say that if the metal were run directly into this from the iron ladle, the sloping walls of basic material would act as a cleanser, since the slag would adhere to the sides of the dish. The cleansing action would be similar to that brought about with mercury when poured through a paper cone with a fine orifice at the bottom. They recommend that ingots should be cast wide-end up, and that the smallest size consistent with requirements should be used. They recommend further a high-ladle, but a low-casting, temperature, since this is found to be advantageous in cleansing the metal. The macrostructure of the ingot is determined by the temperature and method of casting. High-casting temperatures are to be avoided because they give rise to excessive segregation, ghost lines, etc., and coarse crystallisation.

The authors advise that, after casting, the ingot should not be allowed to cool more than is unavoidable, but should be solid forged as soon as possible. This breaks up the crystals, thus refining them. It also assists in the diffusion of the carbon and thus renders the mass more homogeneous. The effect is to produce a much stronger material the thermal treatment of which can be undertaken with greater safety. In carrying this out with large forgings, very slow heating up to the temperature range, 730–760° C., must be adopted. Above this the rate of heating may be quicker. The authors suggest further that they have obtained evidence that mechanical work can be overdone, and that the greater the amount the more prone is the tendency to a laminated fracture. A somewhat similar point was made by M. Charpy in a recent paper published on "The Hot Deformation of Iron and Steel." With regard to the final heat treatment the authors say that the temperature of oil-hardening appears to make little or no difference to the mechanical properties; *the* important factor is the time at the temperature in question. This should be as short as possible, since a prolonged heating even at 850° C. coarsens the grain-size and causes a deterioration in properties.

The paper by Mr. Greaves deals with the "temper brittleness" of a nickel-chromium steel containing 3·5 per cent. of nickel, 0·6 per cent. of chromium, 0·5 per cent. of manganese, and 0·25 per cent. of carbon. This term is applied to the condition induced in such a steel by slow cooling from the tempering temperature, and is revealed by a low absorption of energy in the single-blow impact test on notched bars. The author has found that wide differences in the impact figure with almost identical tensile test results can be produced by suitable heat treatment. He has also found that whereas, after hardening, every tempering treatment involving a final rapid cooling from 600° C. or above produced good impact figures, a final slow cooling produced a considerably lower, and often a bad, impact figure; further, that in any given steel the degree of brittleness which can be produced by a given condition of tempering depends on the original hardening temperature. The higher this is, the lower is the impact figure. He has also found that reheating to about 520° C. produces brittleness, whatever the subsequent rate of cooling, and that this can be removed by reheating to between 600° C. and 670° C. and cooling rapidly.

These results can be explained on the assumption that a critical temperature or temperature range exists in the neighbourhood of 550° C., above which the tough, and below which the brittle, condition is stable. Quick cooling through this temperature retards this change, and the unstable tough condition is retained. Slow cooling results in the production of the stable brittle condition. If the tough material is heated to a temperature rather below the change point, the rate of change to the brittle condition is at a maximum, and brittleness results. The rate diminishes rapidly with fall of the temperature, and below 450° is negligible. Provided, therefore, the critical temperature is not exceeded, the rate of cooling after this reheating is immaterial. Mr. Greaves does not show any cooling or heating curves of his steel. Those published by Messrs. Andrew, Greenwood, and Green on a steel of approximately the same composition indicate that the carbon-change point on cooling occurs between about 490° and 465° C. The character of the curve obtained depends upon the initial temperature from which the steel is cooled.

H. C. H. C.

CEPHALODISCUS AND THE ARCHICHORDATES.[1]

THE history of Cephalodiscus, dredged at 245 fathoms in the Strait of Magellan by the *Challenger*, and at first taken for an Alga, and then for a compound Ascidian, goes back only three dozen years. Moreover, the sole species (*C. dodecalophus*) held the field for twenty-one years before the other species made their appearance; but now, with Dr. Ridewood's memoir before us, the total number of species reaches from twelve to sixteen, though further research may reduce that number. It is noteworthy that whilst the majority group themselves around the South Pole, four occur in the Indian and Pacific Oceans.

In the present memoir Dr. Ridewood, already known as an authority on the subject, keeps to the classification adopted previously, the group Pterobranchia (Aspidophora of Allman) having three subgenera of Cephalodiscus, viz. Demothecia, colony branched, with a continuous cavity throughout the cœnœcium; Idiothecia, colony branched, but each aperture leading into a tube occupied by one zooid and its buds; and Orthothecus, in which the colony is cake- or cone-like, each aperture entering a tube holding a zooid and its buds. The author first treats of the structure of the zooids, the similarity of which throughout the whole series is noteworthy; only in the reduced male zooids of *C. sibogae*, Harmer, is there a divergence. This fact alone would give differences due to variations in the cœnœcium less weight.

Amongst other features of interest are the enlargements at the ends of the tentacles, for instance, in the original species, which the author terms "end-swellings with refractive beads," and it is curious that no special function has been assigned to them. Similar enlargements at the tips of the branchial filaments are prominent features in Filograna and the so-called Salmacina, and great weight has been placed on them specifically, and even generically, by certain observers. In all probability they are sense-organs in both groups, since they are not connected with secretion, nor do they perform the function of opercula in Filograna (a Serpulid), in which form they are present or absent with puzzling indifference, for the plasticity of the species is phenomenal. The changes in the character of the epithelium on the dorsal and neural surfaces of the arms, and on the two surfaces of the post-oral lamellæ, are probably due, as in other forms (*e.g.* the Serpulids), to differences in function. The length of the testis is thought by the author to be a specific character, but that of the ovary is not.

Details are given of a new species, *C. evansi*, a branched form, in which each ostium leads into a tube ending blindly in the middle of the branch. The other three species procured in the expedition were formerly known, viz. *C. nigrescens*, Lankester, *C. densus*, Andersson (which the author considers to be a variety of the next), and *C. hodgsoni*, Ridewood. Thereafter a discussion on the Demothecia occurs, the species being extremely difficult to distinguish either by cœnœcium or zooids, and it is possible that future observers may reduce the number of species, since the variations of both cœnœcium and zooids in a single species are considerable.

No new feature is given in connection with reproduction and development further than that the author thinks there is no certain relation between the number of arms and the sex, as Andersson did, and that in *C. hodgsoni* the short stalk of the egg spreads over the egg-shell. Males, females, and hermaphrodites are found in *C. hodgsoni*, *C. aequatus*, *C. nigrescens*, *C. solidus*, and *C. densus*, whilst no males have yet been found in *C. dodecalophus*, *C. levinseni*, and *C. gracilis*. In *C. sibogae* and *C. agglutinans* only males are known, and in *C. gilchristi* and *C. evansi* both sexes frequent the same colony.

The author makes no allusion to the systematic position of Cephalodiscus in zoological classification, or to the homologies of the organs which have received the attention of many zoologists in connection with that classification. Dr. Masterman's Archichordata (Trimetamera), therefore, stands as before, with its two classes (1) Hemichordata (*e.g.* Balanoglossus) and (2) Diplochordata (*e.g.* Phoronis, Cephalodiscus, and Rhabdopleura), though not without dubiety in certain aspects, which even the labours of Spengel, Weldon, Cori, Fowler, De Selys-Longchamps, Lankester, Harmer, Gilchrist, Ridewood, Schepotieff, Davidoff, Hill, Gravier, Pixell, and Roule have not quite elucidated. Much of the dubiety is connected with the notochord and the gill-slits. Dr. Harmer thought that the proboscis-vesicle and "heart," with the notochord, essentially agreed with the condition in Balanoglossus, as described by Mr. Bateson; but Dr. Masterman, keenly working at Actinotrocha, Tornaria, Phoronis, and the young forms of Cephalodiscus, held that the primitive types had a double notochord, and his beautiful and accurate drawings speak for themselves whatever interpretation may be put

[1] "British Antarctic (*Terra Nova*) Expedition, 1910. Cephalodiscus. By Dr. W. G. Ridewood. With 12 text-figures, 5 plates, and a map (Published by the Trustees of the British Museum (Natural History), 1918.) Price 12*s*.