

Research Items.

SKILL.—The nature of skill is discussed by Prof. T. H. Pear in the October issue of the *Journal of the National Institute of Industrial Psychology*. He begins by defining skill as an integration of well-adjusted performances, and distinguishes it from capacity and ability; it shows itself in the rapid adjustment to a changing environment and to unforeseen circumstances. Skills may be classified as (i) collections of imperfectly adapted responses, for example, much domestic work and the skill of most workers in semi-skilled trades; (ii) perfectly adapted responses which do not exhibit personality, for example, movements on parade of the perfectly drilled soldier; (iii) responses resembling habits, but less specific and automatic; (iv) responses like those in (iii) but exhibiting in their totality a pattern characteristic of the individual; (v) creative skill. Prof. Pear then discusses the possibility of the transfer of training between motor abilities. Although experiment is very difficult in this field, yet there does seem to be experimental evidence in favour of the belief that manual habits acquired during training do not transfer to other activities. Prof. Pear suggests that the reason may be because in many low-grade industrial tasks only minimal attention is required: transfer might therefore not be expected between this almost 'insulated' entity and the rest of the personality. Although the belief in transfer is widespread and the problem is an old one, yet whenever attempts have been made to obtain experimental evidence, that evidence so far has been negative.

RESPONSES OF CORALS TO ENVIRONMENT.—In the *Bernice P. Bishop Museum Bulletin No. 45*, Mr. Charles Howard Edmondson records the results of his work in a paper entitled "The Ecology of an Hawaiian Coral Reef." A section of the Waikiki Reef was specially studied, situated on the south shore of Oahu, close to the Marine Biological Laboratory of the University of Hawaii, where most of the experimental work was carried out. The responses of the corals to temperature and salinity, silt and sunshine, were studied. Rising and falling temperatures completely inhibit the feeding responses of Hawaiian shallow water corals within a few degrees of their death points. On the reversal of temperature after complete inhibition of the feeding responses, feeding is resumed much more quickly from a condition of heat paralysis than from that of cold rigor. The corals show greater resistance to decreasing than to rising temperature, although resistance varies according to the species. *Leptastrea Agassizi* and *Favia Hawaïensis* live within the widest range of temperature, enduring extremes of both heat and cold, provided the thermal change be gradual. Exposure of 30 minutes to fresh water is fatal to nearly all species of these shallow-water corals, but by a process of gradual accommodation many can live in greatly reduced salinities, the planulae of *Cyphastrea ocellina* being capable of enduring a 50 per cent dilution of sea water for 25 times as long as the adult. The corals adapt themselves less easily to increased salinities. Of the 23 species buried under 4 inches of sand and silt, all but 2 survived a period of 12 hours, less than 50 per cent. endured it for 24 hours, and only 3 species were alive after 5 days. It was interesting that some individuals of *Favia Hawaïensis* and *Leptastrea Agassizi* survived after 10 days. *Favia* seems to be strongest of all and most resistant in every way. Although 50 per cent of the species die within 30 minutes if entirely removed from sea water and exposed to the direct rays of the sun during the hottest part of the

day, if the bases of the colonies remain submerged those with porous skeleton may live much longer, and sunlight is important in the life of the shallow-water corals. About 50 per cent die in 18 days if cut off from direct sunlight.

MARINE OSTRACODS.—In the *Occasional Papers of the California Academy of Sciences*, 15, August 1928, Mr. Tage Skogsberg continues his "Studies on Marine Ostracods," Part I having been published in 1920. The present part (Part 2) deals with the external morphology of the genus *Cythereis*, and describes twenty-one new species. Of these, five are from California, the remainder having been taken in the Antarctic regions by the Swedish Magellan Expedition in 1896, or by the Swedish Antarctic Expedition in 1901-03. *Cythereis* has a thick shell usually with elaborate sculpture, both shell and sculpture being very variable. It was raised from a subgenus of *Cythere* to a separate genus by Baird in 1850, the shell only being then known, and in 1865, G. O. Sars described the appendages of certain species. The present author finds that a subdivision of the genus on the basis of the shape and structure of the shell is not practicable. He therefore bases it on the structure of the appendages and of the penis, the differences in the latter organ being of importance. Three subgenera are recognised, and the descriptions of the species are detailed and elaborate. The paper is well illustrated by text figures by the author, and plates by Mr. G. Liljevall.

NEW COMMENSAL COPEPODS.—Mr. H. R. Seiwell has discovered two new species of copepods living as commensals in the branchial chamber of the compound ascidian *Amaroucium* commonly known as 'Sea Pork.' These he describes in the *Proceedings of the United States National Museum*, vol. 73, art. 18, 1928, No. 2739. "Two New Species of Commensal Copepods from the Woods Hole Region." Both copepods belong to the Harpacticidae, and are of the genera *Tisbe* and *Amphiascus*, and both occurred abundantly. The branchial chamber of ascidians is a favourite habitat for copepods, and probably much new material might be found if a careful search were made.

DISEASES OF GAMMARUS.—Dr. H. Pixell Goodrich (*Quart. Jour. Micr. Sci.*, Oct. 1928) records the occurrence in *Gammarus pulex* of *Thelohavia* and *Nosema*, and gives a full account of observations on a yeast-like organism, *Cryptococcus gammari*, which may be so abundant that the blood appears almost solid and the amphipod has an opaque whitish appearance. The yeasts are ingested by phagocytes, and some of the latter secrete a chitinoid substance which envelops them. By co-operation of phagocytes, large chitinoid nodules may be formed which afterwards become dark brown and may be seen through the body wall. The chitinoid secretion of the phagocytes is not identical with true chitin of the exoskeleton. There appears to be a tendency for the yeasts to accumulate in the tips of the appendages, and such infected appendages have been observed in process of being thrown off autonomously, separation from the body taking place at a joint across a plate of chitinoid substance secreted by phagocytes which had collected in that region. A similar chitinoid substance by which wounds are closed in *Gammarus* is also a product of the leucocytes.

AGALINIS AND ALLIES IN NORTH AMERICA.—The first part of a survey by Francis W. Pennell (*Proc.*

Acad. Nat. Sci. Philadelphia, vol. 80, p. 339-449) of the North American species belonging to the hemiparasitic Scrophulariaceous genus *Agalinis* and its allies deals with the taxonomy and distribution of seven of the nine genera. A full consideration of the phylogeny of the group based on a comparison of the several genera with a hypothetical prototype points to *Aureolaria* as approaching most nearly to the ancestral type, and *Anisantherina*, in which morphological specialisations indicate a closer affinity to a series of Old World genera than to any other American genus, as the most highly evolved. The largest genus, *Agalinis*, is counted of recent origin in the United States. The relationship of the genera shows their common origin, and the occurrence of the most primitive species in Mexico is adduced as evidence for that area being the geographical centre of the American species.

THE 'HYBRIDISATION NODULES' OF SWEDES.—On certain cultivated cruciferous plants, tumour-like outgrowths or nodules occur upon the roots which are very reminiscent of the well-known 'finger-and-toe' disease caused by *Plasmidiophora Brassicæ*, but in many of these growths no parasitic organism has been found. These excrescences frequently give rise to adventitious buds from which colourless leafy shoots push up through the soil. Such nodules were very fully discussed by Helweg in his investigations of hybrids between the swede and turnip. He concluded that the tendency to form these nodules is a hereditary character that appears in certain hybrids. Since this work such structures have been described as 'hybridisation nodules,' but this point of view must be revised in the light of A. W. Bartlett's paper in the *Transactions of the British Mycological Society*, vol. 13, Parts 3 and 4, Oct. 1928. Swedes bearing nodules of this type occur frequently in the fields around Newcastle-upon-Tyne, and under microscopic examination, whilst the nodule itself was free from any parasite, a species of *Olpidium* was found in abundance in the cells of the rootlets that were springing from the base of the nodule. Both temporary and resting sporangia of *Olpidium radicum* de Wildeman were usually obtained, this being the first record of this species for Great Britain. It appears to be very destructive to seedling plants of swede and turnip, and Bartlett supplies experimental evidence that it may be responsible for the appearance upon the diseased host plant of the so-called 'hybridisation nodules.'

EUCALYPTS IN CALIFORNIA.—A key by Eric Walther to the species of *Eucalyptus* grown in California has been published in the *Proceedings of the California Academy of Sciences* (4th Ser. vol. 17, No. 3; 1928). "Of California's cultivated trees," the author writes, "the most striking are easily the several species of Eucalyptus. Their towering, serried ranks dominate the landscape and lend it a unique, exotic flavour totally lacking in other parts of the United States." The only species generally seen and planted to-day is *Eucalyptus globulus*, but during the boom a few years ago many other species were tried. It was apparently not realised that Australia had a great diversity of climate with fairly moist as well as dry regions, some 350 species of the genus being found there. The consequent variation in requirements of different species probably accounts for the want of success attained in California with many of the species made use of. In the author's opinion, before further planting was undertaken or new species introduced into the country, it was necessary to collect statistics regarding the species already to be found in California and their relative status. It is with this object that he undertook the work of preparing his key, and it

may be conceded that he appears to have admirably succeeded in his task. Species and varieties to the number of one hundred are actually growing in California to-day, more especially in Golden Gate Park, San Francisco, on the University Campus at Berkeley, and at the former Experiment Station at Santa Monica, and elsewhere. In his paper the author has closely followed the late J. H. Maiden's comprehensive work, "A Critical Revision of the Genus *Eucalyptus*." The method adopted in the preparation of the key to the species appears simple, and should readily enable the user to run down the species he is interested in. Following the key an alphabetical list of the species is attached. The author also appends a list of the names of no less than 77 species, which he states "have been reported at various times as grown in California, or seed has been offered. No opinion can be expressed as to the correctness of these names until sufficient material for their determination becomes available." Mr. Walther may be congratulated on a paper of much general utility.

TERTIARY SHELLS FROM JAPAN.—Prof. Matajiri, Yokoyama, continues his researches into the Tertiary mollusca of Japan, and contributes two more papers to the *Journal of the Faculty of Science of the Imperial University of Tokyo* (Sect. 2, vol. 2, pt. 7). The one on the "Pliocene Shells from Hyuga," in the island of Kiushiu, deals with specimens collected in the neighbourhood of Takanabé. Upwards of a hundred species are recorded, including many that are new. These last, as well as some rare or important species, are specially described and illustrated on two plates. The other paper concerns "Neogene Shells from the Oil-field of Higashiyama," in the province of Echigo, Main Island. Nearly a hundred species are tabulated, nine being regarded as new, and figured on two plates.

A NOVEL VISCOSIMETER.—A new viscosimeter, resembling the well-known Engler pattern, is described in the *Chemiker-Zeitung* of Nov. 7, in which the special feature is a double system of corrugated radiator plates attached radially to the inner wall of the outer vessel and to the outer wall of the inner vessel respectively. By means of this device, uniform distribution of heat is secured without the use of a stirrer, and it is claimed that very satisfactory tests extending over a number of years have been made. The outer bath is protected from rapid loss of heat by radiation by means of an asbestos covering and a double-walled cover is provided. Other fittings include a levelling device, a special outlet valve for the oil, and a stopcock by means of which the heating-bath can be drained. The readings are the same as with Engler's viscosimeter, so that no correction is required. The apparatus is supplied by the firm Emil Dittmar and Vierth of Hamburg, and can be adapted for heating by gas or electricity. Viscosimeters of older pattern can also be fitted with the new radiators.

THE SPECTRA OF HAFNIUM.—A large gap in descriptive spectroscopy has been filled through the publication by W. F. Meggers of a list of wave-lengths of some fifteen hundred lines of hafnium. The investigation was made at the United States Bureau of Standards, and is described in the issue of the Bureau's *Journal of Research* for August. The purest available samples of hafnium salts, presented by Profs. Bohr and Hevesy, were used, but the spectroscopic examination showed that even these were considerably contaminated, in particular with zirconium and columbium. In spite of this, however, and the added difficulty of unravelling the arc lines from a prominent band spectrum, presumed to be that of an oxide, a satisfactory separation of the lines was made into those originating with the neutral atom (Hf. I), and

with the singly charged ion (Hf. II), whilst some lines in the ultra-violet probably came from multiply charged ions (Hf. III or Hf. IV). The *raie ultime* of the neutral atom has been tentatively identified as a line in the violet at 4093 Å., but it does not appear amongst Rowland's list of the solar Fraunhofer lines, although there are some lines of the first spark spectrum amongst the latter. No analysis of these spectra has yet been effected, although it is stated that this is being attempted, and since on Hund's theory the fundamental term of the spectrum of the neutral atom is only an F triplet, it is to be anticipated that the problem will not present any insuperable difficulties.

THE STRUCTURE OF MOLECULES.—The fourth of Dr. F. Hund's papers on the significance of molecular spectra has appeared in the issue of the *Zeitschrift für Physik* of Nov. 12. The results which he has obtained are closely similar to those recently published by Prof. Mulliken, the electronic states of a number of light diatomic molecules being deduced by application of the same principles that have been used with such conspicuous success for single atoms, but Dr. Hund's analysis is rather more general than Prof. Mulliken's, and he has also added a few remarks on the structure of polyatomic molecules. When there are more than two nuclei in the compound, he has shown that in all probability not more than two electrons can occupy each quantum path, although with diatomic molecules as many as four electrons may be equivalent in this respect. He has also pointed out that the tendency of some atoms and radicals to form chains—for example, atomic oxygen in the oxy-acids of chlorine, and the group CH_2 in numerous organic compounds—is closely connected with the fact that the atom or group contains eight electrons, which tends to preserve a general similarity of the electronic grouping in the molecule to that met with in the inert gases. This, again, would indicate that such compounds should be diamagnetic, which seems usually to be the case, although, as is emphasised, the occurrence of diamagnetism is not an infallible criterion for the existence of these particular arrangements of electrons. Some of the ideas which are being developed by Dr. Hund and Prof. Mulliken in this connexion are admittedly not new, but they do now take on the aspect of logical consequences of the fundamental concepts of the quantum theory.

CONSTANTS OF AN ELECTROMAGNETIC OSCILLOGRAPH.—An oscillograph records photographically the wave form of the electric currents or the discharges that pass through it. They are of two types: first, the electronic or cathode ray type; and secondly, the electromagnetic oscillograph, under which heading is included also the electrothermic instruments. In a paper communicated to Volume 67 of the *Proceedings of the American Philosophical Society*, Dr. A. E. Kennelly describes a new method for determining the constants of the electromagnetic instrument. He discusses mainly its performance when used to record alternating currents which have reached the steady stage. Owing to the effects of inertia in the moving parts of the vibrator, the response of an oscillograph to alternating current impulses of different frequencies is not the same. When an oscillogram is analysed into a series of Fourier components of different frequencies, it is known that a correction factor should be applied to each component to eliminate the error due to inertia. The magnitudes of the various corrections depend on the frequency. The author has shown in his book on "Electrical Vibration Instruments" that if the resonant frequency of an oscillograph vibrator could

be identified experimentally and also its 'quadrantal frequencies,' then the correction factor for any recorded frequency could be evaluated. Recently, however, improved methods of supplying a wide range of alternating current frequencies to an oscillograph for testing purposes have become available, and this simplifies the determination of the correction factors: The behaviour of an oscillograph at all frequencies is completely specified when its resonant frequency, its 'specific deflection,' and the 'bluntness of the resonance' are known. The 'specific deflection' is the deflection per unit of testing current taken at some convenient frequency of reference, such as 60. The 'bluntness of resonance' is simply the reciprocal of the sharpness. The method given is mainly useful when the time which the observer can devote to the calibration of the instrument is limited.

ACTIVE NITROGEN.—The relation of the formation of iron nitride in the iron arc to the presence of active nitrogen is discussed by E. J. B. Willey in the *Journal of the Chemical Society* for November. The amount of nitride present in the arc appears to decrease from 12-15 per cent. at the metal-vapour zone to about 6-8 per cent. at the outer edge of the arc. Examination of the arc light by means of a Hilger spectrometer failed to detect the presence of the nitrogen afterglow spectrum. It is suggested that either the reaction between the iron vapour and the active nitrogen is so rapid that the concentration of the latter remains exceedingly low, or that the chemically active nitrogen is present in a non-luminous form.

CRYSTAL STRUCTURE OF SILVER SUBFLUORIDE.—Sub-compounds are of interest chiefly because of the peculiar valency relationships involved. The crystal structure of one of the best defined of these compounds, silver subfluoride, Ag_2F , is described by H. Terrey and H. Diamond in the *Journal of the Chemical Society* for October. The substance was prepared by the electrolysis of a concentrated solution of silver fluoride at 60°, and was examined by the power method. The structure appears to resemble that of cadmium iodide, and the density indicated that there is only one molecule in the unit cell, which is hexagonal and has the dimensions, $a = 2.989$ Å. and $c = 5.710$ Å. The authors suggest that perhaps in the molecule of subfluoride two silver atoms partly share their uncompleted electron rings, leaving between them the one electron required by the fluorine atom. Such a hypothesis affords some explanation of the metallic properties of silver subfluoride.

THE CO-ORDINATION NUMBER OF COBALT.—According to Sidgwick, elements up to the end of the first long period in the periodic classification do not have a covalency higher than six. This rule appeared to be violated by the existence of a cobalt allylamine, prepared by Pieroni and Pinotti (1915), in which the cobalt apparently had a co-ordination number of eight. The *Journal of the Chemical Society* for October contains an account of the re-investigation of this compound by W. R. Bucknall and W. Wardlaw. Their analysis differs considerably from that of Pieroni and Pinotti in the value for cobalt, and they have carried out molecular weight and conductivity measurements. Bucknall and Wardlaw conclude that the compound

probably has the formula $[3\text{al} \cdot \text{Co} \begin{array}{c} \diagup \text{O}_2 \diagdown \\ \text{—OH—} \\ \diagdown \text{OH} \diagup \end{array} \text{Co} \cdot 3\text{al}] \text{Cl}_3$,

thus assigning the normal covalency of six to the cobalt. A second allylamine, also prepared previously, was examined, and this is believed to be

$[3\text{al} \cdot \text{Co} \begin{array}{c} \diagup \text{O}_2 \diagdown \\ \text{—OH—} \\ \diagdown \text{OH} \diagup \end{array} \text{Co} \cdot 3\text{al}] (\text{NO}_3)_3$.

METALLIC CORROSION.—G. D. Bengough, J. M. Stuart, and A. R. Lee have given an account of some further experiments which they have made on the etching of zinc by potassium chloride, in the presence of oxygen, in which they have found, *inter alia*, that hydrogen may be formed in the reaction under some conditions (*Proc. Roy. Soc., A*, 121, Nov. 1). They have now collected a considerable body of results, most of which they have summarised in a convenient tabular form, and they conclude that these support quantitatively the newer version of the electrolytic theory of corrosion. An important practical question that they have raised is that of the time-period to be adopted in carrying out laboratory tests to determine relative corrodibility. The relation between the amount of corrosion and the time is usually not linear, and the reduction of results to any such form as a weight of metal corroded per unit area per day is thus not very significant. The convection of the etching fluid is also not usually properly controlled, and this, in their opinion, is one of the chief reasons why tests of this kind are not reproducible. Their remarks in this connexion should, however, apply strictly only to cases in which the oxygen exerts the main control; the formation of films, which is in other cases at least as important, is to be dealt with in a later paper. These researches have been carried out for the Corrosion of Metals Research Committee of the Department of Scientific and Industrial Research.

PROPERTIES OF PERMINVAR.—When iron, nickel, and cobalt are melted together in certain proportions the resultant alloys, after definite heat treatments, are found to possess very unusual magnetic properties. A group of these nickel-iron-cobalt alloys is found to possess practically constant permeabilities when subjected to moderate magnetising forces. The constancy is better than that of soft iron, although the initial permeability is very much greater. In the *Bell Laboratories Record* for September, G. W. Elmen describes the discovery of these alloys and points out some of their peculiarities. When the hysteresis loop for a sample of these alloys is carried up to very intense magnetisation, it is found to have a characteristic but unusual shape. It is something like an ordinary hysteresis loop with the two sides of the loop touching at the centre, so that there is no remanence and no coercive force. The characteristics of these alloys are unique, and it is proposed to call them perminvars, a name constructed from 'permeability' and 'invariable.' The perminvar properties are obtained by heat treatment. The alloys are heated at 1000° C. for a short time and then cooled. It is found that the rate of cooling from 600° C. to 400° C. determines the degree of the development of the characteristic properties. The best results are obtained when the alloy is cooled through this range in five hours. When the cooling is rapid the perminvar properties disappear altogether. The results obtained with a 45 per cent nickel, 25 per cent cobalt, and 30 per cent iron alloy specially heat-treated, are given. For magnetising forces not exceeding 1.7 gauss the permeability is practically constant, the variations being well within one per cent. This is a very remarkable result, as the permeability is nearly 500, which is nearly double that of iron for low magnetising forces. When armco iron was subjected to the same range of magnetising forces, its permeability increased from 250 to a maximum of 7000, which it had when the force was 1.3 gauss. It then decreased to 6000.

POWER UNITS IN AGRICULTURE.—The report of the conference held at Rothamsted on power for cultivation and haulage on the farm, held in 1928, has now been published (London: Ernest Benn, Ltd. 2s. 6d.). It consists of six papers by leading experts, an account

of the discussion, and a résumé by Dr. B. A. Keen. There are five forms of power in use for agricultural purposes in addition to that obtained by horses, namely, steam, gas, petrol, low-grade fuel, and electricity. In the near future there seems little likelihood of the horse being replaced by mechanical forms of power, owing to its great adaptability to all kinds of work. When steam power is used it is generally obtained by hiring from contractors. The development of steam wagons for general road haulage has not yet spread to agriculture. A few stationary gas engines are employed, but their number is decreasing. Petrol engines are those most commonly employed in farm work, and recent types are very economical compared with those in use before the War. A successful form of light tractor using a Diesel-type engine consuming low-grade fuel has been introduced. The electric motor is by far the simplest form of prime mover, only the two main bearings and the brush holders requiring occasional attention. The cable that has to be wound and unwound as the implement passes across the field is a drawback. The petrol-electric system is worthy of serious consideration, as it combines the advantages of electric drive with freedom from fixed cables. Increased speed of work is of great use for cultivation as well as in connexion with road haulage. Owing to the great developments in the imported meat trade, the policy of laying down land to grass in periods of agricultural depression may need revision. An alternative is the intensification of arable farming by paying special attention to vegetable products of a semi market-garden type. This would necessitate an extended use of power for farming methods.

ELECTRIC KILNS FOR CERAMICS.—Experiments on electrically heated kilns for use in the ceramic industries have been in progress for the last ten years, but it is only recently that improvements have been made which promise that they will be useful in commerce. A reduction in the price of electricity would widely extend its use for furnaces. The great purity of the atmosphere in an electric furnace makes it ideal for decorated pottery. A normal coal-fired muffle furnace requires about 19 hours before a satisfactory result can be obtained. According to S. R. Hind in *World Power* for December, better results can be obtained in half the time by an electric furnace. The exceptional accuracy with which the temperature of the furnace can be controlled and what may be called the 'availability' of the energy as compared with that obtained from fuels, leads to excellent results. In British potteries the technique associated with the heat treatment of the higher grades of clay wares has grown up almost entirely by rule-of-thumb trials. The results obtained in this way have been transmitted traditionally amongst a special privileged class of craftsmen. The ends aimed at were to use solid fuel to the best advantage and to reduce the cost of the necessary labour. Hence for high temperature work very large ovens were used. For the manufacture, however, of the insulators used for the 'grid' electrical transmission scheme, which is being constructed in Great Britain, it is found that very steady heating is required. The specifications for these insulators are very strict. The porosity, for example, must be less than a tenth of one per cent. They have to withstand a combination of very severe electrical and mechanical stresses. Sufficient time, therefore, must be allowed for the temperature to become uniform throughout the thickness of the ware. Vitrification must proceed uniformly and the recrystallisations and conversion of its constituents must proceed evenly and without strain. Hence the temperature of the furnace has to be closely regulated.