

RESEARCH ITEMS

Genes and Development

In two papers, H. Grüneberg (*J. Genetics*, 45, 1–22, 23–29; 1943) describes his recent work in analysing the manner in which genes causing abnormalities in the mouse exert their influence. A recessive gene *ch* results in the development of hydrocephalus, but the most interesting point is that the final effects of the gene are due to anomalies in the early development of cartilage. As a result of the aberration in cartilage development, there is a shortening of the basi-cranial cartilage and nasal septum. This gives rise to a dorsal bulging of the cranial hemispheres. The lower part of the brain is compressed and interferes with the normal drainage function of the foramen of Magendie; hence hydrostatic pressure is increased. The bulge thins out the osteogenic membrane and prevents the formation of the membrane bones. Strain on the blood sinuses leads to internal hæmorrhage, while skin strain gives rise to other anomalies. These various pleiotropic effects are thus shown to be secondary effects of the cartilage anomaly. Grüneberg claims that pleiotropism does not exist, but that a gene produces only one chemical reaction; and there is no reason to suppose that genes have more than one action. The gene, says Grüneberg, is cell- or tissue-specific and never organ-specific in action. He suggests five postulates for the analysis of gene action, which include biochemical and morphological methods. In the second paper Grüneberg describes two further mutants in the mouse—fidget and hydrocephalus—which present interesting features for similar developmental studies in the future.

Development in *Drosophila*

C. H. WADDINGTON (*J. Genetics*, 45, 29–44) and C. H. Waddington and R. W. Pilkington (*J. Genetics*, 45, 45–50; 1943) describe the effects of several leg and eye genes respectively in *Drosophila melanogaster*. The obvious effects of the leg genes *dach*, *dachous*, *comb-gap* and *four-jointed* are seen in the fore-shortening of the legs, but they also affect other parts of the body. In combination, there is found additive effects and exaggeration phenomena in different organs in an apparently inconsistent series. Waddington considers that the explanation should be sought in the effect of the genes upon the folding of the imaginal buds. Where abnormal folding of the buds takes place by aberrant growth, the succeeding abnormal histogenesis will give rise to the various pleiotropic effects. Indeed, X-ray radiation of the imaginal buds during their growth gives similar abnormal folding and similar manifestations in the characters. Waddington and Pilkington have traced the development of eyes of *Drosophila* carrying the genes *facet*, *lozenge-spectacled*, *ophthalmopædia* and *morula*. Several remarkable divergences from normal development are described. The authors consider that, as in the work described in Waddington's paper, the genes disturb the method of folding of the imaginal buds.

Wheat-Puccinia Relationships

ALTHOUGH the haustoria in *Puccinia graminis Tritici* penetrate the cells, they remain external to the protoplasts, and the latter can be plasmolysed independently of the haustoria, which themselves are plasmolysed by solutions with concentrations 3–4 atmospheres higher. This aspect focuses renewed

attention on the permeability of the host cells, as in a recent paper (Thatcher, F. S., *Canad. J. Res.*, C 21, 151; 1943). Haustorial invasion always seems to be accompanied by an increase in the permeability of the host cell, often to the extent of being fatal. Treatment of plants with chloroform vapour, which increases the permeability of the protoplasts, leads to a lowering of resistance. Cold hardening, which also increases the permeability of the host cells, in some cases lowers the resistance, but this effect is probably offset by the increase in osmotic pressure induced at the same time. When the wheat variety Kubanka is grown at 80–85° F., the increase in permeability of the host protoplasts caused by the higher temperature seems to be the cause of the rapid early growth of the fungus—later the host protoplasts appear to have an adverse effect on the parasite since just before they die they cause the formation of brown walls round the haustoria and a kind of encystment. This results in the 'browning reaction' characteristic of Kubanka when grown at high temperatures. Certain varieties, which appear to occupy a threshold position between resistance and susceptibility, give an 'x' or 'mesothetic' reaction with certain races of *Puccinia graminis Tritici*. Infection rapidly leads either to pustules or resistant brown flecks, often both on the same leaf. Host cells from pustule and fleck areas showed higher and lower permeabilities respectively than did those from normal healthy areas. The mature resistance of Hope wheat may be due to its possession of a low water availability to the parasite—seedling leaves have a higher permeability and are less resistant than mature parts. The susceptibility of the host to rust is not modified by previous infection with smut, neither in oats, barley and maize nor in wheat.

Mineral Deficiencies in Fruit Trees

Two recent papers add to our knowledge about mineral deficiencies of fruit trees (*J. Pom. and Hort. Sci.*, 20, Nos. 3 and 4; 1943). J. B. Duggan (pp. 69–78) has succeeded in restoring the green colour to the leaves of cherry trees which were chlorotic through manganese deficiency. This was accomplished by injecting solid manganese sulphate into large branches and into the trunk. Neither injection nor spraying with solutions of the salt was satisfactory in practice. The deficiency of manganese was established by spectrographic analysis of the leaves. D. W. Goodall investigated the intake of calcium, iron, magnesium, manganese and potassium into the apical, middle and basal leaves of various kinds of shoot and spur of the apple Cox's Orange Pippin. He found that intake of the various ions varied with manurial treatment. Samples from plots receiving sulphate of ammonia, for example, contained 42 per cent more manganese than from the plots without added nitrogen. Differences in the manganese and potassium status of different trees are reflected more clearly in the composition of the basal leaves of the fruiting spur than in that of other leaf types.

New Methods in Plant Breeding

DELPHINIUM species and varieties are diploid, tetraploid or hexaploid. Interbreeding between these groups will naturally lead to sterility if the hybrid is obtained. *D. cardinale* is a diploid species with a distinctive scarlet colour. G. H. L. Mehlquist, C. O. Blodgett and L. Bruscia (*J. Hered.*, 34, 187; 1943) have used several methods of applying colchicine to

this species and have obtained tetraploid derivatives. These have been used in crosses with commercial tetraploid varieties of *D. elatum*, to introduce the scarlet colour and the high resistance to Erysiphe (powdery mildew) of *D. cardinale* into existing varieties. So far a few hybrids have been obtained, but many more can be expected.

Forms of Phosphoric Oxide

It has long been known that phosphoric oxide (P_2O_5) exists in different crystalline and glassy forms. W. L. Hill, G. T. Faust and S. B. Hendricks (*J. Amer. Chem. Soc.*, **65**, 794; 1943) have made a study of the preparation and identification of the different modifications, measurements of their optical constants, the phase transformations by the quenching method, and an interpretation of vapour pressure data. They conclude that there are three crystalline forms: hexagonal, rhombic and a stable (probably tetragonal) form, as well as a glassy form. The system involves three triple points at which solid, liquid and vapour (P_4O_{10}) co-exist in equilibrium, and there are at least two distinct liquid forms, one a stable polymer of the other, which were identified with the melting of the stable and hexagonal forms, respectively. Some X-ray data are given for the three solid forms. The stable form can be superheated above its melting point.

Bonded Deposits on Economizer Heating Surfaces

IN a paper on this subject read recently in London by J. R. Rylands and J. R. Jenkinson before a joint meeting of the Institution of Mechanical Engineers and the Institution of Electrical Engineers, it was pointed out that the problem of boiler plant availability in power stations has become so prominent that a better understanding of the causes of the fouling of heating surfaces by deposits from the products of combustion is essential. Earlier theories based on fused ash particles, sodium sulphate bond or high dew-points have not satisfactorily accounted for various well-established facts of observation. The latter include the existence of a period of apparent immunity from deposits in a new boiler plant, the characteristic behaviour of the dust from pulverized fuel firing and the peculiar scale-like form of certain hard deposits occurring on economizer and boiler tubes. The authors have found that hard bonded deposits on economizers result from certain chemical reactions between fuel dust and sulphuric acid. The type of reaction depends on the temperature of the metal parts associated with the deposits. Practical suggestions for the prevention of hard bonded scale formation in economizers are made, various types of coal ash being discussed, and characteristics favouring bonded deposit formation pointed out. The influence of the authors' proposals on plant design is considered.

Solar Prominences

AN important paper by E. Pettit (*Astrophys. J.*, **98**, 6; 1943) deals with the classification of solar prominences according to their association with sunspots, their origin, their motion and their structure. A tentative evolutionary sequence includes prominences of the quiescent, active, eruptive, sunspot and tornado types, and a new type, the coronal prominence, is distinguished. A comparative description of each type is given, and subdivisions of many of the classes are illustrated by diagrams and photographs. The paper forms a valuable summary of the

results obtained by the assiduous study of the solar surface at the Yerkes and Mt. Wilson Observatories during the past two decades.

Multi-Colour Photometry of Stars

A NEW photo-electric photometer for stellar work has been recently brought into use at the Mount Wilson Observatory, and is now described by J. Stebbins and A. E. Whitford (*Astrophys. J.*, **98**, 20; 1943). With the 60-in. reflector, measurements can be made in a spectral range as wide as 3530–10300 Å. on stars as faint as the ninth magnitude. The photo-cell used is of the caesium oxide type and is especially sensitive to red radiation. A series of filters enables measurements to be made at six points from the ultra-violet to the infra-red. The instrument was designed to measure the colours of faint extended sources such as the nebulae, but some results on stars incidental to the main programme are now published because of their intrinsic interest. These concern the colours of 69 stars of types *O* and *B* showing various degrees of reddening by interstellar absorption. Small deviations are found from the λ^{-1} law of reddening, in the sense that the radiation is fainter in regions intermediate between the ultra-violet and infra-red, but the law is the same for all directions in the galaxy. Even the simple λ^{-1} law requires *ad hoc* assumptions regarding the size distribution among the absorbing particles, and the deviation found will give further material for study. That the form of the reddening is constant simplifies matters somewhat; evidently equilibrium has been reached and the interstellar cloud must be regarded as a permanent feature of the galaxy.

Determination of Time Corrections

THE Astronomical Institute of Sciences of the U.S.S.R. has issued "Ephemerides for the Determination of Time Corrections by Equal Altitudes (Zinger's Method) for 1941". Four quantities for each pair of stars are tabulated, these quantities depending only upon the co-ordinates of stars entering the given pair. The values of the four quantities refer to the moment of upper culmination of a fictitious star over the Greenwich meridian. The right ascension of this star is the mean of the right ascension of the two stars, and the moment of upper culmination is called the moment of culmination of the pair. Tables are given which provide these four quantities in a continuous reckoning through every ten culminations, that is, through ten sidereal days. In the heading of each pair of stars selected are numbers which denote the various working ephemerides, and the names of stars corresponding to the numbers are given in Table IV. Full explanations of the use of the ephemerides are given with examples, and the necessary calculations are very easily effected. In addition, it is shown how the calculations of chronometer corrections are carried out, and these are facilitated by a special table compiled for the purpose. Special attention is directed to the fact that, in computing the long-period terms of nutation, certain terms are omitted which have been newly introduced by some ephemerides, such as the "Nautical Almanac" and the "Berliner Jahrbuch". It is shown that the total effect of these terms on the half-sum of the right ascensions is negligible. The effect of the short-period terms of nutation are easily computed by means of special tables given for the pairs of the ephemerides by Prof. Zwetkoff.