reviewed the occurrence of the eight dihydroflavonols in the plant kingdom: dihydro-kæmpferol and -myricetin occur most frequently. Dihydroflavonols have been synthesized by six methods: oxidation of 2′-hydroxychalcones and flavanones; bromination of flavanone, followed by nucleophilic replacement of halogen; ring-closure of 2′-hydroxy-α-methoxychalcones; treatment of 2′-acetoxychalcone dibromides with silver acetate or alkali; dithionite reduction of flavonols; and reaction of aromatic aldehydes with 2-hydroxyphenacyl chlorides. Under the influence of alkali, dihydroflavonol disproportionates into the flavonol and flavanone, or affords the corresponding 2-benzyl-2-hydroxycoumaran-3-one.

Dr. W. B. Whalley (Organic Chemistry Department, University of Liverpool), discussing the stereochemistry of the chromans and related compounds, dealt with a stimulating application of conformational analysis. In common with King, Dr. Whalley agrees with the assignment to catechin and *epi*catechin of *trans*- and *cis*-structures, respectively, but he produced evidence in favour of fresh conformations with 3(*a*)-hydroxyl groups for both substances. Conformational analysis has been extended to the 3-hydroxyflavanones, 2-hydroxy*iso*flavanones and flavan-3:4-diols, and it is evident that Dr. Whalley will elucidate the conformation of the complicated O-ring heterocyclics by application of stereo-specific reactions.

The Society will publish the symposium lectures and discussions in book form, and this should interest all those whose work brings them into contact with polyphenols, tannins and vegetable tannin materials.

D. E. HATHWAY

EAST AFRICAN INDUSTRIAL RESEARCH ORGANIZATION

REPORT FOR 1954–55

THE East African Industrial Research Organization, which incorporates the East African Industrial Research Board, came into existence on April 1, 1955, and its first annual report* is a progress report covering the period January 1, 1954–June 30, 1955. The new Organization absorbs the staff of the previous Board, and provision is made for a 50 per cent increase during the next two years. The British Government is contributing, from Colonial Development and Welfare Funds, 75 per cent of the capital expenditure for offices and laboratories and housing, and half the recurrent expenditure during the next two years. The Organization will be responsible to a board, on which the East African Government and the East African High Commission are represented.

The present report summarizes the work in the production of hecogenin from sisal waste, the plant for which has operated successfully since it was officially opened in June 1954. A preliminary report has been issued on the investigation of coffee processing which indicates that there are three stages in drying fermented coffee and that it is desirable to dry-wash the fermented coffee initially as quickly as possible, without using too high a temperature. When the coffee is dry enough to be safe from deterioration, the remaining process may be a slower removal of moisture in a conditioning bin. Work with dual-fuel engines, using oil and indigenous wood, has shown that producer gas can replace diesel oil in a diesel engine and is utilized as efficiently thermally as the oil. Satisfactory ignition of the gas–air mixture can be achieved with a low proportion of the full-load consumption of oil; at least 70 per cent of the full-load rating of a coupled diesel engine and alternator can be carried on gas, while the governor retains full control of speed, and existing engines can be modified economically on the site.

Chemical engineering research has been concerned with the utilization of natural steam, the production of salt and lime burning; in ceramics a refractory grog has been produced by calcining fine kyanite, bonded into pellets with molasses in a rotary kiln, and also a porous grog by grinding raw kyanite with charcoal, pelleting with molasses and calcining in the laboratory at 1650° C. Other work has been concerned with the production of phosphatic fertilizers and the pelletizing of cetyl alcohol for use in retarding the evaporation of water from dams. For this latter purpose, following work by A. F. C. Cole, who died during the period, apparatus has been devised by which an output of 20 lb. a day has been achieved. The apparatus is described and illustrated in the report.

* East African High Commission. East African Industrial Research Organization: Annual Report 1954–55. Pp. ii+17. (Nairobi: East African Industrial Research Organization, 1955.)

CURRENTS THROUGH THE STRAITS OF DOVER

NEARLY a hundred and twenty-five years ago Faraday predicted that electrical potential differences would be set up in sea water, a conducting fluid, by its motion in the Earth's magnetic field. His predictions were verified by measurement of voltages induced on submarine cables. During recent years, oceanographers have begun to use measurements of the voltage differences in sea water as a useful method of studying water transport. In a recent paper (*Phil. Trans. Roy. Soc.*, A, **248**, 953; 1956) K. F. Bowden has demonstrated the value of the method in his study of the flow through the Straits of Dover. He has taken as his raw material fifteen months of continuous observations of the voltage fluctuations induced on a cable crossing the Straits of Dover, together with four months of similar observations on a cable crossing the south-western portion of the North Sea. Regular voltage fluctuations, about one volt in amplitude, produced by the tidal currents are a dominant feature of his records. These fluctuations, while serving a useful purpose for calibrating the voltage in terms of the mean flow through the Straits, have to be eliminated to study the more interesting residual currents. The calibration, which depends on the conductivity of the sea bed as well as the sea water, is done empirically. Shorter-period fluctuations produced by magnetic disturbances are eliminated by filters in the measuring equipment and by smoothing of the graphical records.

Prof. Bowden shows that the residual currents, which sometimes run with speeds as high as one and a half knots in either direction, are highly correlated with the local winds and the slope of the sea surface along the Straits. The correlation is also high with the wind system over the southern part of the North Sea and the English Channel, indicating that the surface slope along the Straits is largely a consequence

of the regional wind system, though influenced as well by other factors. Prof. Bowden's measurements enabled him to make estimates of the coefficients of wind stress and of bottom friction. These estimates, though somewhat high, agree in magnitude with other independent estimates and strengthen the probability that further development of the dynamics of the air–sea interactions can be made through similar studies. Such studies are at present being made of the Gulf Stream through the Florida Straits and of currents in the Cook Straits of New Zealand, and others are being planned.

Prof. Bowden was perhaps fortunate in studying a region that has been extensively surveyed in the past and he had access to detailed meteorological and tidal information in carrying out his analysis. The method he has employed has emerged as a powerful supplement to the usual techniques of oceanographic survey and is, at present, the only practical way in which large-scale currents can be continuously monitored.

N. P. Fofonoff

AMPHITHALLISM IN FUNGI

By M. Eileen Kennedy and Prof. J. H. Burnett

University of St. Andrews

It has generally been found that the mating systems of fungi are very constant features and that if, for example, a species is heterothallic, it regularly produces spores which are homocaryotic in respect of mating type. However, exceptional fungi are known which produce spores both homocaryotic and heterocaryotic for mating-type factors on the same fruit body. Lange[1] introduced the term 'amphithallism' to describe this condition in species of *Coprinus*.

Recently we have investigated an amphithallic condition in some strains of bipolar gasteromycetes of the *Nidularia denudata* 'complex', and it is now evident that confusion has arisen in the application of Lange's term. This is because, first, different mechanisms give rise to the condition and, secondly, because the term has been applied to quite different phenomena.

At least four mechanisms are known which can result in the production of spores both homocaryotic and heterocaryotic for mating-type by a single fruit body, namely:

(1) In certain Basidiomycetes with four-spored basidia, an additional mitosis after meiosis results in the occurrence of eight-nucleate basidia. Two nuclei migrate into each basidiospore and they may carry the same or different mating-type factors, that is, the basidiospores will be homocaryotic or heterocaryotic for mating type, respectively. Unequivocal cytological and breeding evidence for this situation has been obtained in strains of *Nidularia denudata* by one of us (M. E. K.), details of which will be published elsewhere. Circumstantial evidence for a similar mechanism is available in *Omphalia flavida*[2], *Coprinus plagioporus* and *C. subpurpureus*[1].

(2) In certain Basidiomycetes with two-spored basidia, meiosis occurs in the basidium and two nuclei migrate into each basidiospore. Single basidiospore isolates usually germinate to give a mycelium bearing clamp-connexions. Exceptions have been recorded in *Coprinus sassii* (= *C. ephemerus* f. *bisporus*)[1,3], *Galera tenera* f. *bispora*[3], *Aleurodiscus canadensis*[4] and *Mycena rubromarginata*[5]. In these fungi some single-spore isolates failed to form clamp connexions, and appropriate matings demonstrated that such isolates, of the same species, carried complementary mating-type factors, that is, the basidiospores from which these isolates originated were homocaryotic for mating-type factors. Recently, Terra[6] has demonstrated that this interpretation is correct in *Stropharia umbonatescens* and has also demonstrated, by mechanical separation, the heterocaryotic nature in respect of mating type of the rest of the basidiospore isolates. It is not known at present why basidiospores of such fungi are normally heterocaryotic in this respect, although an association between nuclei of complementary mating type during migration into the spore has been suggested[3].

Basidiomycetes have been described which, in addition to two- and four-spored basidia, possess a variable but usually small number of basidia which bear three, five or more spores. It has been suggested[7,8] that unequal distribution of the four nuclei derived from meiosis to these basidiospores would result in spores homo- and hetero-caryotic in respect of mating type. No acceptable experimental evidence has been presented, as yet, in support of this claim.

(3) Most Ascomycetes regularly produce eight, initially uninucleate, ascospores; but occasionally some of them are replaced by 'giant' binucleate spores, some of which may be heterocaryotic for mating-type factors, for example, *Neurospora crassa*[9]. In other Ascomycetes four, initially binucleate, spores, each heterocaryotic for mating type, are formed regularly in each ascus. But in these fungi uninucleate ascospores, which are necessarily homocaryotic for mating-type, are formed exceptionally with variable frequencies, for example, in *Neurospora tetrasperma*[10], *Podospora anserina*[11]. The mechanism common to both these exceptional conditions is the irregular delimitation of the cytoplasm at spore formation, but the causes of such irregularities have not been fully investigated. A similar kind of irregularity is presumably responsible for the occasional heterocaryotic meiospores produced by the Phycomycete, *Phycomyces blakesleeanus*[12].

(4) Heterocaryosis for mating-type factors in the ascospores of the four-spored Ascomycetes such as *N. tetrasperma* is a consequence, not only of the mode of spore delimitation, but also of the orientation of the spindles during nuclear divisions in the ascus and the time of segregation of the mating-type factors during meiosis[13]. However, the occurrence of asci with initially binucleate ascospores, which are homocaryotic for mating type, has been reported[14,15]. In *N. tetrasperma* it has been suggested[16] that this may come about as a result of irregularities in spindle orientation; but a different mechanism, the intervention of crossing-over between the mating-type locus and the centromere, which alters the spatial segregation pattern of the mating-type factors in the ascus, has been described[15] for *P. anserina*. Completely acceptable cytological and genetical evidence for these hypotheses is not available.

Amphithallism can be applied to the results of the four types of behaviour described, since they all lead to the production of spores, homocaryotic and heterocaryotic for mating type, by a single fruit body. But amphithallism will affect the mating systems of different fungi in quite different ways. For example, in an outbreeding form such as *Coprinus subpurpureus*, amphithallism restricts the degree of potential outbreeding, but in an inbreeding fungus