

T. Swain (Cambridge), in the course of investigations on the chemical composition of some horticultural varieties of *Dahlia variabilis*, has found that the petals and leaves of some of these plants contain aglycones, which have not hitherto been discovered in this species, namely, sulphuretin, 2':4:4'-trihydroxychalkone, naringenin, eriodictyol, quercetin and kempferol.

H. Erdtman (Stockholm) outlined the comparative biochemistry of the genus *Pinus*. The following flavonoid constituents have been identified in extracts of the heartwoods of these species: chrysin, tectochrysin, 6-methylchrysin, 2:3-dihydrochrysin, 2:3-dihydrotectochrysin, pinobanksin, pinobanksin 7-methyl ether, strobopinin, cryptostrobin, and strobobanksin. Here the distribution of these substances shows a positive taxonomic interest. Botanists divide the genus *Pinus* into two parts, namely, diploxylon and haploxylon. In the diploxylon species, no flavones are encountered, only flavanones occur; in the haploxylon species, however, flavones and flavanones exist simultaneously.

F. E. King (Nottingham) has isolated derivatives of the catechin group (3-hydroxyflavans) in the heartwoods of many species of *Azalia*. He re-examined classical views concerning the structure of such derivatives and, in the light of present stereochemical theory, he concludes that the 'epi' series should have a 'cis' configuration. Melacacidin, another component isolated from the wood of *Acacia melanoxylon*, has been identified as 7:8:3':4'-tetrahydroxyflavan-3:4-diol and must be considered as a typical leucoanthocyanidin.

H. Schmid (Zurich) dealt with the chemistry of non-benzopyronic lactones. He described their chemistry and physical properties in relation to molecular structure. Various methods of determining the nature of the heterocyclic ring (pentagonal or hexagonal), the number and positions of the double bonds, etc., were given. He reviewed some naturally occurring well-defined types, for example, protoanemonin, kawain, nepetalactone, etc.

W. Whalley (Liverpool) spoke about sclerotiorin and rotiorin, which are pigments obtained from several strains of *Penicillium sclerotiorum*. They have the empirical formulae $C_{21}H_{22}O_5Cl$ and $C_{21}H_{22}O_6$, respectively, and both contain the same branched C_9 ethylenic chain. They almost certainly possess an α -pyrone ring characterized by the fact that the heterocyclic oxygen can be replaced by $-NH-$ with subsequent formation of the corresponding α -pyridone.

The structure of calophyllolide, a compound isolated from the nuts of *Calophyllum inophyllum*, was discussed by Mme. Polonsky (Paris). This has the empirical formula $C_{28}H_{22}O_6 \pm CH_2$. It is an $\alpha\beta$ -unsaturated- γ -enol-lactone having one methoxyl group. With 40 per cent potassium hydroxide it gives 5-hydroxy-7-methoxy-4-phenylcoumarin ($C_{16}H_{12}O_4$), the structure of which was confirmed by comparison with an authentic sample.

A third series of reports were devoted to analytical work.

Mme. G. Aulin-Erdtman (Stockholm) described the $\Delta\epsilon$ method and its possible application to the analysis of flavone and flavone derivatives. This method is based on the modification of the ultra-violet spectra caused by ionization or other convenient chemical reactions. The change in ϵ -values determined at various wave-lengths (λ) is represented graphically, giving a $\Delta\epsilon$ curve. This curve is a

characteristic of the chromophore, which can be modified and is independent of non-reactive chromophores. The method is sometimes better than ordinary ultra-violet examination in analysing complex natural extracts.

Finally, two papers dealing with the biological properties of oxygenated heterocyclics were presented.

F. Teyeau (Bordeaux) has shown that leucocyanidol, isolated from the teguments of the arachid nut, increases vascular resistance both in animals and in men. Moreover, it possesses anti-anaphylactic properties which might be explained by its inhibitory power towards hyaluronidase. It is fixed by seric proteins, more particularly by the globulin fraction. At a certain concentration it induces formation in serum of a precipitate containing all the lipids and only very small quantities of proteins.

H. Ferrando and J. Bost (Lyons) have studied the action *in situ* of several flavones on the intestines of rabbits. Ferguson has already shown that tricrin (5:7:4'-trihydroxy-3:5-dimethoxyflavone) strongly inhibits contraction of this organ. Its 4'-methoxy derivative, on the contrary, reduces the effects of tricrin.

It will be seen from the summaries that much current work in the field of oxygenated heterocyclics was presented at this colloquium. It is to be regretted, however, that a number of centres of research in the United States, Australia, Africa and Asia could not, owing to geographical considerations, send representatives to the colloquium.

ANIMAL SOUNDS IN THE SEA

DURING the Second World War the ocean waters were widely explored for the first time with sensitive listening devices. Submarine eavesdroppers heard sounds which they took to be from ships where there were no ships, and many mysterious 'beeps', 'groans', 'croaks', 'crackles', 'whistles' and 'moans' came to their earphones. It was suspected that these noises were the chatter of underwater animals, and, after the War, the U.S. Office of Naval Research launched a comprehensive study of sea-animal sounds. This study has been reported by Marie Poland Fish (*Sci. Amer.*, April 1956).

Scientific workers have listened with hydrophones and recorded on tape the sounds of hundreds of species of animals, from shrimps to porpoises. The articulate denizens of the sea 'speak' a confusing variety of dialects, but each is distinctive, and with experience it is possible to identify the kind of animal by its sounds, as one recognizes a familiar voice on the telephone. Listening to tropical fishes in the waters of the Caribbean, trained recorders can recognize them on approach before they come into view. Fishes and other sea animals have no vocal organs: they make sounds in diverse and intriguing ways which sometimes involve a large part of the anatomy.

One group produces sound by vibrating the walls of their balloon-like air bladder, the bladder acting like a sound-box or drum. The toadfish, for example, sets up vibrations of its bladder by means of muscle contractions, and the sound emitted ranges from a grunt to a 'fog-horn' boom. Experiments have shown that the sound originates in the air bladder. When the bladder was removed, the fish could produce no sound. But the air bladder alone, placed

in a jar of sea water and stimulated by electricity, emitted grunts which were typically 'toadfish' to the ear.

A second class of sound-makers produce noises by scraping one body part against another; this is particularly common with the 'teeth-grinders'. The squirrelfish, for example, grinds together toothed areas in the back of its mouth, called gill teeth, and so generates a sound which is amplified by the adjacent air bladder and becomes a rasping grunt.

One of the most puzzling sounds which was encountered was that of the sculpins, a family of spiny sea fishes like the freshwater bullhead. These fishes issue a dull low-pitched drone which suggests the hum of an electric generator. The sculpin has no air bladder, and it was difficult to understand how the fish produced its sound. Examination of its anatomy and recent experiments suggest that the noise is made by rapid vibration of muscles attached to certain bones in its skeleton.

The most garrulous fish is the sea robin. Most fishes try to make a silent escape when something strange approaches. This is not the case with sea robins, which keep up a barrage of grunting and cackling—disturbed or undisturbed. A tame sea robin in an aquarium clucks softly when stroked, like a purring cat, but if handled too much will break away in seeming annoyance and emit a burst of noise. Other fishes appear to be noisy only when noise is called for. With the approach of a ship, fishes usually cease their chatter instantly.

Fish apparently make noises for a great variety of reasons. They use sound to communicate. Squirrelfishes, which are inclined to be nocturnal; eels and catfishes, which live in muddy, murky waters; croakers, which become most active after sunset—

these and similar species must find sound useful for aggregating. Many fish become most loquacious during the spawning season.

Competition seems to be a common stimulus to sound. Sprinkling of food in a tank of sonic fishes incites a general noisy commotion.

Experiments have indicated that sea horses may use sound for orientation. During the first few days of captivity they make vigorous snapping noises, apparently associated with the strangeness of the new environment.

Of the more primitive forms of life, the shrimps make most noise. The combined popping of thousands of shrimps in their unseen beds makes a crackling chorus day and night. Experiments indicate that this noise accompanies the ejection of jets of water which the shrimps use for offence and defence.

In the case of marine mammals, the noises of whales and porpoises may be heard all over the oceans. The noises have been described as "propeller or screw noises", and clucking and squealing sounds covering the whole sound band and 'pings' suggestive of echo-ranging.

Learning sea sounds and languages has certain practical uses. Already the U.S. Navy has found the research helpful for predicting underwater sound conditions in strategic areas, for developing underwater acoustic gear and for training sonar operators. Commercial fishermen are using acoustic finders to locate schools of fish. They would like 'hearing aids' which could spot concentrations of food fish, identify them by their sounds and track their movements in bird-dog fashion. It may eventually be possible to use stationary, remotely controlled listening posts, comparable to sonar buoys, which will detect and broadcast the position of migratory fishes.

CHELATING AGENTS AS PLANT GROWTH SUBSTANCES

A POSSIBLE CLUE TO THE MODE OF ACTION OF AUXIN

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THE observation which gave rise to this work was made during an attempt to prevent the inhibiting effect of chromatographic paper on the growth of wheat coleoptile sections in the straight growth test as modified by Hancock and Barlow¹. It was found that acid-washed paper, treated with ethylenediaminetetra-acetate (EDTA) and washed, caused significantly more growth than occurred in the complete absence of paper. An experiment was therefore carried out without any paper, in which EDTA was given at concentrations of zero and 10^{-10} to 10^{-5} M, both with and without 10^{-5} M 3-indolyl-acetic acid (IAA). It was found that after 19 hours 10^{-5} M EDTA alone gave practically the same increment of growth compared with controls as did 10^{-5} M IAA alone, and even 10^{-10} M EDTA alone apparently caused some increase.

In this experiment the interaction between IAA and EDTA did not approach statistical significance ($P \approx 0.2$), consistent with the hypothesis that their effects were independent and additive.

Similar experiments were then carried out using seven chelating agents, of very various molecular structure, at concentrations of zero, 10^{-9} M, 10^{-7} M and 10^{-5} M in combination with zero and 10^{-5} M IAA. It was found that all the agents tried could act as growth substances, namely, EDTA, uramil-diacetic acid (UDA), anthranilic acid diacetic acid (AADA), nitrilotriacetic acid (NTA), iminodiacetic acid (IDA), 8-hydroxyquinoline (8HQ) and sodium diethyldithiocarbamate (DIECA). It was found that although DIECA, a heavy metal enzyme inhibitor, could act as a growth-promoting substance, another such inhibitor, namely, potassium cyanide, which was not a chelating agent, depressed growth at the same concentrations. In this series of experiments no indications of interactions with IAA were found,

Table 1. MEAN LENGTH (cm.) OF WHEAT COLEOPTILE SECTIONS, ORIGINALLY 1 cm., AFTER 19 HOURS AT 25° C. (1.12.55). FIVE REPLICATES, EACH OF FIVE COLEOPTILES

IAA	EDTA: 0 M	10^{-10} M	10^{-9} M	10^{-7} M	10^{-5} M	10^{-5} M	10^{-5} M
0 M	1.81	1.91	1.91	1.93	1.95	2.02	2.05
10^{-5} M	2.06	2.06	2.07	2.07	2.08	2.13	2.25
Mean	1.94	1.99	1.99	2.00	2.02	2.08	2.15

Significant difference ($P 0.05$) for means of + and - IAA = 0.055