RECENT DEVELOPMENTS IN MOLECULAR SPECTROSCOPY*

RELIABLE determination of the molecular constants is of great importance for many applications as well as for progress in the theoretical understanding of molecular structure. In recent years increasingly accurate determinations of molecular constants of diatomic molecules are being made by microwave absorption spectra and by the more powerful spectrographs and improved techniques available now.

Because of the very high resolving power available in the microwave technique it has been possible to obtain with great accuracy the rotational constants of a large number of different types of poly-atomic molecules and also several diatomic molecules such as CO, ICl, etc. It has been also possible to study the hyperfine structure of rotational spectra, and to obtain nuclear spin, electric quadrupole moment and isotopic mass-ratios Similarly in microwave and radio-frequency magnetic resonance spectra applied to molecular beams, transitions between the hyperfine structure components in a magnetic field give the nuclear magnetic moments. The electric analogue of the magnetic resonance method gives electric dipole moments, moments of inertia and quadrupole interactions. Similar methods are also employed with atomic beams. Other methods such as nuclear magnetic resonance, nuclear induction and nuclear quadrupole resonance have been applied to liquids and solids as well as for gases for the study of nuclear properties.

Much work remains, however, to be done in diatomic spectra with regard to molecules that have not yet been investigated and with regard to new electronic states of known molecules. A whole lot of spectra involving multiplicities greater than three awaits attention. In the vacuum ultra-violet, Rydberg series for many diatomic molecules have yet to be studied.

In the case of polyatomic molecules, isotopes are useful for the species classification of frequencies. Particularly profitable has been the use of deuterium. It has twice the mass of hydrogen which it displaces and therefore gives rise to pronounced effects on the vibrational spectra of the molecules. So also, in the study of rotational levels using microwave spectroscopy, it becomes necessary, to use isotopic species of the molecule, because of the structural complexity of a polyatomic molecule. Now that elements enriched with any desired isotope are available from atomic piles, it is possible to increase the efficiency of the method of microwave spectroscopy, with its enormous resolution and dispersion. At present microwave spectroscopy offers the only method which can be employed for obtaining the spins, isotopic mass ratios, quadrupole moments and coupling constants, of the nuclei of radioactive elements of short life and low concentration which are important for nuclear physics.

Experimental investigation and theoretical development of the electronic spectra of polyatomic molecules are still in the exploratory stage. Because of the instability of an excited polyatomic molecule it has been very difficult to excite emission spectra. Nearly the same situation exists with regard to fluorescence spectra. It is only in a few cases that emission spectra have been observed. Emission in benzene derivatives excited by electron impact and in the positive column of a specially designed discharge tube in the presence of rare gases has been studied in recent years by Schuler and collaborators. The interpretation of the results is not yet very clear. Emission bands that correspond to the known absorption bands of the molecule have been obtained in benzene, toluene, aniline and several other organic aromatic molecules by Asundi and his co-workers.

* Excerpts from the Presidential Address to the Physics Section of the Indian Science Congress, Baroda, 1955, by Professor R. K. Asundi.

FLOWERING IN PLANTS*

TWO environmental factors, light and temperature, have marked influence on the onset of reproductive phase in plants. Flowering in some plants may be hastened or delayed by presowing temperature treatment; in some others, a minimum period of darkness and some light is required; there are also a few which are apparently independent of such requirements.

Under suitable conditions of light and/or darkness, some compounds are formed in the leaves which are transported to the growing points where floral primordia are formed. The stimulus is transmissible through graft partners

* Abstract of Presidential Address to the Botany Section of the 42nd Session of the Indian Science Congress, by J. C. Sen Gupta on *"Control of Flower Initiation in Plants"*.

and is probably the same for plants of different flowering behaviour. The success claimed by various workers in extracting the active substance has not been reproduced.

There are at least three simpler processes concerned with the perception of the stimulus. There is a high intensity light process (requirnig ca. $6 \cdot 6 \times 10^4$ of light energy) which must precede a dark period but can be bypassed by administering sugars or some Krebs cycle acids. With tracer carbon (C^{14}) it has been shown that such compounds are synthesised in light and metabolised in darkness as the dark period becomes longer, supplying substrates for the ultimate synthesis of the "flowering hormone", if any. The dark reaction can be inhibited by a flash of light in the middle of the dark period; this is a low intensity light process probably not identical with photosynthesis. The pigment which perceives the stimulus is probably of phycocyanin type having absorption maximum at 6,600 Å convertible into an isomer absorbing maximum at 7,350 Å The pigment is also present in lettuce seed, oat mesocotyls, eliolated pea internodes and tomato cuticle.

Low concentrations of auxin inhibit the flowering of short-day plants, while promoting that of some long-day plants; higher concentrations are inhibitory to both It has been suggested that the auxin level in plants may be the controlling factor in floral initiation. For short-day plants a low auxin level appears to be conducive to reproduction. The possible factors which may reduce the auxin level are the activities of naturally occurring inhibitors, indolacetic acid oxidase, enzymes concerned with the synthesis of indoleacetic acid—the native auxin and X-radiations. Synthetic auxin-inhibitors like 2, 3, 5-triiodobenzoic acid, 2, 4-dichloranisole, etc., counter the inhibitory effect of auxins and promote flowering under non-inductive daylengths. There is good evidence, however, that the effect is indirect and auxins probably act by influencing the metabolic pathways concerned with the synthesis of the flower forming substance.

Recent investigations on CO_2 fixation indicates that CO_2 is essential during the dark inductive period for floral initiation in short-day plants. *Kalanchœ blossfeldiana*—a succulent, fixes CO_2 vigorously in the dark as the induction treatment is prolonged but this CO_2 is evolved as soon as the plants are subjected to light. Using $C^{14}O_2$ it has been shown that the dark fixation pattern in short- and long-day plants is different, the rate of photosynthesis is influenced strongly and new compounds are formed in light photosynthetically and non-photosynthetically. The rate of steady state photosynthesis in induced plants is increased to seven times that of the vegetative plants, and there are qualitative and quantitative differences in the products formed. C^{14} labelled compounds have been traced to the growing points

The most promising line of study appears to be the isolation of the flower-forming substance or a synthetic compound capable of bringing vegetative plants into flowers.

RADIOACTIVITY OF THE HUMAN BEING

THE amount of radioactive substances deposited naturally in the normal human being has become one of the key figures in recent discussions on "tolerance" dose, "permissible" dose and "damaging" dose in repeated, as well as in single, total body exposures to ionizing radiations Its magnitude, originally reported by Krebs as close to the accepted permissible body content of 1×10^{-7} g. radium element permanently fixed in the body, became uncertain, when Hursh and Gates in 1950 found values 100 to 1,000 times smaller than the accepted permissible content. While the reasons for this discrepancy were under discussion, Sievert in 1951, using a special gamma ray sensitive device for measurements on the intact living body as a whole, reported an average radioactivity of the human being close to the values given by Krebs and thus close to the permissible content.

New data on this subject have been reported by Burch and Spiers and reviewed by Krebs in *Science* (1954, 120, 719). Krebs observes that in order to promote knowledge in the field, the following studies would seem to be necessary:

(*i*) Measurement of the radioactivity of as many people as possible from different regions of the globe with the modern total-body activity measuring devices (*ii*) Measurement of the kinds of radioactive substances in the body, especially with regard to α-emitting, β-emitting and/or γ-emitting elements. (*iii*) Detailed investigations of the radioactive materials incorporated daily by human beings from air, water and food.