sists of three displacements of 211, 865, and 909 cm^{-1} . It is concluded from an analysis of the Raman data that the ion has a symmetrical, bent structure.

More than workers in other countries, Indian physicists have directed attention to the interesting changes in the Raman spectra of crystals on account of different crystal settings, and of the influences of the directions of the incident and scattered radiation. T. M. K. Nedungadi has extended our knowledge on this topic by an exhaustive investigation of the Raman effect in a single crystal of naphthalene. The spectrograms obtained for various settings of the crystal with respect to the directions of the incident radiation and the line of observation and with various directions of vibration in the incident and scattered radiation are reproduced. Experimental data confirm predictions of group theory that six low-frequency lattice oscillations exist in three pairs of close doublets: 38, 47; 72, 78; and 107, 121 cm^{-1} . The higher member of each pair arises from oscillations symmetrical to the elements of symmetry of the monoclinic lattice, whereas the lower members of the pairs are due to antisymmetrical oscillations. On frequency and intensity considerations these pairs of lines correspond roughly with rotational oscillations of the molecule. Theoretically, naphthalene should possess twenty-four normal modes of vibration and these have been identified. Polarization data have shown that some of the internal oscillations, particularly 512 and 1576 cm^{-1} , split up into symmetric and antisymmetric components; this is interpreted as showing that polarization data are controlled, as are lattice oscillations, by symmetry properties.

Work continues on determination of the Raman frequencies and their intensities and polarization characteristics and on deducing the characteristic Raman frequencies of chemical groups and linkages. Contributions in this direction are made by Dr. C. S. Venkateswaran and N. S. Pandya with data on aniline, diethyl sulphide, and two binary liquid mixtures. The binary mixtures investigated—*cyclohexane*-aniline and *iso*-propyl alcohol-water—possess a critical solution temperature and, from changes in the position and intensity of five lines of the second mixture, it is concluded that at the critical solution temperature only monomeric molecules of *iso*-propyl alcohol exist. This is an interesting new departure in Raman spectral investigations, and shows that the directions in which the methods of Raman spectra can be applied to the investigation of chemical problems are, indeed, manifold.

The remaining papers of the symposium deal with the scattering of light in gases, in mobile and viscous liquids, in glasses, in alcohols, and in emulsions. The light scattered in a transverse horizontal direction by dilute emulsions is usually elliptically polarized, whereas the scattered light from concentrated emulsions is highly depolarized. In a large variety of liquids hypersonic velocities have been determined and compared with acoustic velocities. K. S. Bai has examined existing theories of light transversely scattered by liquids and has derived thermodynamically a general expression for the intensity.

The contents of the papers constituting the symposium will prove extremely valuable not only to all directly concerned with this field of scientific inquiry, but also to a wide circle of chemists and physicists interested in the applications of these methods to a variety of problems.

W. ROGIE ANGUS.

THE LOCUST PLAGUE

By DR. A. D. IMMS, F.R.S.

ONE of the oldest of all agricultural problems is that of locust invasions. References to such plagues are frequent in the texts of the ancient Egyptians, Greeks, Chinese and Hebrews—the oldest dates back to more than 2000 years B.C. These depredations are not confined to a few countries, although outbreaks regularly appear in individual lands only to devastate many distant territories. It cannot be emphasized too strongly that much of the failure to control these plagues has been due to isolationist policy adopted by those countries directly affected.

This feature was stressed by Dr. B. P. Uvarov in a lecture delivered by him before the Dominions and Colonies Section of the Royal Society of Arts on December 15. As Dr. Uvarov pointed out, history provides examples of great efforts to control locusts in Algeria, Argentina, South Africa, etc., with only temporary results simply because the problem is insoluble within the confines of a single country. He mentions the example of swarms of the desert locust, bred in India, that usually migrate to Persia and Arabia and their descendants proceed to spread over Egypt, Palestine and East Africa.

It is now generally agreed among investigators, and the more enlightened administrators of locust control methods, that international co-operation affords the only sure method leading to the ultimate and permanent solution of the problem. Sporadic attempts to approach some measure of international co-operation have not been lacking, but no practical effect resulted owing to failure to take scientifically planned concerted measures. In 1928 a severe outbreak of the desert locust was the moving factor in the British Government deciding to take steps that might lead to a solution of the causes of the periodical swarming of locusts and the resulting depredations. A Locust Sub-Committee of the Committee of Civil Research (later transformed into the Committee on Locust Control of the Economic Advisory Council) was formed. The actual work was undertaken by a special research unit under the supervision of Sir Guy Marshall and under the technical supervision of Dr. B. P. Uvarov. The history of this important venture and the results so far obtained were dealt with in the lecture referred to. In a few words it may be said that this purely British organization soon attracted attention in other lands.

The first International Locust Conference at Rome in 1930 requested the British organization to act as the centre of anti-locust research. Concerted investigations by parties of British, Belgian, South African, Egyptian and Indian experts have gradually led towards a fundamental understanding of the whole problem. After eight years of intensive work it has become possible to formulate a policy that aims directly at a radical solution of the difficulties. The investigations referred to have yielded abundant data showing that the periodicity of locust outbreaks is closely connected with transformation of these insects from the harmless solitary phase into the dangerous migratory, gregarious one. The transformation can happen only in certain localized areas with special conditions of climate and vegetation which differ for different locust species. It is in these outbreak areas that the first swarms are formed. The important discovery that great locust invasions

have such restricted beginnings has vital implications. It means that once these original outbreak areas are known they can be kept under proper observation, and any tendency towards the formation of incipient swarms can be dealt with before such swarms can spread and cause widespread devastation. It cannot be too strongly emphasized that Dr. Uvarov himself is the guiding agent in all this international locust policy, as it was his original phase theory that provided the scientific basis for the new outlook on the problem as a whole.

STUMP PRODUCTION IN MADRAS TEAK NURSERIES

WHAT has come to be known as stump planting—that is, the use of root and shoot cuttings, has been long known in India, some of the earliest experiments made in this direction having been successfully attempted with the sissu (*Dalburgia Sissoo*) in the irrigated plantations in the Punjab. In *Indian Forest Records*, 4, No. 5, 1941 (Manager, Government of India Press, New Delhi, 1942), A. L. Griffith says that the planting of stumps in Madras displaced direct dibbling of seed and transplanting, as had been done up to that time. In the early days of stump planting in the presidency a number of experimental investigations were undertaken and continued over some years. Mr. Griffiths summarizes the results in the following tentative conclusions for work in a general West coasts type of climate:

(a) The best density of sowing to use is that of 1/8 lb. to 1/5 lb. of teak seed per square foot of nursery bed, and to do no pricking out of seedlings at all. This is most economical in quantity of seed and results in a high proportion of the stumps produced being of the best size for planting at 1 year old (that is, 0.4–0.8 in. diameter). (b) Thus, one standard 40 ft. × 4 ft. nursery bed sown evenly with 20–30 lb. of seed on the average produces enough well-shaped stumps of usable size to plant 1 acre of plantation at a 6 ft. × 6 ft. espacement and also leaves a reserve for casualty replacement. (c) Poor seed years have to be guarded against, and at the end of the first year either the undersized plants can be left in the bed and these together with germination from seed still dormant will produce a full bed of good-sized plants at the end of the second year, or the undersized plants can be pulled out with the bigger ones, stumped, and put back into a reformed nursery bed. These plants at the end of the second year will give a high proportion of well-shaped, good-sized stumps which are in no way inferior to fresh, good-sized one year old stumps. (d) Although teak stumps store well, and travel well, a large central permanent nursery for the production of stumps for an extensive area does not appear advisable, as in a few years stump production falls off seriously in most localities as a result of continued cropping, and this falling off was not prevented by manuring with artificial manure, or by fallowing, or by growing a green manure crop of sunn hemp in alternate years. In addition, pest attack by cockchafer and white ants may be serious in a permanent nursery and occurred in two out of the five years of experiment.

The conclusion arrived at between the permanent and the temporary or flying nursery is most important and of high interest,

ANALYSIS OF ELECTRICAL CONTACT EFFECTS

IN a paper entitled "Contact Non-Linearity, with reference to the Metal Rectifier and the Carborundum Ceramic Non-Linear Resistor" (*J. Inst. Elec. Eng.*, 89, Pt. 1, No. 23; November 1942), A. Fairweather gives an account of an experimental analysis designed to correlate and formulate the behaviour of various structures possessing contact non-linearity. New data are presented concerning representative contact combinations such as various carborundum combinations, the carborundum ceramic non-linear resistor, the cuprous oxide and selenium rectifiers, and the diamond. Measurements have been made of the variation of the characteristic parameters, resistance and capacitance, with each of the four significant variables—current, mechanical pressure, thickness of semi-conductor and temperature. The ranges of current and voltage far exceed those which have been employed hitherto. Examination of the results obtained leads to various conclusions regarding the mechanism of contact non-linearity, but not, however, in conflict with the familiar 'barrier layer' hypothesis, which is fully supported by the work described.

It would seem that three clearly defined regions of operation hold for conduction in both directions through a contact possessing contact non-linearity. For 'small' voltages and for 'large' voltages conduction is ohmic: for 'medium' voltages, which are largely those of interest, conduction is non-linear, and obeys a simple empirical equation of the form $V = Ki^n$, where n depends mainly on the materials, and K on the dimensions, of the contact combination. This type of law might hold for all contact combinations, and its importance is such as to warrant the development of a theory of circuits containing a non-linear resistor having such a characteristic. Since the contact is never likely to be perfect, the current will be concentrated at a number of spots which may be regarded as imperfections in the boundary. The 'small' voltage ohmic resistance is thus identified as a constant resistance arising from spreading current paths associated with these spots. The 'large' voltage ohmic resistance is due to the resistance of the bulk electrodes, which becomes all-important when the boundary resistance has become sufficiently small. The 'medium' voltage non-linear resistance results from conduction across the nominally insulating portion of the boundary.

The simple gap picture of the boundary seems to have been discarded prematurely. In the case of the cuprous oxide rectifier, where it is generally supposed that the boundary layer consists of highly insulating, oxygen-free cuprous oxide, such gaps might result from intercrystalline or crystalline cracking at the boundary, arising during cooling from the high temperature of preparation, and this picture is in closer agreement with the results of experiment. The importance of two much neglected aspects of contact non-linearity are stressed: first, the capacitance parameter, as a possible source of information regarding the insulating portions of the boundary layer, and secondly, the necessity for using structures which are previously unstressed mechanically, for detailed study.

Carborundum, cuprous oxide, and selenium are all shown to be ohmic conductors, in opposition to the views of some workers. The tests on contacts between