Research Items.

Food Supply of India.—In the presidential address delivered to the agricultural section at the seventeenth meeting of the Indian Science Congress at Allahabad (Calcutta: Asiatic Society of Bengal), G. Clarke discussed the necessity of increasing the food supply to meet the needs of the growing population in India. From a consideration of the agricultural returns for 1922–23 and 1925–26, it is evident that the area available for food production in India is 1·2 acres per unit population, whereas in America and France, countries comparable with India as regards the importance of agriculture, the corresponding figures are 2·6 and 2·3 respectively. The amount of new land in India suitable for cultivation is no longer sufficient to provide the increased area required, so that the solution of the problem lies in increasing the yield of the land already in use. Weather conditions and the shortness of the growing season are the chief difficulties confronting the agriculturist, but the use of modern methods of research, and in particular a closer study of the critical periods of crops, that is, those intervals during which the plant shows maximum sensibility to external factors such as moisture or nitrogen supplies, should do much towards the attainment of better results. Further, green manuring is particularly advocated as an economical means for soil improvement and the maintenance of an adequate nitrogen supply. From a comparison of conditions in other countries and analogy with the progress of the sugar-cane industry in India, it is possible to obtain a rough estimate of the increased production likely to follow the application of scientific methods to agriculture. After making due allowance for the inevitable lag in the adoption of improvements, and taking into consideration the abundant labour resources and responsive nature of the soil in India, it is thought that within the next two or three decades an increased output of 30 per cent in normal seasons may reasonably be expected. Increased expenditure on scientific research is, however, assumed.

Bionomics and Morphology of *Paraphædon tumidulus*.—The intensive study of an organism is useful in entomology. By making facts of structure known, it places in the hands of the morphologist material with which he can arrive at ideas of truer relationships. It also serves as a means of giving clues of weak points in the insect's anatomy which may be used by the economic entomologist to bring it under control, if it is injurious in any way. Dr. Nellie F. Paterson's recently published paper entitled "The Bionomics and Morphology of the early stages of *Paraphœdon tumidulus* Germ." (*Proc. Zool. Soc.*, Oct. 22, 1930, pp. 627-676) is an effort of this nature. The insect belongs to the Chrysomelidæ—a large family of beetles which are all phytophagous; and consequently many of them are serious pests of cultivated plants. The study was made in the zoological laboratory of the University of Cambridge while the author was holding a scholarship awarded by the University of the Witwatersrand, Johannesburg. The study contains notes on geographical distribution, food-plants and nature of damage, and details of life-history. The exoskeleton and the internal anatomy are reviewed in great detail. The paper is illustrated by four plates and seventeen text-figures. An interesting feature is that the author has formulated a system of enumeration and nomenclature of the larval chætotaxy. Although it may apply to some Chrysomelid larvæ, it cannot be a comprehensive scheme which would embrace the whole family. Dr. Paterson is to be congratulated on her fine study.

An Australian Myriothela.—E. A. Briggs (*Rec. Austr. Mus.*, Sydney, **18**, 1930) gives an account of the salient features in the histology of *Myriothela harrisoni* from the coast of New South Wales. The ectoderm of the hydranth is described as stratified; the supporting lamella is thin and from its outer surface extend simple or branched secondary lamellæ, on each side of which the well-developed longitudinal muscle fibrils of the ectoderm are situated. The endoderm presents the usual types of cells—goblet, gland, vacuolate, and storage. The tentacles of the hydranth are remarkable for the extraordinary development of the supporting lamella in the capitulum where it is produced into radially arranged fibres which form the main mass in the apex of the tentacle. The fibres keep this part of the tentacle expanded when the remainder is contracted. The blastostyles, which are borne on the middle zone of the hydranth in such numbers as to hide the surface, are mouthless, and each is continued into a single terminal tentacle. The mature gonophores borne on any one individual are of the same sex; both male and female gonophores have an apical opening representing the velar aperture.

Biological Control of the Prickly Pear.—Several species of *Opuntia* have spread very widely in Australia since their accidental introduction, and two species, *O. inermis* and *O. stricta*, have become very serious pests. In 1912, the Queensland Government appointed a commission to investigate the natural enemies of these plants, and since 1919 the Commonwealth Government has co-operated with Queensland and New South Wales, the work of searching for natural enemies of the prickly pear in its natural haunts being placed under the control of the Commonwealth Prickly Pear Board. The whole of the cactus belt in the United States was examined, and some seventy different kinds of insects were found on the prickly pear. Under the title, "Ten Years' Research on the Prickly Pear", C. Schindler, of the University of Brisbane, gives an account of this work in *Discovery* for February. Very striking success appears to have accompanied the introduction of the moth, *Cactoblastis cactorum*, which was found in La Plata in 1914, and re-discovered in the Argentine and Uruguay in 1925. A shipment of eggs reached Australia safely in 1925 and was an immediate success. The caterpillar tunnels in the fleshy stem and, living gregariously inside this spine-covered fleshy mass, is protected against birds. Schindler estimates that the area covered by the prickly pear in Australia is now being reduced by one million acres a year, as a result of the various methods of biological control now in use, instead of this pest spreading to about the same acreage of new country each year, as was formerly the case. This Australian work will have considerable interest for other countries, for example, South Africa.

Spiral Ringing and Solute Movement in Trees.—Profs. L. H. McDaniels and O. F. Curtis have published the results of their latest experiments on the ringing of trees in *Memoir* 133 of Cornell University Agricultural Experiment Station (October, 1930, 31 pages). The results refer mainly to the spiral ringing of apple trees, and the findings confirm the opinion of these workers that the phloem is the tissue most concerned in translocation, handling solutes taken in by the roots and foodstuffs elaborated in the leaves. Photographs showing the effect of spiral ringing in increasing the fruitfulness of apple branches are given,

and the practice of tapping trees for oleoresin is also reviewed. Lateral transference of solutes and foodstuffs in the trunk is shown to be slow, immediately after the ring has been made. It is suggested that the meeting of the downwardly moving foodstuffs and the upwardly directed solute current causes an electrical polarity of the cells at the junction, that is, the incipient cambium, and the responses of plants to such practices as propagation, pruning, and grafting are discussed from this point of view. The regeneration of the tissues following ringing has been studied, and leads to the conclusion that translocation rapidly becomes normal after the wounding.

Selection of Maize for Germination and other Tests.—Mr. R. C. Malhotra, of St. Mary's College, Kansas, writes to say that in germination tests of maize seedlings he finds that the irregularly shaped seeds taken from the tip and butt ends of the ear, especially those in which the embryo is located at the side of the seed, seldom if ever germinate. The use of such seeds, even if of heavy weight, may cause an experimental error of 20-25 per cent in germination. In the middle of some ears a number of compressed, thin, undeveloped, and starved seeds may be found. They germinate promptly, probably because of the thin pericarp, but produce poor, under-nourished seedlings and should be excluded from germination experiments. In experiments with X-rays and ultra-violet light, the effect of exposure is very different according to which side of the seed is exposed, as the embryo is much nearer one side than the other. The embryo side should be exposed for uniform results.

The Theory of Isostasy.—In a critical review of isostasy by Hubbert and Melton, appearing in the *Jour. Geol.*, pp. 673–695, 1930, the underlying theory is very clearly summarised, and special attention is directed to Hopfner's recent inquiry into the problems involved. Hopfner claims that the observed gravity anomalies can be accounted for, without recourse to the principle of isostasy, by taking into consideration the effect of elevation and depression of the geoid relative to the spheroid of reference (Brun's term). These effects lead to the conclusion that gravity ought to be deficient over the continents and excessive over the oceans, as indeed it is, this being the leading fact that isostasy has been invoked to explain. The authors state that although the results of Hopfner are admittedly qualitative, "they are of sufficient importance to cast a large shadow of doubt over the whole of isostatic theory". Against this depressing conclusion there appears simultaneously an important paper by Heiskanen in the *Am. Jour. Sci.*, Jan. 1931, pp. 39-50. It is admitted that the reduced gravity values g_0 are referred to the geoid, whereas the theoretical values γ are referred to the spheroid, but several lines of evidence are presented to demonstrate that gravity anomalies could be explained by Brun's term only if its quantitative value were about ten times greater than it actually appears to be. Heiskanen concludes that Hopfner's arguments are founded on a qualitatively correct basis; but that he has greatly exaggerated the influence of the effects deduced. Readers of the first paper referred to above should on no account omit to study the second. Taken together, they provide a most illuminating account of an intricate subject that is rarely clearly understood.

Gas in Relation to Oil Production.—B. J. Ellis discussed this subject at the meeting of the Institution of Petroleum Technologists last December, and, in effect, gave a very practical interpretation of S. C. Herold's well-known recent work on simple perfect fluids and their mechanics. As he (Mr. Ellis) pointed out, Herold's thesis deals in the main with ideals—perfect gases and liquids in homogeneous reservoirs; and although the principles enunciated have obvious application to oilfield circumstances, such conditions cannot be realised in actual practice. The author proceeded to examine the concrete variables, the gas, oil, and the reservoir, as existing in Nature, and thereafter sought to modify Herold's theories in terms of actual conditions. Such a study is bound to bring in its train the more practical questions of re-pressuring oil pools and gas drive, and some attention was devoted to these aspects of field-development, while a possible method of increasing the recovery of petroleum by a modified form of gas drive was indicated. In this latter conception is probably the most interesting part of the paper. What is known as 'centripetal production' was shown to be one of the best means of obtaining more oil from a reservoir from which utmost production had been obtained by normal methods, a means apparently applicable, at least in theory, to virgin production. Briefly, centripetal production implies the injection of gas by wells specially drilled for the purpose at geometrical points determined by the positions of output wells and their circles of influence; injection should take place at a pressure equal to or slightly higher than the original reservoir pressure.

River Flow Records in the Ness Basin, Inverness-shire.—Previous notice has been given in NATURE (Mar. 1 and 29, 1930, pp. 334, 514) at some length of the series of observations of river flow in the Ness Basin, Inverness-shire, made in 1929 by the voluntary organisation known as River Flow Records, under the direction of Capt. W. N. McClean, of Parliament Mansions, Victoria Street, S.W.1. These observations have since been extended to cover the period from January to September inclusive, 1930, and the results relating to the river Garry are embodied in three quarterly reports recently issued. The reports show that during the period in question, in addition to rainfall observation, there have been five months actually spent on river gauging work, with the design and construction of new gear for flood measurements and the erection and maintenance of water-level gauges. Much useful and interesting data have been acquired and, for local, and even general reference, the statistical tables will be of great value. The latest of the three reports provides an opportunity of comparing the flow and period losses of the two rivers, Garry and Moriston, over a full twelve months period, from which it may be noted that while both have catchment areas of 150 square miles, the twelve months' flow-off of the Moriston is about 73 per cent of that of the Garry. The 'period losses' in each case were fractionally above and below 14 inches. The report concludes with some comments on the organisation required to maintain these records of flow after the actual gauging work is completed.

A Gyroscopic Clinograph.—Another interesting application of the gyroscope is the subject of an article entitled "Oil Well Surveying with the Gyroscope", in the November issue of the *Sperryscope*, the organ of the Sperry Gyroscope Company, Inc. In the boring of oil wells many things lead to a deflection of the path of the drill from the vertical, and it is important to the driller that he should be informed of any such deflection. There are several methods by which the angularity of an oil well can be determined, and some success was obtained with the use of the magnetic compass. In conjunction with the Sun Oil Company, the Sperry Gyroscope Company has now brought out the 'Surwel' gyro-

scopic clinograph. In this apparatus are incorporated a gyroscope with its axis set north and south, a box-level gauge, a chronometer, and a film camera, these parts being contained in a steel cylinder $5\frac{1}{2}$ in. in diameter, which can be lowered down the well. The bubble in the box-level shows the inclination; a pointer on the gyroscope gives the direction of the inclination; while the camera, timed by the chronometer, takes a series of photographs of bubble, pointer, and chronometer hands. As the rate of lowering is known, the exact depth at which each camera observation is made can be found, and thus the inclination and its direction can be determined at any given depth. The data recorded on the film can also be plotted on squared paper and a graphic picture of the well's course through the ground can be obtained.

Loud Speaker Acoustics.—The design of commercial loud speakers is largely empirical and, indeed, a complete theoretical treatment of the problem is not yet possible. A number of important factors affecting the reproduction of speech and music by coil- and reed-driven speakers are discussed in a paper by N. W. McLachlan and G. A. V. Sowter (*Phil. Mag.*, **11**, pp. 1-54). It is shown that a *rigid* coil- or reed-driven disc system would be of little value in the reproduction of either speech or music. The energy from the coil-driven disc decreases very rapidly above 1000 cycles, whereas the energy from the reed-driven disc is centred round the resonance frequency of the combination. A reed-driven *flexible* disc fails as a reproducer, owing to prominent, widely spaced, natural frequencies due to the limited number of modes of vibration of the disc in the audible frequencies. Actual coil- and reed-driven diaphragms give better reproduction than would be expected from the rigid disc theory, and they possess an almost continuous succession of minor resonances. The theoretical conclusions are supported by experimental evidence. Measurements of the radial velocity of sound in discs were made, and it was found that near the periphery of a conical diaphragm the velocity is considerably less than in air. A summary of sixteen electrical, acoustical, and mechanical factors causing distortion in the reproduction by moving coil systems is given at the end of the paper and indicates the extreme complexity of the problem.

Records of Slow Electrons.—In a paper by P. H. Carr in the December number of the *Review of Scientific Instruments* an account is given of a very promising method for recording slow electrons of energy less than 100 electron-volts. A piece of metal, which may be either in a massive form or a sputtered film, is mounted in the vacuum apparatus, in exactly the same position as a photographic plate would be. After exposure to the beam of electrons, the speed of which is readily controlled by magnetic sorting, the metal is treated chemically, when, with the appropriate reagents, a visible trace of the area of impact appears. Gold, silver, and zinc have been studied in the greatest detail; the best developing agents for the latent images were found to be mercury, iodine, and hydrogen chloride respectively, all in the vapour phase. Gold gives the greatest contrast if the images are to be reproduced afterwards by ordinary photography, but with silver striking colour effects can be produced, which are especially useful for demonstration of the effect. Zinc is the least trustworthy of the three metals, but when images are present on it, they are of excellent definition. It appears that although the technique involved is rather laborious, yet the method is less liable to failure with the slowest electrons than ordinary photography, whilst it has the great advantage that it is not subject to interference from light, either extraneous or from hot filaments within the apparatus.

Isotopes of Beryllium.—The element beryllium occupies rather an anomalous position in that it appears to be a simple element of mass 9, although, from the properties of other elements, it might be expected to have an isotope of mass 8. Evidence for the existence of this isotope has now been found by W. W. Watson and A. E. Parker, from a study of the band spectrum of beryllium hydride in the neighbourhood of 5000 A. (*Physical Review*, vol. 37, Jan. 15). When this is photographed in the third order of a 21-ft. concave grating, giving a dispersion of 1·3 A. per millimetre, every main line in a certain region is found to be accompanied by a weak satellite, and taking the main lines to be due to the molecule Be^9H, the satellites can be shown to be in the positions appropriate to Be^8H. The relative intensities of the Be^8H lines and the Be^9H lines are about 1 to 2000. These results, if substantiated, will confirm Lord Rayleigh's suggestion, which is based on the occurrence of unusually large quantities of helium in the mineral beryl, that a Be^8 nucleus is less unstable than has hitherto been supposed.

Organic Selenium and Tellurium Compounds.—The January number of the *Journal of the Chemical Society* contains two papers by Morgan and Burstall on *cyclo*-selenohexane and *cyclo*-tellurobutane respectively. *Cyclo*-selenohexane, containing Se interposed between two CH_2 groups in *cyclo*-hexane, is a pungent-smelling oil, obtained in small yield by the action of sodium selenide on $\alpha\xi$-hexamethylene dibromide in alcoholic media, the main product being a mixture of at least two polymeric forms. It gives a crystalline mercurichloride, $C_6H_{12}Cl_2SeHg$, a dichloride, a dibromide, a di-iodide, and a methiodide, by direct addition. *Cyclo*-tellurobutane, a five membered ring compound, was obtained by the interaction of tellurium with $\alpha\delta$-tetramethylene di-iodide at 130°, giving the *cyclo*-telluributane di-iodide, which can be reduced to *cyclo*-tellurobutane, a pale yellow oil of repulsive odour which oxidises rapidly in air, the tellurium atom taking up an atom of oxygen. The cyclic tellurohydrocarbon forms very stable dihalides, the chlorine and bromine compounds crystallising unchanged from water. A mercurichloride and a methiodide were also prepared.

Distortion of Flame Surfaces in Electric Fields.—Guénault and Wheeler, in the January number of the *Journal of the Chemical Society*, describe some experiments on the effect of an electric field between two parallel metal plates on the propagation of a carbonic oxide flame initiated at the centre of a spherical bulb. The paper contains some excellent photographs of the flames produced, which show a decided effect of the field. There appears to be little or no alteration in the rate of growth of the flame in a direction transverse to the field. The field did not stimulate the growth of the flame between the plates in the direction in which electrons produced in the flame would be moving, so that such electrons do not appear to assist the propagation of the flame. The speed of the flame was, however, increased in the opposite direction, in which the positive ions are moved. There was also a bodily movement of the whole of the spherical flame surface in the same direction, and sometimes wholly away from the igniting spark. The movement in the opposite direction is, therefore, not only retarded but actually reversed by the field. This suggests that the movement of the flame surface may be mechanical, due to the movement of the heavy positive ions dragging the flame-surface with them, and not necessarily the result of a stimulus to chemical activity imparted by the electric field.