Research Items.

THE MAXIMUM POSSIBLE POPULATION OF THE WORLD.—Sir George H. Knibbs concludes in *Scientia* (Nov. 1925) his examination of the world-problems of population, with special reference to the conditions governing the maximum possible population. He gives various estimates (based upon certain considerations) of the possible population ranging from 2942 millions—if the world's existing population increased in ratio of O. R. Baker's estimate of possible increase in the U.S. agricultural area—to 9792 millions —if all existing arable land in the world could support three persons per acre—and a final maximum of 13,440 millions if an average of a person per 2½ acres applied to the whole land surface of the world. But, as he points out, any one estimate is unsatisfactory, because the possible number must depend upon the world's social and economic organisation, upon ethical considerations governing these, and upon the extension of man's knowledge of Nature, and he briefly examines some of the main issues. Assuming that the present standard of living is retained, together with the present national prejudices and egoisms, Sir George considers it doubtful whether the population will ever reach the 5000 million limit. If man better co-ordinates his efforts so as to involve less expense in non-productive effort, then possibly the advance of science may enable the 7000 million limit to be reached. The friendly study of universal economic conditions and of the adjustment of all territorial and economic relations, together with the advances made through systematised knowledge, would perhaps make possible a population of 9000 millions, though this would leave only a small area available to each individual.

JAVANESE ARCHITECTURE.—In December 1924 at a conference of the Java Institute held at Jogjakarta, one of the questions discussed was the value of the ancient Javanese monuments for the present and future Javanese culture. A report of the discussion appears in a translation by Mary A. Rüs in the *Indian Antiquary* for December. Among the speakers, Mr. Maclaine Pont enforced his argument by an analysis of the native and foreign elements in Javanese architecture. The Javanese monuments have many special features which are absent from the Indian buildings, such as the Hala head, the Makara, the spouts. The strong personal element in Indian images gives way in Java to a stereotyped "loveliness." Javanese style is elegant, correct, and accurately balanced, while the Indian is overloaded, overpoweringly vital, more solid, but not pure. The great buildings in Java coincide in date with the struggle for supremacy of the two great dynasties of Palembang and Java, but they represent the spiritual aspirations of a people rather than the feeling of Hindu rulers and upper classes. There must have been an architecture in Java resembling the primitive Jameh style before the Hindu dynasties came. It may be assumed that the Hindu dynasties gained their power in the first instance by missionary propaganda which developed canonical architecture in accordance with Indian proportional outlines. The style of the Javanese school perhaps originated from Central Asia through Indo-China. A close study of the reliefs of the great temple of Borobudur reveals that the sculptors had not the slightest knowledge of Indian structure; that in illustrating Hindu tales, they pictured the persons in complete Javanese surroundings, and this convention was accepted by both priestly and civil builders. The conclusion, therefore, is that influence was brought to bear on Javanese compositions by Hindu rulers and priests who had themselves no technical knowledge.

INDIA AND THE PACIFIC.—In the *Ceylon Journal of Science*, vol. 1, Pt. 2, Capt. A. M. Hocart marshals in some detail the evidence which, in his view, points to an explanation of the similarities of culture in India and in Fiji as due not to a convergence from a distinct origin, but as being essential elements of a resemblance which could only be due to derivation from a common prototype. The points to which he refers are the cross-cousin system with a common *religious* background as shown in certain ritual practices connected with that relationship, a social organisation with a dichotomous system in each case on Capt. Hocart's interpretation, the relation of the elements within the two caste systems, succession and chieftainship and their attendant rituals and the ceremony of fire walking. Certain divergences are to be explained as due to a simplification that has taken place in Fiji. On the whole, Fijian culture is more archaic and is not to be derived from that of the Vedic literature. It is suggested that this pre-Vedic culture may have been carried to the Pacific by a Mongoloid element of North India, which was partly swamped by the aborigines, partly pushed back into the Himalayas and eastward by western invaders. It is at least certain that everything in south Asia is farther east than it was, and the spread of pre-Vedic culture to the Pacific is merely an episode in a great retreat of people along the southern shores of the Asiatic continent and into the islands.

TRIAL AND ERROR IN THE BEHAVIOUR OF CERTAIN ARTHROPODA.—Prof. W. E. Agar gives an account (*Australian Journ. Exp. Biol. and Medical Science*, Vol. 2, Part 3, 1925) of observations on the behaviour of several arthropods, which were placed in conditions unfavourable to their normal activities, from which in each case there were two apparent avenues of escape—one actually leading to freedom, but the other ending in a cul-de-sac and thus failing to afford relief. In the majority of the experiments the animal was placed in the stem of a Y-shaped passage and when it arrived at the bifurcation had to make a choice between the right or left branches. Experiments with Daphnia involving more than 1400 trials failed to reveal any power on the part of the animal to learn by experience, and a similar finding is recorded for water mites. Young crayfish (Parachæraps) gave very different results, soon learning to avoid the wrong passage and to take the right one, *e.g.* in one experiment in which entry into the wrong passage, besides failing to bring freedom, resulted in an electric shock, the animal took the wrong (left) turn at its first trial but then chose the right passage seven consecutive times. The electrodes were then transferred to the right-hand passage and the animal continued to go into this passage for eight more times, receiving a shock each time, but out of the next twenty-one times made the correct choice nineteen times. The difference of intelligence may perhaps be correlated with the modes of life—the crayfish searches out its food by means of its sense organs, while Daphnia has far less initiative, feeding on microscopic organisms collected by a current of water produced by the movement of certain appendages, and shows no evidence of awareness of other animals or bodies.

HERRING INVESTIGATIONS.—The report for 1924–1925 of the Dove Marine Laboratory, Cullercoats, Northumberland, edited by Prof. A. Meek, contains further investigations on herrings from various localities by Mr. B. Storrow, who, in continuing his

work of previous years, finds that the fish hatched in 1920 formed the bulk of the catches from the Shetlands, Firth of Forth, and the north of Scotland. Those caught inside the Forth consisted mainly of much younger fish than those caught south of its entrance; a fact regarded as indicative of a southerly migration for spawning. The author believes that there is again evidence pointing to extended migration from the North Sea and the north-west of Ireland to oceanic waters, and there are possibly similar indications from the south-west of England, but the small number of herrings examined from Milford Haven and St. Ives makes this latter statement very uncertain. He sums up with the following words: "Our work points to migrations from seas to or towards the ocean, and return migrations towards or into seas for spawning." Mrs. Cowan adds data dealing with the size of these same samples. In the faunistic notes the spawning of the lug-worm *Arenicola Marina* is described. White patches were seen in the water towards the end of September 1924, in ripple marks on Cullercoats sands, which proved to be masses of sperms, and the worms were found close to the patches. Most of those examined had already spawned, and on the next day all the worms had disappeared. This probably represented the end of the autumn spawning.

SPECTRAL PHOTOMETRY.—The issue of the *Physikalische Zeitschrift* for December 8 contains a report by Dr. H. B. Dorgelo, of the Scientific Laboratory of the Philips Electric Lamp Works, Eindhoven, Holland, on the recent progress in the methods of determining the intensities of spectral lines by photography. He deals first with the expression of the blackening of a photographic plate as a function of the intensity of the light falling on it and the time of exposure. Then follows a section on the comparison of the intensities of the lines of a narrow group in a photograph by means of photometers and the use of semi-transparent wedges of platinum deposited on quartz as absorbers. For lines far apart it is necessary to compare the photograph of each with that produced by a standard source of light for which the relation between energy emitted, wave-length, and blackening produced is known. Several sources, including the tungsten incandescent lamp, are discussed and the various types of spectro-photometers are considered. Some of the most striking results of observations are given, with references to nearly a hundred papers mainly of recent date.

THE VELOCITY OF SECONDARY CATHODE RAYS.—The results of an investigation, in which homogeneous cathode rays are made to fall on a blackened metal surface and the secondary cathode rays are retarded by an opposing electrostatic field, are given in a paper by Dr. A. Becker in the November *Annalen der Physik*. It is shown that the secondary electrons are, in general, considerably more numerous than the primary electrons of similar low velocities reflected or diffused backward, so that it is not difficult to determine the manner of emission of the former. The velocity distribution proves to be identical with that of the δ-radiation. The most probable exit velocity, and therefore the absolute value of all the secondary velocities in the cases investigated, is independent of the velocity of the primary rays; there are signs of a decrease at 24 volts, when the limiting velocity for the excitation of secondary radiation is approached. The most probable velocity of the secondary rays is about 2 volts, which agrees with that found for δ-rays. This velocity depends on the nature of the atom in which the secondary ray originates, and it is on the atom that the amount of energy abstracted from the primary corpuscular ray depends. The results fit in perfectly with the views of Lenard on secondary radiation.

THE PRESERVATION OF FRUIT.—B. T. P. Barker and O. Grove discuss a valuable practical application of sulphur dioxide for the preservation of fruit for subsequent use in jam making or as cooked fruit in the home, in the *Journal of Pomology and Horticultural Science* for December. Starting from the problem as to how to preserve pulped fruit put aside at periods of pressure until its conversion into jam is practically convenient, they have reached the conclusion that a better method of preservation of the fruit is to drop it direct into a 0·08-0·1 per cent. solution of sulphur dioxide in an air-tight container. Red fruits in particular lose their colour, but this is largely though not completely restored on boiling, and the skin of gooseberries and currants is toughened as the result of the treatment, but otherwise fruit so treated seems little if at all inferior to fresh fruit for subsequent cooking purposes, and the sulphur dioxide, being volatile, is driven off on boiling. The method therefore seems likely to supersede pulping for the jam manufacturer, whilst in the home, if used with suitable precautions, it may replace the somewhat more troublesome process of bottling in sterile, air-tight containers.

CHEMISTRY IN THE ARTHAŠĀSTRA.—In two recent issues of the *Chemiker Zeitung* (Nos. 134 and 135, 1925) Prof. E. O. von Lippmann deals with those sections of the Arthašāstra which are of scientific interest. The text of the Arthašāstra has only comparatively recently come to light; it has been translated into English by Dr. R. Shamasastry, whose edition is that upon which Prof. von Lippmann has worked. The Arthašāstra is ascribed to an author of the name Kautilya, who lived in the time of King Chandragupta (321-296 B.C.); it deals with problems and methods of government and administration and is largely compiled from more ancient works of a similar character. The latter fact is of particular importance, since it enables us to get an idea of political and administrative conditions in India in a pre-Buddhist age. In the course of the book many facts of scientific interest are mentioned incidentally; these Prof. von Lippmann has gathered together and enriched with annotations. Among the metals gold takes the first place. It is of two kinds—river (alluvial) gold and rock gold. The pure metal is yellow, brilliant, heavy, and very malleable, and on the touchstone gives a characteristic streak. If impure, gold may be purified by fusing it with an appropriate quantity of lead and afterwards treating it with cow-dung and oil. By melting gold with 1 to 15 parts out of 16 of copper, 16 standard alloys can be obtained; these give streaks which can be compared with those of unknown alloys, and thus the composition of the latter may be ascertained. Pure silver is white, shining, and malleable; if it contains impurities, these may be removed by melting the metal with a quarter of its weight of lead. The most important remaining metals are copper (*tâmra*), lead (*sîsa*), tin (*trapu*), iron (*hâlayâsa*), bronze (*kâmsya*), brass (*ârakûta*), *urtta* or *vritta* (?), and *vaikrntaka*. Other substances described are salt (*kshâra*), alum (*sphatika*), borax, blue vitriol (*tîkshna*), and green vitriol (*kâsîsa*). On heating the latter a poisonous vapour with a strong smell is obtained. A number of plant and animal products are also mentioned, together with several poisons (*yôgapâna*). Although fermented liquors are discussed at some length, there is no indication that alcohol was recognised as a distinct substance.