Research Notes.

Kinetics of Bimolecular Reactions in Solution.

IT is well known that the rates of chemical reactions can all be represented to a close approximation by an expression of the form $PZe^{-E/RT}$, where Z is the collision frequency and P, a factor independent of temperature. The interpretation of P which can have any value between unity and 10^{-8} (as one passes from the normal to the "slow" reactions), has been a matter of great difficulty. The transition state method developed by Eyring and Evans and Polanyi is helpful in interpreting the rates of "slow" reactions, apparently making no arbitrary assumption. This has thrust the classical mechanism (based on the specification of the collision conditions) to the background. In a recent paper, however, Hinshelwood and Winkler (*J. Chem. Soc.*, 1936, 371) have shown that the transition state method does involve certain arbitrary assumptions. Furthermore, they have shown how the whole range of the values of P can be understood, qualitatively at least, in terms of relatively simple classical ideas and conclude that one should seek all help one can by applying both methods, in the elucidation of kinetics of reactions in solution.

K. S. G. D.

Emulsification by Ultrasonic Waves.

A VERY interesting study on emulsification by ultrasonics has been made by Boudy and Solluer (*Trans. Faraday Soc.*, 1936, **32,** 556; 1935, **31,** 835, 843). The first paper deals with the mechanism of emulsification. With water-oil systems, the formation and collapse of cavities (loose spaces) brought about by the influence of ultrasonic waves, result in emulsification. The idea of formation and collapse of cavities is made familiar to the reader with examples like Osborne Reynold's experiment on "the boiling water in an open tube at ordinary temperature", *i.e.*, water passed through a convergent-divergent tube turns opaque at the narrowest constriction of the tube with a loud hissing noise, and the singing of a kettle shortly before the water boils. Cavitation is also accompanied by partial degasing. Cavities collapse as soon as the conditions which have led to their formation cease to exist. In most cases decavitation is due to rising pressure, as in Osborne Reynold's experiment or decreasing temperature as in the singing of the kettle. Pressures of thousands of atmospheres may be developed at the moment when the cavity collapses to a small fraction of its original diameter. The mechanical impact due to decavitation produces heavy erosion. Chemically inert glass is attacked under corresponding conditions. If steam is brought through a nozzle into water-oil interface, it condenses with the well-known rattling noise as in the case of the singing kettle, a highly dispersed emulsion of the oil-water type being formed. This is a case of emulsification by cavitation and decavitation (collapse of steam bubbles). Acoustic waves consisting of periodical compression and expansion are shown to cause cavitation during the expansion phase and expel the dissolved gas in gas-containing liquids. Ultrasonic vibrations also may cause cavitation in view of the fact that liquids of low boiling point distil at room temperature, a gas-containing liquid is degased when radiated by ultrasonics. Liquids radiated in vacuum by ultrasonics only boil. Cavities are only formed but they do not collapse. The presence of a gas is essential for emulsification by ultrasonics. A certain value of external pressure is found to be necessary. Emulsification is much feebler when the liquids are hot. No mechanism other than cavitation and decavitation would account for this fact.

With mercury-water or organic liquids systems, however, gases have only stabilising effect whereas with water-oil systems they are instrumental in the formation of emulsions. In presence of protective agents, the influence of the presence or absence of gas entirely disappears. The mechanism of emulsification with mercury emulsions is different, since emulsification takes place in vacuum, *i.e.*, under conditions where no effective collapse of cavities can occur. Steam causes no emulsion at mercury-water interface. Therefore the mechanism consists in the minute droplets of water being thrown into mercury, in which they unite when thin films of mercury separating them burst with the formation of a drop of mercury emulsion. This last process happens at the interface. This is true with

mercury-organic liquids systems also. The mechanism of the protective action of gases which would hold for both water and organic liquids with mercury is still obscure.

In their third paper Bondy and Solluer have discussed quantitative results, concerning the nature of emulsions produced under different conditions. In pure emulsions the concentration would rapidly reach a limiting value, the rate of emulsification being equal to the rate of coagulation. The rates of formation and coagulation increase with increasing energy. Regarding the degree of dispersion, highly dispersed emulsions are formed when the time of radiation is short and the energy small. A long time of irradiation and high energy favour coarser particles. An emulsifier favours higher degree of dispersion. Metallic emulsions of wood metal, alkali metals and mercury with oils have also been studied.

K. S. RAO.

Effect of Heat on the Nutritive Value of Proteins.

HAYWARD, STEENBOCK AND BOHSTEDT (*J. Nutrition*, 1936, **11**, 219) have found that the low nutritive value of the raw soya-bean proteins, is doubled when they are cooked at 105° and 120° C. for 90 minutes. The poor growth of animals experimented upon with raw proteins was attributable more to some type of deficiency than to a lack of palatability and this suspicion was confirmed by the normal growth which was secured when casein was supplemented to the diet. The increase in the digestibility and the biological value of the soya-bean protein brought about by cooking is possibly due to the heat having rendered some essential protein fraction, ordinarily unavailable in the raw soya-bean, available for absorption and metabolism.

Work of this character is sadly lacking in India and from the point of national efficiency and economy, the proteins of Indian foods should be investigated under culinary conditions to which they are subjected.

M. S.

The Variability in the Yield of Coffee Bushes.

THE extraordinary variation in yield from plant to plant in coffee is brought in a study of the plants belonging to different varieties carried out with the object of isolating the high yielding strains for propagation by Felix N. Natino (*The Phillipine Agriculturist*, **24**, No. 9). The types of coffee studied were liberica, excelsa, robusta, quillou, and canephora. The range of variation was surprisingly high and also differed with the different varieties mentioned. Thus in Excelsa the range was from 10·1 to 9032·5 grms.; in Liberica from 20·1 to 6700·7 grms.; in Robusta from 5·1 to 7360 grms.; in Quillou from 10·1 to 5708 grms; and in Canephora from 9·6 to 2425 grms. of fresh berries per plant. Taking trees which have given a higher yield than the mean yield for its group based on the average for ten years it was found that in Robusta only 33·7 per cent. of the total could be classed as good yielders; percentage ratios for the other varieties were also low: thus it was 30·3 in Excelsa, 36·9 in Quillou, and 29·4 in Canephora and 56·2 in Liberica thus bringing out forcibly what a very large number of plants in a plantation are poor yielders and the need that therefore exists for ensuring greater care in the selection of plants to propagate from.

The Gum Disease of Citrus.

THIS common and destructive disease which is often responsible for the extinction of various kinds of citrous plants all over the world has been the subject of studies reported in the *Phillipine Agriculturist*, **24**, No. 10. The authors state that in the Phillipine islands the causative organism is *Fusarium solani*, which is also the organism causing the disease in the Citrus trees in Egypt. The Phillipine type of gum disease is said to be less destructive than those elsewhere which are put down as caused by *Pythiacystis citrophthora* and *Phytophthora parasitica*. The fusarium was found in everyone of the specimens studied and it was also found to produce the disease in inoculation experiments. Different species of Citrus showed variation in the degree of susceptibility to the disease; and the four main commercial species in the Phillipines, *viz.*, *C. nobilis*, *C. sinensis*, *C. maxima*, and *C. mitis* may, for this purpose, be arranged in the descending order of the degree of susceptibility. The disease was found to be present throughout the year, the effect being more conspicuous in the dry season than in the rainy months. The inoculum for infection in the

field may come from the rotted bark and the sap and gum oozing out of the lesions. The fusarium seems to tide over adverse conditions in the form of spores in the gummed rotted bark and in the form of mycelium in the partially healing lesions. As regards remedies, limited trials showed that the gum disease can be controlled by cutting out all the invaded bark to the healthy wood, disinfecting the wounds with dilute mercuric chloride solution (1 : 1000) and then painting them over with coal tar. The need for better cultivation and for a study of the possibilities of raising resistant stocks are also indicated.

Variola Vaccinia in Milch Cattle.

DETAILS of a generalised outbreak of cow-pox among buffaloes and cattle in Lahore during March, April and May 1934 has been reported by G. K. Sharma (*Imp. Council of Agr. Res. India, Selected Clinical Articles*, Bull. No. 8, 1936). He has shown from figures collected from several localities in the city that mostly milch buffalo-cows were affected although some milch cows were also attacked. 199 cases were noticed among the former as against 33 among the latter. The characteristic symptoms of fever and the appearance of papules on the teats, udder, vulva, etc., which later developed to vesicles, pustules and crusts were noticed. As a sequelæ 15 to 20% of the affected developed mastitis and stenosis of the milk ducts was observed in 50 to 60% of the cases. The infection spread by contact directly and through milkmen.

S. D. A.

The Economic Minerals of the Gangapur State.

IN presenting a paper on the mineral resources of Gangapur State Dr. M. S. Krishnan (*Transactions of the Mining and Geological Institute of India*, **30**, Pt. 2) has shown that the State consists mainly of Dharwar schists with a subordinate development of Gondwana rocks. They are highly folded and metamorphosed and are made up of a series of manganiferous rocks, quartzites, phyllites, dolomitic marbles and mica schists. The occurrence of gold, lead, manganese, various types of ochres, fire clay, sillimanite, mica and coal have been noticed, but importance is attached only to coal, manganese and building materials, like marble, slate, etc., since they alone occur in fairly large quantities.

The Movement of Underground Waters.

IN discussing the movement of underground water Dr. C. S. Fox (*Transactions of the Mining and Geological Institute of India*, **30**, Pt. 2) has shown that the most important factor is the size of the pore space and not the percentage of the pore space volume which controls such underground water supply. This water during its movement underground carries along with it a large quantity of mineral matter in solution and numerous examples of subsidences caused thereby is given in the body of the paper. The scarcity of radium salts in mineral springs is partly due to the rarity of the material and partly to their insolubility. The mud precipitated from such springs are highly radioactive. He has further shown how earthquakes considerably alter the movement of underground water. Particular care should be taken for the disposal of the sewage water since it finds an easy access to the underground water. In all such cases the advice of the Geological Survey is essential for successful operations.

The Evolution and Classification of Ascidians.

THE evolution and classification of ascidians forms a very fascinating chapter in the history of chordate phylogeny. In a recent paper in the *Phil. Trans. Roy. Soc., Lond.* (B, 530, 1936) N. J. Bevill gives us a new classification from what has been accepted till now. Moreover, the development and variability of the heart, pericardium and epicardium throughout the group are also described. A complete account of the anatomy and development of the primitive genus *Ciona* is given. In ontogeny the tadpole larva after metamorphosis gives rise to a post-larval ascidian. This one differs from the adult in many respects, *e.g.*, the post abdomen,—an epidermal stalk into which extend the retractile muscles of the siphons. As the young assumes adult conditions, this shrinks and is only represented as the vessels of the test in the adult. The author points out that from a ciona-like ancestor, ascidians must have evolved in two directions :—one involving the descent of the viscera into the stalk (Aplouso-

branchiata) and the other where the viscera shifts forwards along the branchial wall. After describing the descent and ascent of the viscera, the influence of dwarfing, the Perophoridæ is dealt with. It is noted that the Perophoridæ may represent an evolution from the primitive cionid stalk independently of the two major trends of descending and ascending viscera described. The inter-relationships of the various orders. families, and genera is given in the form of a genealogical tree.

Behaviour of Bacteria in the Trachea of Immunised Animals.

IN a valuable paper appearing in the *Archiv für Hygiene and Bakteriologie* (1935, **114**, 121–136) Krishnamurthy has described the results of his investigations on the behaviour of bacteria in the tracheal epithelium of normal and immunised animals. A number of micro-organisms are phagocyted by the epithelium of the trachea of guinea pigs and are, therefore, non-pathogenic. In the case of a staphylococcal injection of the nose of the mouse, a strong phagocytosis through the leucocytes but not through the epithelial cells was observed. Many micro-organisms, particularly the 'milzbrandbazillen' of maugeri, pass through the tracheal mucus membrane. In the case of the epithelium of the nose of the mouse phagocytosis was not observed in any particular cell. Non-pathogenic staphylococci were fully phagocyted through leucocytes. With pathogenic pneumococci, it was discovered, only once, that the cocci had penetrated into the lymphatic folds, but this did not happen in the case of immunised animals. The organisms remaining on the mucus membrane are phagocyted by leucocytes. This was observed with pneumococci using immunised mice, with weakened 'milzbrandbazillen', and with virulent 'milzbrandbazillen' using immunised animals. The bacilli are killed in most cases through the action of the exudate or leucocytes or both.

Bequest of Pavlov to the Academic Youth.*

WHAT can I wish to the youth of my country who devote themselves to science?

Firstly, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness and gradualness. From the very beginning of your work, school yourselves to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap-bubble will rejoice your eyes by its play it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you never can fly. Without them your "theories" are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of the facts. Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty. Never think that you already know all. However highly you are appraised, always have the courage to say of yourself—I am ignorant.

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse useful advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.—(*Science*, 1936, **83**, 369.)

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* Written just before Pavlov's death, at the age of 87 years, on February 27, 1936. Translated from the Russian by Professor P. Kupalov, chief assistant in the Pavlov Institute at Leningrad.