determinism of sexuality in the Protozoa; the Vaillant prize to Maurice Gevrey for the whole of his work on partial differential equations; the Houllevigue prize to Albert Policard for his work in histophysiology and histochemistry; the Saintour prize to Albert Vandel for his work in zoology and general biology; the Lonchampt prize to Etienne Canals for his study on the physiological rôle of magnesium on plants; the Wilde prize to Ernest Chaput for his geological work; the Caméré prize to André Coyne for his work in civil engineering; the Gustave Roux prize to Pierre Bonnet for his thesis on sloughing, autotomy and regeneration in spiders with a study of the European Dolomedes; the Thorlet prize to Adolphe Richard; the Albert I of Monaco prize to Louis de Broglie for his researches in wave mechanics.

Special Foundations.—The Lannelongue foundation between Mmes. Cusco and Raphaël Rück; the Hélène Helbronner-Fould prize to Mme. Gustave Ferrié.

Prizes of the Grand Ecoles.—The Laplace prize to Jacques Desrousseaux; the L. E. Rivot prize between Jacques Desrousseaux, Georges Périneau, Jean Crussard and Jacques Aubriot.

Foundations for Scientific Research.—The Trémont foundation to Lucien Malassis for his inventions and work in connexion with calculating machines; the Gegner foundation to Wladimir Margoulis for his work in nomography with applications to aerodynamics and aviation; the Jérôme Ponti foundation to Jean Orcel for his work in metallography and opaque minerals; the Hirn foundation to Adolphe Buhl for his studies on the transformations and invariances of multiple integrals; the Henri Becquerel foundation to Henri Galbrun for his work on the calculus of probabilities and other mathematical researches; Mme. Victor Noury foundation between André Lwoff for his work on the physiology and nutrition of the Protozoa, Louis Corbière for his work in systematic botany and his contribution to the study of Norman flora; François Raoult for his analytical researches on rocks and Joseph Repelin for his geological work in Provence; the Henry Le Chatelier foundation to Paul Bastien for his researches on the alloys of calcium, niobium and gallium; the Roy-Vaucouloux foundation to Albert Brault for his studies on glycogen in the development of tumours, normal tissues and organised beings; the Charles Frémont foundation to M. and Mme. Albert Thomas for their researches on a photo-electrograph for the use of the blind.

THE LOUTREUIL FOUNDATION

1. *Researches on Definite Problems.*—5,000 francs to Marcel Brillouin for carrying out numerical calculations relating to the theory of dynamic tides; 2,000 francs to Paul Dechambre for continuing his researches on the physical properties of wool; 5,000 francs to M. and Mme. Joliot-Curie for travelling and other expenses in connexion with their work on physics at the Jungfraujoch station; 2,000 francs to Gustave Lesbouyries for the study of the diseases of birds due to filtrable viruses; 2,500 francs to Lucien Panisset and Goret for their researches on infectious anæmia of the horse; 5,000 francs to Marcel Petit for assisting his researches in comparative anatomy; 5,000 francs to Mme. Lucie Randoin for researches on vitamins; 2,000 francs to Victor Robin for researches on radiodiagnosis and radiotherapy in animals; 3,000 francs to Mme. de Vomecourt for assisting work to be done in the New Hebrides.

2. *Voyages and Explorations.*—15,000 francs to Camille Arambourg as a contribution to an expedition to eastern Africa; 9,000 francs to Auguste Chevalier as a contribution to a botanical expedition to Central Africa; 5,000 francs to Jacques Petit for an expedition to Madagascar.

3. *Purchase of Material.*—8,000 francs to the Lyons National Veterinary School for the purchase of a cinematograph apparatus; 3,000 francs to Augustin Mesnager for the purchase of an apparatus showing the distributions of strains in elastic solids; 5,000 francs to Albert Granger for the purchase of a furnace.

4. *Libraries.*—4,000 francs to the Toulouse National Veterinary School for its library; 6,000 francs to the Polytechnic School for its library; 10,000 francs to the Botanical Society of France for the establishment of a card catalogue of its library.

5. *Publications.*—5,000 francs to the National and University Library of Strasbourg for preparing and printing a catalogue of periodicals; 4,000 francs to the Astronomical Observatory of Zò-Sé, for its publications; 9,000 francs to the National Acclimatisation Society of France for the publication of a book by (the late) Rollinat on the biology of the reptiles of central France; 5,000 francs to the widow of Jean Thomas for the publication of a book dealing with his work resulting from the expedition between the Congo and Lake Tchad.

Instability of Liquid Surfaces

THE problem of the instability of the 'liquid surface' separating two media has fascinated and attracted many investigators but the complexity of the phenomenon as seen in the laboratory and in everyday life, as well as the difficulty of the mathematics, have made progress very slow in the direction of a solution.

A reference to the instability of the surface of separation between two fluids is first found in a paper by Helmholtz[1], and Kelvin[2] in an investigation of the influence of wind on waves in water, supposed frictionless, discussed the conditions under which a plane surface of water becomes unstable. Adopting a suggestion due to Kelvin, Rayleigh[3] investigated the instability of such a surface and obtained results which by now are classical. To a first approximation, the system is unstable for all wave-lengths and the amplitude of an initial displacement of the form $y = a\cos kx$ increases exponentially with the time. The first approximation, however, shows no tendency in the direction of the formation of vortices, but a recent investigation by Rosenhead[4] shows that the tendency towards rolling up is apparent if account is taken of second order terms in the approximation. In order to obtain the ultimate form of the surface of discontinuity, Rosenhead departs from the Rayleigh method and by means of an approximate numerical process demonstrates the formation of vortices. This method, however, does not discover the wave-length which ultimately becomes dominant in the system and so fixes the distance between successive vortices.

Banerji and Ghatage have now investigated the motion of the 'liquid surface' separating two portions

of the same medium which are at different temperatures.[5] The account of the investigations is illustrated by a number of excellent photographs showing the rolling up of the surface of discontinuity into vortices, and the separate convolutions can easily be seen. There are also several tables of numerical results which can be used when we have a complete theory capable of explaining the rolling up and of giving the value of the dominant wave-length or wave-lengths.

Previous investigators, theoretical and experimental, seem to have concentrated on discussing the surface separating two streams of equal temperature but differing velocities. Banerji and Ghatage supplement the existing information by investigating the effect of a difference in temperature in addition to the difference in velocity. The results, some of which might have been expected on general grounds, are interesting. A discontinuity in temperature alone, and hence a discontinuity in density, was introduced by making a cylindrical or rectangular column of water in a large tank differ in temperature from the adjoining fluid. Discontinuities in velocity as well as in density were produced by making two streams of water meet at various angles under different thermal conditions.

In all cases the initial surface of separation was in a vertical plane and not, as in most previous work, in a horizontal plane. This makes the basic motion unsteady, so that the surface of discontinuity has a tendency to change its position quite apart from its inherent instability. The instability, however, was quite apparent. The surface assumed a wave pattern, each crest or trough took up the form of a breaker and rolled round itself, thus producing a vortex and a series of spiral-shaped three-dimensional vortices was formed. "In the direction of motion the vortices showed a progressive increase in dimensions and number of convolutions. The greater the difference of temperature at the surface of discontinuity, or the greater its slope, the smaller was the diameter of the vortices. For very small difference of temperature the vortices had enormous diameters. The greater the difference of temperature at the surface of discontinuity, the more rapidly did the vortices develop." The shape of the surface of discontinuity was obtained by colouring various parts of the liquid and by photographing the visible stream lines in horizontal and vertical sections. The paths of the particles at the surface of discontinuity were also photographed but the actual material used to make the motion visible probably has some small influence on the paths of the particles of fluid.

L. ROSENHEAD.

[1] Helmholtz, *Phil. Mag.*, **36**; 1868.
[2] Kelvin, *Phil. Mag.*, **42**; 1871.
[3] Rayleigh, *Proc. London Math. Soc.*, **10**; 1879.
[4] Rosenhead, *Proc. Roy. Soc.*, A, **134**; 1931.
[5] Banerji and Ghatage, *Indian J. Phys.*, **7**; 1932.

Population Density and Egg-Laying in Flies

IN a paper of much interest, Prof. Raymond Pearl has made a study of the influence of density of population upon egg production in Drosophila (*J. Exp. Zool.*, vol. 63, No. 1), which is a continuation of his investigations on the biological relations underlying the growth of populations.

The flies were placed under standard conditions and deposited their eggs on an agar surface of fixed area where they could be counted. In general, the higher the number of pairs of flies in a bottle of given size the smaller the number of eggs laid per individual. This result, obtained with different populations of flies, was then repeated by comparing the egg production of the same flies when kept for alternating twenty-hour periods under conditions of high or low population density. More than 100,000 eggs were counted in these experiments.

The decrease in the rate of egg production with increasing density of population is described by the same type of mathematical equation as that which relates the density of a gas to the mean free path of its molecules. From numerous observations of the behaviour of single flies under isolated conditions, they are found to go through regular cycles of feeding, walking or flying, resting and cleaning their legs. These rhythms are easily disturbed and the flies are found to be extremely sensitive to slight environmental disturbances. The denser the population the more they interfere with each other's rhythmic activities, thus decreasing the amount of food intake and oviposition and increasing their muscular activity. That the area of agar surface for feeding and egg-laying, and not the volume of air, is the significant factor, was shown by comparing the oviposition in bottles of twice the size but with the same area of agar.

In the same journal, Dr. Alpatov has investigated egg production in vestigial- and long-winged flies under different conditions of development, the former showing much lower productivity. The influence of temperature and underfeeding in the larval stage were investigated. At a low temperature, egg production begins earlier. Underfeeding reduces productivity, and a negative correlation is found between length of life and egg production.

Mycorrhiza on Conifer Roots

A VERY thorough study of the root system of young conifers has been made by Dr. E. V. Laing for the Forestry Commission, and an account of this work is published by the Commission as Bulletin 13 under the title of "Studies on Tree Roots" (1932). This account contains an interesting contribution to our knowledge of mycorrhiza on these roots.

There are two forms of mycorrhiza; the ectotrophic, in which the fungus grows mainly on the surface of the root, and the endotrophic, in which it penetrates the cells of the cortex practically as far inwards as the endodermis. Dr. Laing points out that whilst both forms may occur on the same tree yet, on the whole, the ectotrophic type is common in pine, spruce and larch, whilst the endotrophic type is characteristic of *Cupressus*, *Thuya* and *Taxus*. This distribution of the fungus correlates in an interesting manner with differences in cortical structure. In the first group of conifers the cortical cells have thin walls and contain little starch; in the second group characteristic girdle thickenings occur on the walls of the cortical cells and these cells usually contain starch; this is the type of cortex which is usually invaded by the fungus.