sterone by a tissue incubation technique invented at the Middlesex Hospital Medical School; a three-year programme of research and development on the selective removal of gold from cyanide liquors with ion exchange metals; hydrogen–oxygen fuel cells, including the construction of prototypes and the development of high-pressure electrolysers; the development of improved types of exchange membranes and electro-dialysis cells for the purification of salt and brackish liquors and other uses in the chemical, food and antibiotic industries and the treatment of effluents; the development of a groundnut harvester designed by the National Institute of Agricultural Engineering; and the design and construction of a prototype rolling mill to enable thin strip to be rolled in a few passes to thicknesses down to 0·0001 in. Work at the National Institute for Research in Dairying and at the Courtauld Institute of Biochemistry on the structure of mircestrol and at the University of Cambridge on the stability of towed flexible oil barges and methods of preventing their tendency to 'snake' is also being supported.

Of the 631 inventions communicated to the Corporation during the year, 240 were from Government departments and research councils, 100 from universities, 54 from Commonwealth official organizations, 16 from industrial research associations, and 213 from private firms and individuals, of whom 192 were within the United Kingdom and 17 others within the Commonwealth. Of patent rights assigned during the year, 105 were from Government departments and research councils and 26 from universities, while at the end of the year the Corporation held 701 United Kingdom granted patents and 373 patent applications, on which 335 licence agreements were in force, as well as 942 overseas patents and 1,054 patent applications.

## THE GRASSLAND RESEARCH INSTITUTE*

THE removal of the Grassland Institute from Drayton to Hurley was completed in September 1955 and the staff has been able to settle down to its programme of research designed to secure a basis for the future progress of pastoral farming in Britain. Research is being carried out by five departments and three units, which together constitute a team working on problems centred on the grass/legume sward involving four main aspects concerned with its development, potential characteristics, level of productivity and its utilization at all times of the year.

The object of the Herbage Agronomy Department is to study ways and means of extending the season during which pasture can be offered to stock. It is also concerned with the influence of management on grass production. Experiments in animal agronomy are concerned with all phases of beef-cattle production from rearing trials to carcass quality studies. Grazing experiments with sheep and pigs and the effect of poultry management on the white clover content of grass/clover swards are also included in the programme. The influence of the botanical composition on soil fertility, the utilization management and the use of nitrogenous fertilizers is being studied by the Ley Agronomy Department. Development of methods for estimating pasture intake by grazing animals, and investigations of the composition of nitrogenous and carbohydrate constituents of herbage plants at different stages of growth are the concern of the Department of Biochemistry and Animal Nutrition. The study of grassland necessitates a sound basic knowledge of the growth and development of different grass species and it is the aim of the Plant Physiology Department to provide this information.

The Unit of Microbiology has so far studied the fungal population of decomposing tissues of ryegrass, but doubtless there will be many other problems that will repay investigation. A station of this kind would not be complete without adequate facilities for statistical consultation and advice, which is provided by the Statistical Unit. Besides its advisory function, the Unit is investigating the particular requirements of experiments carried out at the Station. The Extra-Mural Unit carries out experiments at a considerable number of centres, particularly on the production of winter grass and early bite. The long-term effect of different fertilizer-levels on productivity of leys is being studied.

* Grassland Research Institute. Experiments in Progress No. 9: Annual Report for 1956. Pp. viii+61. (Hurley, near Maidenhead: Grassland Research Institute, 1957.) 5*s*.

## LABORATORY ANIMALS

IT is essential that laboratory animals should be bred under stringent conditions, with due regard for their genetic and other characteristics, their freedom from disease and for other factors which may influence the experimental results obtained. The International Committee on Laboratory Animals, founded in December 1956 as an independent body supported by Unesco (*Nature*, **179**, 240; 1957), issues a *Bulletin* on the subject in March and September of each year, the second issue of which (March 1958) has recently been published.

At its meeting last December the Committee recognized the importance of primary type-colonies of breeding stock of known genetic and other controlled characteristics and undertook to help in their selection and establishment. It also recommended the production, translation and distribution of technical manuals on the care of laboratory animals, the preparation and distribution of films and the establishment of a specimen programme of courses for laboratory technicians. It was recommended that scholarships and fellowships should be awarded in the field of animal care, production, genetics, nutrition and disease and the Committee undertook to help both applicants for such awards and those who might make applications.

Surveys have been completed of the production and use of laboratory animals in the Benelux countries, India, Italy, Japan, Scandinavia, Switzerland and the United Kingdom, and a critical analytical

review of the information obtained will be published by Unesco this year. Further surveys are in progress in Australia, France, Turkey and the United States and others are being planned.

Information is being collected about the regulations governing the export, import and international transport of laboratory animals and about humane regulations or recommendations that are in force. The Committee is also organizing an international symposium to be held in October at the Centre de Sélection des Animaux de Laboratoire, Centre National de la Recherche Scientifique, Gif-sur-Yvette, near Paris, which will discuss what provision of laboratory animals is needed, what resources are available to-day, and the work of the International Committee. The proceedings of the symposium will be published.

The *Bulletin* outlines the functions of a national laboratory-animal organization as a recognized centre of information in contact with similar organizations in other countries, the functions of which include keeping a register of important sources of supply of laboratory animals. A list of existing national organizations in the United Kingdom, the United States, Czechoslovakia, France, Holland and Japan, is also given. Similar organizations are being formed in Australia, Belgium, India and Italy. A valuable list of books and other publications on vertebrate and invertebrate laboratory animals of many kinds occupies about seven pages of the *Bulletin*, which also announces the change of title of the United Kingdom Laboratory Animals Bureau to the Laboratory Animals Centre and the removal of this centre on March 31 to its new address at the Medical Research Council Laboratories, Woodmansterne Road, Carshalton, Surrey.

The Collegium Internationale Neuro-Psycho Pharmacologicum is holding its first congress in Rome during September 9–12, and will discuss, among other things, the behaviour of animals in normal conditions and after the administration of psychotropic substances. Further information can be obtained from Dr. C. Radouco-Thomas, 44 Route des Acacias, Geneva, Switzerland.

G. Lapage

# SURGES IN GLACIERS

By Dr. J. F. NYE

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Attention has been directed by Lighthill and Whitham[1,2] to a class of wave motions which are physically quite distinct from the classical wave motions in dynamical systems. They show that these so-called kinematic waves exist in a one-dimensional flow system if there is an approximate functional relation, at each point $x$, between the flow $q$ (quantity passing a given point in unit time, for example, number of vehicles on a road), and the concentration $k$ (quantity per unit distance). The wave property follows directly from the equation of continuity satisfied by $q$ and $k$, namely:

$$\frac{\partial k}{\partial t} + \frac{\partial q}{\partial x} = 0 \qquad (1)$$

They show that there are waves of constant $q$ which travel with a velocity:

$$c = \left(\frac{\partial q}{\partial k}\right)_x$$

In general, $c$ is different from the velocity $v$ of the medium itself, which is given by $q/k$. They applied the analysis to flood movements on long rivers[1] (of which some independent treatments had already been given), to the group velocity phenomenon[1], and to traffic flow on long, crowded roads[2]. Frank has used a similar method to analyse the movement of small steps over a crystal face during crystal growth and evaporation (private communication). Now it appears that the same analysis may be used to explain the passage of surges through glaciers.

The movement of bulges of increased thickness down a glacier faster than its normal flow has been postulated, because increased accumulation by snowfall in the upper part of a glacier makes itself felt at the lower end long before any of the new material can have been carried that far. As remarked by Sharp[3], this was spectacularly demonstrated by the sudden advance of several glaciers in the Yakutat Bay region, Alaska, a few years after the severe earthquake of 1899, which shook down much ice and snow on to the heads of these ice streams. A bulge of increased thickness is reported to travel with a velocity of 3–4 times that of the glacier[3].

To apply Lighthill and Whitham's analysis we identify $q$ with the discharge (volume of ice passing a given cross-section per unit time) and $k$ with the thickness of the ice. Then to work out $c$ we need to know the dependence of $q$ on $k$. The simplest case is a very wide glacier of rectangular cross-section. A theoretical treatment[4] gives $q$ as the sum of two terms, one due to plastic deformation in the bulk of the ice, and the other due to sliding of the ice over its bed; for unit width,

$$q = ak^{n+2} + v_b k \qquad (2)$$

In this equation, $a$ is a constant for given $x$, determined by the flow properties of ice, its density, and the slope of the channel. $n$ is the power in the quasi-viscous creep law of ice,

$$\text{rate of shear-strain} \propto (\text{shear stress})^n$$

and is found experimentally[5] to be about 3 or 4. $v_b$ is the velocity of sliding on the bed, and it will depend on $k$ in a way that is not easy to estimate. On Weertman's theory[6], in a glacier the bottom surface of which is at the pressure melting point, $v_b$ at any point is proportional to the $(n + 1)/2$ power of the shear stress in the bottom layer of the ice. This shear stress is directly proportional to $k$ (ref. 4). Hence we may write, tentatively,

$$v_b = bk^{(n+1)/2}$$

where $b$ is a constant for a given $x$.

We therefore have, at a given $x$,

$$q = ak^{n+2} + bk^{(n+3)/2}$$

Thus, $c = dq/dk = (n + 2)ak^{n+1} + \frac{1}{2}(n + 3)bk^{(n+1)/2}$. But $v$, the mean velocity of the ice over the section, is given by:

$$v = q/k = ak^{n+1} + bk^{(n+1)/2}$$