Import, export, transport, selling or buying are also dealt with in regard to species taken illegally, and eggs are considered equally with the birds themselves.

Certain methods for the mass capture or destruction of birds are condemned. This is a particularly difficult subject owing to old-established customs and widely diverging points of view and national temperaments. What is regarded as a normal state of affairs in one country may be deplored by its neighbour, and it is not easy to arrive at a general agreement, a tolerant give and take and gradual change being the only solution.

A point which was of no great importance in 1902, but which has become of vital importance in 1948, is the safeguarding of habitat which is the fundamental for the existence of any species of bird; with the rapid spread of civilization this is becoming more and more serious so far as all forms of wild life are concerned.

In addition to the Convention another important question dealt with by the Paris Conference was the International Inquiry into the status of the Anatidæ in Europe, and the progress being made in the various countries regarding this. The British Section, which has been allocated the task of correlating the information sent in from all over Europe, presented a report on the arrangements being made to carry out this work.

Other matters discussed were the conditions of transport of birds by air, a biological station on the Neusiedlersee in Austria, and the publication of the second edition of an International Ornithological Dictionary by Denmark.

The membership of the International Committee now numbers thirty-five, Iceland having been the latest country to form a national section. The headquarters are at the British Museum (Natural History), London, with further secretariats in Brussels and New York.

BIOLUMINESCENCE

THE increasing use of the fluorescent lamp in recent years has served as a stimulus to the study of the mechanism of the emission of cold light; and this in turn has led to a renewed interest in the production and utilization of such light in luminous animals. The Section of Biology of the New York Academy of Sciences held a Conference on Bioluminescence in November, 1946, and the papers submitted, which have now been published*, provide a comprehensive review of the subject.

In a general survey, E. Newton Harvey points out that about forty different orders of plants and animals, ranging from bacteria to fish, contain self-luminous species. A few of these, such as the fish *Photoblepharon* and *Anomalops*, make use of luminous bacteria housed in special pouches which can be covered or exposed at will by a sort of eyelid. Chemiluminescence in general is reviewed by R. S. Anderson. Colour, fluorescence and chemiluminescence are probably degrees in an analogous process. Emission results from the loss of a quantum of energy during the change from an excited electronic state to a ground-state with less energy, these changes being independent of high temperature. Only in comparatively recent years, with the discovery of the bright chemiluminescence of aminophthalhydrazide and dimethylbiacridinium nitrate, have systems been obtained which can rival in luminosity the substances extracted from living organisms. It was in 1886 that Dubois first demonstrated that light production in animals results from the interaction of luciferin and the enzyme luciferase. In the Ostracod *Cypridina* these two components are discharged in the form of granules from separate glandular pores and then interact in the sea water. This animal, therefore, affords ideal material for the study of these substances *in vitro*, and the recent work in this field is reviewed by A. M. Chase. The structure of luciferin has not been fully elucidated; but there is evidence that it has a relatively small molecular weight and contains a hydroxybenzene structure which is reversibly oxidized to a quinone. F. H. Johnson and H. Eyring discuss the action of pressure, temperature and drugs on the enzymes concerned in bacterial luminescence.

By far the longest paper is by J. B. Buck, who provides a comprehensive review of the anatomy and physiology of the light organ of fireflies and contributes some new suggestions on the control of light emission. There is the utmost diversity in the anatomy of the light organ in the beetles; their histology ranges in complexity from a group of loose independent giant cells, apparently without tracheæ, similar to, and perhaps identical with, the œnocytes (such as occur in *Phengodes*), to the highly complicated arrangement in *Photinus* or *Luciola* where a reflective layer containing urate granules underlies the photogenic layer. In the most complex type a rich supply of tracheæ runs vertically through the reflective layer and then enters specialized cylindrical rods of tissue which pass straight through the photogenic layer. Here they give off lateral branches which end in conspicuous tracheal end-cells by breaking up into the tracheoles which supply the photogenic cells. Buck is satisfied that the tracheoles do not enter the cells; but there is evidence that they are connected together by an ultra-tracheolar network which may, perhaps, consist of open tubes.

It is this very highly evolved system which provides some of the most intriguing problems in the physiological control of luminescence. Light may be emitted as a steady glow or in the form of brilliant flashes showing a remarkable periodicity which is under the control of the organism. It is the control of flashing which has excited most controversy. There is no doubt that the organ is supplied by nerves which stimulate it to activity. It is equally sure that the production of light is dependent upon the access of oxygen to the photogenic cells. Argument has centred around the question whether the cells are stimulated directly to produce light—perhaps by the dissolution of barriers which normally separate the enzyme from its substrate—or whether the nerves control the access of oxygen. It is well known that the endings of the tracheoles in many insects contain liquid which may be absorbed into the tissues during activity and so replaced by air. It has been suggested that the enhanced oxygen supply which then results may be the cause of the light flash; but, as Buck points out, if this change does occur in the tracheoles of the luminous organ it is more likely to be secondary to the metabolic activity of the cells. The tracheal end-cells, an enlarged form of the cells which occur in many insects where the tracheæ break up into tracheoles, are a characteristic feature of the flashing type of organ. It has often been suggested that they

[1] *Annals of the New York Academy of Sciences*, 49, 327 (1948).

play some part in the process. Dahlgren described what appeared to be a sphincter around the tracheole at this point, and beyond it a structure with radiating fibres. Buck outlines a reasoned hypothesis according to which the glowing of the organ is dependent on the diffusion of oxygen into the tracheoles, while the flashes are due to the mechanical projection of 'jets' of air into the tracheole by the controlled relaxation and contraction of the sphincter mechanism in the tracheal end-cell. But he concludes that the evidence at present available is insufficient to decide between this hypothesis and that of direct nervous stimulation of enzymic activity in the photogenic cells.

V. B. WIGGLESWORTH

SYMPOSIUM ON SEARCHLIGHTS

ONE of the most important features of a scientific society is its capacity to arrange a symposium on a special feature of its activities and to publish the resultant papers. There are many subjects where the interested people are too few for the probable financial return to tempt an author to the publication of a book, and where in addition the knowledge is so specialized that no one author can easily do justice to it. The publication under review* is such, and the Illuminating Engineering Society deserves the thanks of those who, either as user or manufacturer, need to know about searchlights in some detail. The scope of the book is indicated by the sectional headings: "The Function and Design of Army Searchlights", by E. W. Chivers and D. E. H. Jones; "High-power Searchlights of Wide Divergence", by Air Commodore W. Helmore, H. K. Cameron, F. S. Hawkins, L. B. W. Jolley and L. M. King-Brewster; "Photometry of Searchlights", by H. K. Cameron, E. H. Rayner, E. R. Thomas and G. T. Winch; "The Visibility of Targets in a Naval Searchlight Beam", by W. D. Chesterman and W. S. Stiles; "Some Visibility Problems Associated with Anti-Aircraft Searchlight Beams", by S. S. Beggs and J. M. Waldram; "Aircraft Searchlights for Anti-Submarine Warfare", by Commander C. J. Carr.

There are, in addition, some twelve pages of discussion.

The meeting was held in London on April 15, 1947, and presumably the difficulties of post-war publication are responsible for the delay in the appearance of the book.

As the titles suggest, there is a marked war-time flavour about the publication, although some of the work was carried out before 1940 but has not previously been made available to the scientific public. The balance between the historical background of searchlight design, theory and photometry, and the immediate foreground of practical war-time development has been well maintained, and the result is a record which will find a place in many industrial and technical libraries.

It may come as a surprise to many that an increase in intensity of a searchlight from 100 megacandles to 500 megacandles only increases the range by some 50 per cent in clear weather and by only some 15 per cent in medium weather. One may therefore be allowed to wonder whether the effort put into the development of the larger sizes of searchlight was justified, especially as it meant the complication of additional spare parts.

Probably the part which will attract most attention is the description of the design and manufacture of high-powered projectors for such special purposes as the interception of night-flying aircraft and submarines lying on the surface of the sea. The 'Turbinlite'—to use the war-time code word—as finally designed consumed 140 kw. with a 90-cm. mirror and was supplied by batteries which could operate for four periods of 30 sec. The whole was carried in the nose of an aeroplane, and the success of the scheme was demonstrated on many occasions. Figures are also quoted for the 'Leigh Light'—used against submarines—showing that the number of U-boats seen was increased sevenfold by its use and that 11 per cent of all night attacks carried out by its use resulted in 'kills'. The specialist in photometry will find summaries of considerable value, of both theory and practice as applied to these mammoths of the illuminating engineer's industry, much of it available in convenient form for the first time. In the case of 'visibility', many of the problems only became urgent under the stress of enemy action. Some of the solutions are especially neat, such as the 'perspective' explanation by Beggs and Waldram of the case of the apparent sudden ending of a searchlight beam to an observer near the projector.

There are a number of errors and misprints which may cause difficulty, as, for example, p. 44, Fig. 17(*b*). The symbols θ and ψ appear to be interchanged. P. 45, third line, this expression has been disarranged in the printing. P. 133, in the formula the symbol φ has been omitted after K in the square brackets.

The book provides in a convenient form a technical treatise on its subject and, in addition, a record of war-time achievement of which the various authors have reason to be proud. The diagrams and pictures are clearly and well produced; but an index would have increased the reader's pleasure and the utility of the production.

W. M. HAMPTON

* Searchlights. A series of five papers, with the discussion on those papers and a further written contribution. Pp. 164. (London Illuminating Engineering Society, 1948.) 17*s*. 6*d*. net.

AFFORESTATION FOR BENGAL

ANYONE who has travelled by railway throughout India must have noticed the disparity reigning in the distribution of the forests in that country. In some parts the railways pass through great and apparently interminable tracts of forest and jungle. In others, of which Bengal forms one of the best of examples, the converse is the case. Between Calcutta and the foot of the Darjeeling Hills the traveller by railway passes over a great plain devoted mainly to the production of rice, the villages mostly in groves of palm trees, but a total absence of forest. The forest part in Bengal represents only 0·07 acre per head of population. Bengal has only 9 per cent of its surface under forest, and a considerable part of the latter is in the Darjeeling Hills and the Sundarbans south of Calcutta.

Modern conditions and demands resulting from the Second World War, to some extent, and the great necessity to improve the agricultural soils of the Province, have at length roused the authorities. These soils are not manured. The large quantities of cow dung obtained from the great herds of cattle kept by the villagers are at present, and have been for many centuries past, utilized as fuel for heating