There is, therefore, more than ever a widespread interest in thermal power stations, of which the turbines and generators at least are likely to be the instruments of power conversion from nuclear reactors. With the decrease in availability of coals, it is becoming essential that power stations shall generate at the maximum efficiency and thus steam-plant design is becoming more complicated. Multiple reheat and bleed-steam preheating systems using up to nine stages are being applied, more perhaps in the United States than in Europe, to approach more closely the Carnot cycle.

A whole section was devoted to the construction and operation of steam boilers. In the search for higher efficiencies, steam generating temperatures have risen by 18° F. per annum, the maximum value now being about 1,200° F., a temperature at which austenitic steels must be used. Below this a gap in the range exists, the maximum temperature feasible for ferritic steels being about 1,000° F. Operational pressures have risen to very high figures, especially when reheat is introduced; two commercial examples are 1,150 and 2,850 lb. per sq. in., while experimental plant uses up to 5,000 lb. per sq. in. Average boiler capacities have risen to between 450,000 and 900,000 lb. per hr., with some boilers generating 2,400,000 lb. per hr. Boiler efficiencies of 90 per cent are reported and availability is nearly 100 per cent. Boiler systems are largely orthodox, of the natural circulation drum type, but forced circulation monotube boilers are used to an increasing extent, particularly on the Continent of Europe. Design of boilers is also being influenced by the necessity for burning inferior coals with their more acute flue cleaning and ash disposal problems. One new method of cleaning the convection heating surfaces on load is to pour small steel balls over the tubes, and collect them in the ash hopper, where they are removed from the ash and cleaned.

Steam boilers appear to be in their heyday, possibly at about the stage of development of the reciprocating engine in the year 1900. No doubt bigger and better boilers are yet to come; but, to quote the general report, "it seems that developments in the field of atomic energy will outdate endeavours towards a further improvement in existing methods of power generation". Steam generation by nuclear reactor heat is the problem of the immediate future. The temperatures available are unfortunately low, 500° F. with water-cooled, possibly 750° F. with sodium-cooled fast breeder reactors. It is suggested that compound plants where superheating is accomplished by oil firing may be evolved.

Many other aspects of power generation are treated by one or more papers. Developments in the use of solar energy—never of great concern in the temperate zone—have progressed to some extent; but direct use of the sun's heat is still inconvenient and usually uneconomic. Even in India the preference of an oriental population for preparing their meals in the evening has reduced the sale of solar cookers. Heat pumps and fuel cells, the latter of great academic interest, are discussed in British papers, while complete sections are devoted to statistical compilation of data, purification of industrial effluents, and the technical and economic aspects of international co-operation.

The tremendous field covered at the Conference must be apparent from the number of papers presented by thirty-five countries. It is inevitable that somewhere the field must be bounded and that all the field may not be covered in the detail some would wish. For example, the application of power to transport, the developments of gas turbines and diesel and free-piston engines are only briefly considered. It is also disappointing that more attention was not given to the reminder of the president, Sir Harold Hartley, who said in his address: "Food is the most urgent need of the world to-day and I would ask you if we are devoting enough thought to the place of power in agriculture as compared with the emphasis we place on industry. . . .".

Generally, the tone of the Conference was optimistic, in spite of the shadow cast by falling fuel resources: the tone seems to be one of certainty that more and more power will be needed, combined with an equal certainty that a wider search for power reserves, coupled with a more effective use of known resources, and development of nuclear reactors, will provide that power. Finally, a word in praise must be said for the general reports summing up the proceedings of each section. These are admirably translated into French, German and English, and are remarkable for their concise and balanced interpretation of the mass of technical data presented. They are worthy of an international conference, which presents a remarkably clear picture of present-day practice and of the directions in which scientific research in power production is leading.

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ANIMAL REPRODUCTION

THIRD INTERNATIONAL CONGRESS IN CAMBRIDGE

THE Third International Congress on Animal Reproduction, attended by more than five hundred representatives of no fewer than fifty different countries, was held in Cambridge during June 25–30. The proceedings were conducted in three sections, devoted to physiology, pathology and artificial insemination, respectively. About one hundred and fifty papers were presented, many of which were concerned with the practical aspects of animal breeding, clinical problems, and technical advances in the methods of semen storage and artificial insemination. A noteworthy feature of the Congress, however, was the relatively high proportion of papers of more general scientific interest, dealing with the physiology of mammalian gametes and the early stages of embryonic development. The growing impact of two fundamental sciences in particular, namely, biophysics and biochemistry, on research in the field of animal reproduction, was specially evident from the nature of the Congress exhibits and

demonstrations, many of which were provided by the scientific staffs of the Agricultural Research Council Unit of Reproductive Physiology and Biochemistry and other departments in the University of Cambridge.

A large number of original contributions dealt with semen physiology, bearing witness to the impressive advances in this field, which continues to expand in several directions. One of these concerns sperm morphology and motility; here the advent and perfection of powerful aids to research, such as electron and phase-contrast microscopy, photography in ultra-violet light, the application of fluorescent dyes, and a steady improvement in staining methods which permit the differentiation between live and dead spermatozoa have all helped to open up new possibilities towards the elucidation of the finer structure of spermatozoa. As a result of these studies, much has been learned in recent years about the fibrillar structure of the sperm-tail in relation to sperm motility, and the properties of the acrosome in relation to the 'cold shock' and other phenomena associated with senescence changes in spermatozoa. A second line along which research on spermatozoa has been rapidly developing relates to the survival of sperm cells at very low temperatures. Much of this research was inspired by the observation, made a few years ago, that better sperm survival can be achieved when semen is frozen in the presence of glycerol. The same approach has now been extended to the tissues of the gonads themselves. In addition to several communications on the practical application of glycerol in low-temperature storage of bull semen, two papers dealt with the broader physiological aspects of cellular damage resulting from freezing and with the principles underlying the ability of gametes and grafted gonadal tissues to survive in the frozen state. Yet another line along which progress in sperm physiology is being vigorously pursued is the biochemistry of semen. This was quite obvious from the large number of contributions on such problems as the incorporation of radioactive elements into the male gamete, the relation of respiration and fructolysis to sperm motility, the function of seminal hyaluronidase, and the role of mineral constituents in semen, particularly that of potassium ions which, judging from no less than three independent studies, play an important, hitherto largely disregarded, function in eliciting sperm movements.

One of the outstanding problems in reproductive physiology concerns the mechanism which enables the spermatozoa to traverse the female reproductive tract before reaching the site of fertilization, and in this connexion much work has been carried out in recent years on the metabolic processes associated with sperm movements. An important aspect of that research is the elaboration of methods for measuring sperm motility. Several valuable methods have been evolved in recent years; but there is still room for new objective and quantitative procedures. At least one more such technique was reported upon at the Congress, involving the use of a photo-electric cell for registering the movements of single spermatozoa. Strong evidence, however, is steadily accumulating which indicates that apart from motility inherent in the sperm cells, there are other factors which facilitate sperm transport in the female reproductive tract. There is much to show that spermatozoa do not depend entirely upon their own motility but are, in addition, propelled, as it were, by the concomitant contractions of the uterus. These uterine movements, judging from papers presented at the Congress, are dependent on the co-ordinated action of the neuro-hypophysis and hypothalamus. Another phenomenon frequently discussed during the Congress was the so-called sperm-capacitation, which appears to depend on certain peculiar, but as yet poorly understood, changes taking place in spermatozoa before they reach the site of fertilization, and enhancing the fertilizing capacity of the sperm cells.

Whereas the advanced stages of gestation have long been the target of choice for physiological research, data on the mammalian egg and the pre-implantation or near-implantation phases of mammalian pregnancy continued to be rather scarce until recently. However, now that methods for the transfer of mammalian eggs from a donor to a recipient have been greatly improved upon, it is possible to apply these techniques to the study of fertility and the development of normal and abnormal ova in the female reproductive tract. Several speakers dealt at some length with the manifold aspects of the technique of egg transplantation, chiefly in the sheep and the rabbit. Research in this field seems to concentrate largely on perfecting the existing means for preservation of mammalian eggs *in vitro*, and the elaboration of new techniques which would dispense with the need for laparotomy during the transfer of eggs. Results of fruitful research on the physiology of the mammalian egg were presented to the Congress in several communications, some of which dealt with the biochemical relationship between the early embryo and the uterine environment, whereas others described measurements of oxygen uptake by rabbit ova at different stages of development. Varied aspects of reproductive physiology covered by speakers included also attempts at determining the content of oxygen in the Fallopian tubes of the rabbit, and new findings on certain rheological and spectrophotometric properties of secretions collected from the female reproductive tract.

A large group of papers presented at the Congress dealt with the nutritional and hormonal aspects of animal reproduction. Several authors pointed out that the two principal functions of the male and female gonad, namely, the gametogenic and endocrine activity, are by no means equally sensitive to a given nutritional deficiency, and that in many instances, particularly where certain vitamins, proteins and minerals are concerned, the hormonal function of the gonads is affected earlier than gametogenesis. Much useful information on the role of nutrition and hormones in reproduction has been forthcoming from studies of monozygous twins. Two new chemical methods of tackling the problem of malnutrition in reproduction were communicated: one based on the analysis of semen collected from twin bulls, for the assessment of nutritional factors which control the secretory activity of male accessory organs; the other involving the analysis of the mineral content of hair samples taken from the poll region of cattle to serve as an indicator test for an early diagnosis of certain mineral deficiencies.

Among clinical problems fully discussed at the Congress, two received particular attention, judging from numerous communications, namely, the deleterious effect of certain infections (brucellosis, *Vibrio foetus*, *Trichomonas foetus*) on animal reproduction, and the occurrence of genital malformations as a cause of infertility.

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