NATIONAL RESEARCH COUNCIL OF CANADA

SCIENTIFIC research in Canada during the past three years has been directed almost wholly to the solution of new and urgent problems arising out of the War. The National Research Council is serving as a central co-ordinating body directing research within its own laboratories and in the universities and industry. The Council has been appointed the official research station of the Navy, Army and Air Force in Canada.

For the Navy

Scientific problems arising in connexion with the work of the Navy are studied jointly by officers from Naval Headquarters and civilian personnel on the Council's staff. The National Research Council maintains civilian scientific groups at several points on both the Atlantic and Pacific coasts who work in the closest co-operation with the Naval stations. A group is also located in Ottawa and contact is maintained with similar research stations in the United States and Great Britain.

Many of the problems presented relate to the supply of materials and the preparation of specifications. Highly technical problems have arisen from anti-submarine warfare and minesweeping operations. Several sections of the Division of Physics and Electrical Engineering are concerned almost exclusively with research and development programmes for the Royal Canadian Navy. In the Electrical Engineering Section a shock and vibration machine based on standard British Admiralty design has been installed. The specifications for building the machine were modified to permit the use of Canadian materials. This machine is used for testing resistance to shock of various electrical equipment, such as switches, rheostats, junction boxes, lighting fixtures used by Navy and merchant ships. From the results obtained specifications for all electrical equipment for the purposes enumerated are being developed as required. Problems investigated in the electrical engineering section have included studies of gear for magnetic minesweeping. A rocking machine to stimulate the rolling of a boat has been constructed, and tests of various instruments have been made on this unit.

In the Division of Chemistry many problems of interest to the Navy have been investigated. Work on paints, rubber, low-alloy high-strength steels and aluminium alloys, and sea-water resistance of various coatings and inhibition of corrosion of various metals by chemicals may be mentioned. In the Division of Mechanical Engineering, likewise, the several laboratories are engaged on numerous problems for the Navy, notably in matters relating to engines and their lubrication, the design and test of boats of various types.

For the Army

For the Army and also for the other Services all kinds of supplies have had to be tested to determine whether they are acceptable according to required military standards. Apparatus has been developed and constructed for work in ballistics on an increasing scale. Measuring equipment for ammunition proof and gun proof has been developed and is in continuous service at proving grounds. Problems on the direction of gun-fire have been attacked with success. Numerous tests have also been made on the armouring properties of various materials and work is in progress on the improvement of anti-aircraft projectiles.

An important war service was rendered in 1939 by promoting the development in Canada of optical glass manufacture for the production of precise optical parts for military equipment. The project is now being carried forward in production by a Government-owned company. Equipment was installed and a staff assembled in the National Research Laboratories for the inspection of gauges used in the production of guns, shells, fuses, bombs and other mechanical items which are now being made in mass production.

Another important activity of the Army which is built on science is chemical warfare. From a small co-operative effort between the National Research Council and the Army, this activity has developed rapidly and is now a highly co-ordinated project operating as a directorate of the Department of National Defence, but under a director-general who is a civilian scientific worker on the staff of the National Research Council. Of the active personnel about one half are civilian men of science and the rest are Service men.

Indicators for war gases and chemicals for other war services have been synthesized and studied. The rubber laboratory has investigated, for production purposes or improvements, products used by almost every branch of the Armed Forces, including surgeons' gloves, ground sheets, gas-mask components, artillery and tank parts, crash and steel helmets. In addition, the laboratory has made numerous acceptance tests on contract deliveries. Recently much attention has been given to rubber conservation problems and to the study of synthetic rubber processes. Commercial production of fuse-powder charcoal was carried on until recently by the National Research Council; manufacturing has now been turned over to a commercial concern. Research on the fundamental problems involved in the operation is being continued by the Council.

Activities in the textile laboratory have been largely in connexion with acceptance test work and specifications. Special problems included an investigation of methods to reduce weathering of canvas duck, a study of thermal transmission of blankets, colour analyses of certain types of textile products and work on respirator pads. Materials tested included felt, silk gauze, silk thread, braid, vulcanized cloth, box cloth and various types of uniform materials. A large amount of work is being carried out on the development of suitable types of anti-gas impermeable-type fabrics and on the maintenance of suitable standards of quality in material of the type which is being manufactured in Canada. Other studies include work on the water-proofing, mildew-proofing and flame-proofing of cotton textiles.

Inspections have been made and advice given as to the suitability of a variety of leathers for different military purposes. Examination has been made of numerous dressings and waterproofing compounds for leathers. Tensile-strength tests on leathers, and wear-resistance tests, chiefly on composition-sole materials, were carried out for the Department of National Defence. Used militia boots were examined for the cause of cracking in the vamps. Research on the deterioration of shoe uppers has been continued.

Component parts of certain anti-aircraft protection devices were constructed. Transparent sheet resins for military purposes have been tested against specifications; vulcanized fibre identification disks and other objects have been examined, and general consideration has been given to the substitution of plastics for metals in a number of articles and parts related to war materials.

Preservative coatings for use on military vehicles and other equipment for war purposes have been developed. A surprising variety of finishes is required in this field and many of the materials are comparatively new to Canadian industry. The laboratories have co-operated with Government authorities and manufacturers to facilitate the supply of these highly specialized coatings. Gas-detector paints, luminous paints, finishes for rifle barrels, camouflage paints and other special paints have been developed.

Mention should be made of the establishment of an explosives laboratory to carry out testing required under the Explosives Act and to conduct research on explosives and related compounds. This laboratory is under the joint administration of the National Research Council and the Department of Mines and Resources. An Associate Committee on Explosives has been established to co-ordinate and direct all work in this field.

For the Air Force

Establishment of the new aeronautical laboratories just outside Ottawa has provided improved facilities for research on the multitude of problems arising from modern trends in aviation. Closest co-operation is maintained between the Royal Canadian Air Force and the Council's laboratories through the Associate Committee on Aeronautical Research, the chairman of which is the Air Member for Aeronautical Engineering, R.C.A.F. Much of the work in progress relates to problems that have been suggested by Air Force authorities in Canada, the United Kingdom or the United States.

Horizontal and vertical wind tunnels are in use. In the engine laboratory dynamometer rooms are provided for the testing of aircraft engines, while in the gasoline and oil laboratory complete equipment is provided for physical and chemical testing of aviation fuels and lubricants. A structures laboratory provides for the fabrication of prototypes of aircraft and for the test of component parts.

Experimental work required in connexion with scientific problems under investigation in the National Research Laboratories is often carried out co-operatively with the Royal Canadian Air Force Test and Development Establishment, which is really a full-scale experimental flying station.

During the year the Radio Section continued to work on the development of secret radio locator equipment with considerable success. There are already in the hands of the Services numerous different equipments which have been developed in the National Research Laboratories. Some of these have already been used successfully against the enemy.

Medical Research

In the field of medical research an active committee of the Council has made great progress. The original purpose of this committee was to co-ordinate medical research in Canadian institutions and to assist in its development. The activities of this committee are now wholly directed to war problems. The work has grown to such an extent that several new sub-committees have had to be established to deal with questions of shock and blood substitutes, wound infection and surgical problems. Regional committees have been appointed to facilitate the work. Liaison with Great Britain and the United States has enabled Canada to co-operate effectively with them in the promotion of medical investigations arising from war problems. More recently, Australia and New Zealand have been included in the interchange of reports.

In the field of medical research as applied specifically to the Services, three associate committees are in operation dealing respectively with aviation, naval and army medical research problems.

The first of these associate committees, on aviation medical research, was formed early in 1940 and has carried out a most impressive programme of work, especially in the fields of high-altitude flying and protective clothing. The work of the Naval Committee has been directed to the improvement of innumerable factors effecting the efficiency of personnel on boats, and the Army deals with similar problems of Service men who have to operate in tanks and work under the innumerable special Service conditions attendant on modern warfare.

Research activities under these committees have been carried on at most of the universities of Canada and at the National Research Council, the Ontario Research Foundation and the clinical investigation units and other establishments of the Services. The close collaboration existing between the civilian and Service groups of workers and the help and advice so freely offered by industrial concerns have greatly accelerated the solution of a number of important problems.

For War Industries

The Division of Applied Biology has rendered valuable assistance in the fitting of temporary refrigerators on merchant vessels. The successful transport of perishable foodstuffs demands refrigerated shipping space or the conversion of the material to a less perishable form that can be carried in ordinary stowage. This problem is most acute for bacon, which goes forward in large volume. The shortage of refrigerated space has also affected other perishable commodities. Considerable work has been done on the treatment of shell eggs to avoid deterioration during shipment at ordinary temperatures. All export eggs, however, are now shipped in powder form, and the work of this group of investigators is therefore directed towards the development of methods for assessing quality and developing drying processes capable of producing a dried egg material of high quality.

Dehydration of meat, chiefly pork and cured ham, has been studied, and an acceptable quality of product has been obtained. Closely related to food studies on products for shipments overseas is the development of containers in which a substitute for tin plate has been used. Packages based primarily on fibre and wax combinations have been found useful. Dehydrated products require packaging in waterproof materials.

The need for magnesium led to intensive research and resulted in the development of a process well suited to Canadian conditions of production. A plant of ten tons capacity per day, built by the Department of Munitions and Supply to use this process, is in operation, while plants totalling about a hundred tons per day capacity are being built in several centres in the United States.

The shortage of natural rubber, which is so important for military purposes in this age of mechanization, has stimulated research on the possibility of producing rubber from plants that can be grown on the American continent. Synthetic rubbers of various types are being developed and tested, and plants are being established for the production of the more useful types.

SCIENTIFIC PROGRESS SINCE 1840

IN a lecture, "A Century of Progress : Men, Manners, Inventions", given before the Lancastrian Frankland Society on January 15, Dr. E. F. Armstrong drew a stimulating comparison between the conditions of Edward Frankland's early years in Lancaster and to-day. Referring to the encouragement which Frankland received from the Johnsons in Lancaster, who sent him to Playfair in 1845, Dr. Armstrong remarked that the energy to get on in spite of the most adverse and discouraging circumstances was characteristic of the 1840's. A deep interest in Nature and in intellectual matters was also widespread in the north of England during the Victorian period and led to the formation of many local societies, ranging from the mutual improvement societies of the chapels to the mechanics institutes and literary and scientific societies of the small towns and the philosophical societies of the large cities. These societies, which besides spreading knowledge gave inspiration to the younger members, persisted until improved communications, a multitude of technical journals and the spread of technical colleges drove most of them out of existence, although even now technical societies with local sections have a most important function.

Frankland apparently took up science as a career through his parents instilling a spirit of inquiry and the desire to find out things for oneself. Commenting on the fact that the period 1840–70 saw the birth and entry into the sciences of a great many men from very diverse walks of life, whose achievements have laid the foundations on which we are building to-day, Dr. Armstrong directed attention to the early life of austerity and struggle which developed their powers. Among these were James Dewar, Horace and Adrian Brown, Charles Lapworth, Richard Threlfall, Alfred Yarrow, Bates of Amazon fame, C. F. Cross, James Alfred Ewing, and H. B. Baker.

The chief characteristics of the last hundred years, Dr. Armstrong suggested, are the inventions and discoveries which have so markedly affected the material progress of the world that they may well be regarded as the seven modern wonders of the world, superseding the seven architectural wonders of the past. The first of these is pure water supply, in the provision of which Frankland himself played a large part. As a scientific member of the Royal Commission appointed in 1867, he found that the oxidation and destruction of the organic matters present in town drainage took place with extreme slowness, contrary to the previous belief. He found, on the other hand, that slow percolation through porous soil effected this oxidation and destruction with great rapidity. Frankland also improved the old and devised new methods of water analysis, and throughout his life took special interest in the water supply of London, while his son, Percy Frankland, took up the study of the biological aspects of the problem. Continuing this work, Sir A. C. Houston, the pioneer of systematic chlorination treatment on a large scale, was also responsible for the scientific application of bacteriology for improving and safeguarding the purity of water. Dr. Armstrong referred here to his previous suggestion that a tablet commemorating these achievements of Frankland should be placed on the great new dam across Hawes-water.

Second of the modern seven wonders, both in point of time and importance to pure water, must be ranked electricity, which from its gradual development, starting with its use in signalling by Cook and Wheatstone, with no encouragement by the State, has now become a major industry touching almost every home. The third wonder was the spinning of viscose or Rayon from wood, with the consequent revolution in women's dress. Even now we are only at the beginning, the newest of all these fibres being Nylon, a wholly synthetic fibre, built up as it were from carbon, water and air, with properties as good or better than those of silk spun by the silkworm.

The fourth and fifth wonders, the internal combustion engine and hydrocarbon oil, are so interdependent that they may well be considered together. Giving us speedy transport on land, on sea and in the air, they have made the world one community. Speedy travel has had great political repercussions; and no individual, community or nation can withdraw at will to a quiet corner to follow its own inclinations. The development of the internal combustion engine was based on progress in design correlated with progress in metallurgy, while the oil industry was providing raw materials for many diverse chemical operations and was destined to displace coal tar and coal as the world's most important basic raw material for chemical synthesis —probably with further effects on our own post-war economy following on those already involved in the displacement or disappearance of cheap coal.

Next among modern wonders came the radio, which is enabling all to lead a fuller and broader life. Its cultural and scientific significance is not yet fully appreciated, and despite its importance in war the future applications may be astounding. The last wonder, Dr. Armstrong said, was the plastics, of which the man in the street is as yet only dimly conscious, although they are destined to make life easier for us all, to provide objects of utility, and should also make artistic design and beauty available at prices diminishing rather than increasing. Finally, Dr. Armstrong pointed out that the satisfactory solution of the problems of society into which science enters will be based on moral influence, and our effectiveness will depend on the devotion, wisdom and goodwill which we bring to our task.

A SPREAD-SCALE RECORDER

IN an article with this title (*Bell. Lab. Rec.*, **21**, No. 3; November 1942) O. D. Engstrom points out that the transmission tolerances of telephone circuits have become more severe, requiring a corresponding improvement in measuring technique and equipment. When a telephone circuit had only a few amplifiers or other circuit units, each could be permitted a larger share of the total permissible distortion, and errors in measurement of 0·25 db. meant very little. With the present transmission systems requiring many more circuit units than the earlier systems, this situation has changed. More accurate and faster operating testing equipment has been required, and