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LABORATORY WORK, NATIONAL RESEARCH COUNCIL

The National Research Council Laboratories (NRCL), which consists of ten laboratory divisions and the Space Research Facilities Branch, has a staff of over 2,000. The following excerpts from the report of the President for 1970-71 deal with some of the projects in which NRCL is currently engaged:

...The widespread use of snowmobiles as utilitarian and recreational vehicles has resulted in a new and significant noise problem. In an effort to determine the extent of this problem, the Division of Physics made a detailed study of the noise produced by 50 different snowmobiles.

The study showed that an average machine, when cruising, is as noisy as a dump-truck travelling at highway speeds. Many machines are as noisy as tractor-trailers or motor-cycles, yet few are as quiet as passenger-cars.

Experiments showed that a small reduction in noise occurred when the muffler supplied by the manufacturer was replaced by an efficient car-muffler. This test also showed that there are other sources of noise that become important once the

exhaust has been adequately muffled. These are the carburetor air-intake and the surface of the engine.

By attaching a car-muffler to the exhaust and an air-intake silencer to the carburetor and by extending the cowl to completely enclose the engine so as to contain the machinery noise, the loudness of the test vehicle was halved without significantly altering its mechanical performance. The noise produced at full throttle, when measured at a distance of 15 feet from the machine, was then 85dBA, which is the level recommended by NRC for legislation aimed at controlling the annoyance caused by snowmobiles in urban areas.

The study also showed that, for the average machine, the noise-level in the vicinity of the operator's ear is so high that the ability of the driver to hear warning signals such as a car horn is seriously impaired. More important, the operator of a snowmobile is exposed to noise of greater intensity than that, for example, experienced by weavers in a mill, who are known in time to develop an appreciable hearing loss.

The study recommends that regular users of snowmobiles wear ear-plugs to eliminate the risk of hearing damage, except when the machine is operated for less than ten minutes daily. For infrequent or recreational use, it is possible that substantially longer exposures to snowmobile noise could be tolerated. But, unfortunately, there can be no guarantees against noise-induced hearing loss until there is a reliable method of identifying in advance those individuals who are highly susceptible to this damage.

STUDY OF LUNAR MATERIAL

A new technique has been developed at the Atlantic Regional Laboratory in Halifax, Nova Scotia, for the study of glasses and metallurgical slags. The discovery of glass in the lunar material returned to earth by the *Apollo 11* astronauts in July 1969 opened a new field of study and, in September 1969, a formal

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proposal was submitted to the United States National Aeronautics and Space Administration for the examination of lunar glass by this technique.

The nature of this work and its scientific aims are described in a contract between NASA and NRC, in which the responsibilities of both parties are outlined. The provisions, which are common to all lunar-sample investigations, cover such aspects as the availability and release of the lunar material, its receipt, safeguard and return to NASA, and the reporting of analytical results.

Two samples of dust from *Apollo 12* and a fragment of glass from *Apollo 11* have been examined and the laboratory will receive further samples during the ensuing year. Mineralogical studies also are being performed, in collaboration with the Geology Department of Dalhousie University.

THRUST-MEASURING SYSTEM

The Division of Mechanical Engineering and Computing Devices of Canada Limited are co-operating in a research project on the design and development of an "in-flight" thrust-measuring system for jet engines.

The system, to be flight-tested in the near future, will consist of gasflow sensors mounted on the aircraft engine and an airborne special-purpose computer for calculating actual thrust of an engine. The calculation will appear on a cockpit indicator in front of the pilot. The computer also will calculate the thrust the engine should be capable of developing if properly operating.

Under normal operating conditions, pilots of jet aircraft have no problem in assuring that their engines will deliver sufficient thrust. However, this is not the case when jet aircraft are taking off on hot days from marginal runways or runways at high elevations. Under such critical conditions, there is no direct way for a pilot to know the real thrust developed by his engines. There also is no way for a pilot to be made aware of degradation of thrust as a result of in-flight damage to an engine.

The capacity of the thrust-computer to make this assessment, regardless of the flight mode or ambient conditions, would constitute a major improvement over any existing engine-performance equipment.

WASTE DISPOSAL

A research project has been undertaken by the Division of Biology in an effort to assist food-processing plants, particularly those in rural areas or small centres, which are having difficulty in disposing of waste.

Waste from such plants is, in many cases, highly concentrated, nutritionally unbalanced and variable in nature or is produced intermittently. The treatment-method chosen for the study is anaerobic digestion-decomposition in the absence of free oxygen.

This method shows promise of being economical and able to handle high-strength wastes. Pear-waste was selected as the medium for initial work at the

suggestion of a major canning company that felt it was one of the more troublesome wastes. Four 30-litre continuous fermenters have been designed, built and put into operation.

IMMUNOCHEMISTRY

Natural immunity occurs when an animal produces antibodies (serum globular proteins) in response to foreign material introduced into the body by infection or injection. A prime characteristic of this immune response is its high order of specificity, e.g. immunity to pneumonia does not protect against tuberculosis. The specificity is due to the matching-up of determinant groups or active sites on antibodies and antigens (substances that stimulate the production of antibodies) and variations are caused by subtle differences in chemical geometry.

Work in NRC's Biochemistry Laboratory has been aimed at the isolation of specific antigens from disease-causing fungi, yeasts, and bacteria and the characterization of their determinant groups. Polysaccharides (complex carbohydrates) in the cell walls of a series of dermatophytic (skin-attacking) fungi have been shown to be group antigens. A higher order of specificity was found in peptidoglycan antigens isolated from the same organisms and the peptide part of the molecules were established as the determinant groups. Through collaboration with the Skin and Cancer Hospital of Philadelphia these peptidoglycans are being developed as diagnostic agents.

A most significant advance during the past year has been the development of new chemical methods for preparing synthetic antigens. By this means, a compound that is not by itself antigenic can be joined to an antigenic carrier molecule. Subsequent injection of the conjugate into an animal induces the formation of antibodies specific for both parts of the conjugate. It is therefore possible to make synthetic antigens using only a specific determinant group and an antigenic carrier. Practical exploitation of this development requires the isolation of the specific antigens from disease-causing micro-organisms and characterization of their determinant groups. At present such efforts are being concentrated on meningitis and gonorrhoea in collaboration with the Communicable Disease Centre.

This work has required the close collaboration of bacteriologists with facilities to grow highly dangerous micro-organisms, chemists and biochemists with experience and interest in immunology, and access to animal facilities. It represents the interdisciplinary approach to research that is essential for major advances in the life sciences.

MICROWAVE HEATING

Further progress has been made by the Radio and Electrical Engineering Division on industrial applications of microwaves, with emphasis on moisture sensing and drying.

RESTORATION OF QUEBEC'S HISTORIC SITES

As the point of departure for exploration of the North American interior and later as commercial nucleus of the colony, Quebec, at first, lay at the centre of much of Canada's early history. During the coming year, some 15 historic places in the Province of Quebec closely connected with events that shaped Canada's history are to receive special attention. Over \$5 million has been earmarked for their development and maintenance by the National and Historic Parks Branch of the Department of Indian Affairs and Northern Development.

CARTIER-BRÉBEUF PARK

One major undertaking is the new Cartier-Brébeuf National Historic Park. The 16-acre park, located outside Quebec City, where the St. Charles and L'Ange Rivers meet, commemorates the place where Jacques Cartier and his crew spent the devastating winter of 1535-36. Cartier's discovery of the St. Lawrence River opened the way for French settlement and exploration of three-quarters of the continent. Ninety years later, the Jesuit missionary Jean de Brébeuf, together with Fathers Charles Lalemant and Enemond Masse, landed at the same site where Cartier had wintered.

The focal point of the park will be *La Grande Hermine*, a full-size copy of Cartier's flagship, largest of the three ships used on his expedition. (Completed in 1966. *La Grande Hermine* was on display at Expo 67). Nearly \$500,000 will be spent to refurbish the vessel and move it to its final destination, create an artificial basin in which to moor it, and build an interpretation and visitors' reception centre for the park.

FORT LÉVIS

Another major project will be restoration of Fort Lévis 1 on the Lauzon Heights opposite Quebec City. The fort is the single survivor of three built in the 1860s to protect Quebec against invasion from the south. The sole remaining example of an important stage in Canadian military architecture, Fort Lévis was constructed to accommodate the advent of ordinance rifling.

In Montreal, the two-storey stone house once inhabited by Sir Georges-Etienne Cartier, one of the leading Fathers of Confederation, will receive special attention. After negotiations for its acquisition have been completed, "as-found" drawings recording the building's condition will be made, and restoration work on the 130-year-old house on Montreal's historic Notre Dame Street will begin. National Historic Sites Service curators are gathering suitable period fur-



La Grande Hermine, the 160-ton 78-foot copy of Jacques Cartier's flagship, is destined for permanent berth in Quebec City's Cartier-Brébeuf National Historic Park.

nishings to reflect the character of the nineteenth-century statesman's home.

RESTIGOUCHE DEEP-WATER PROJECT

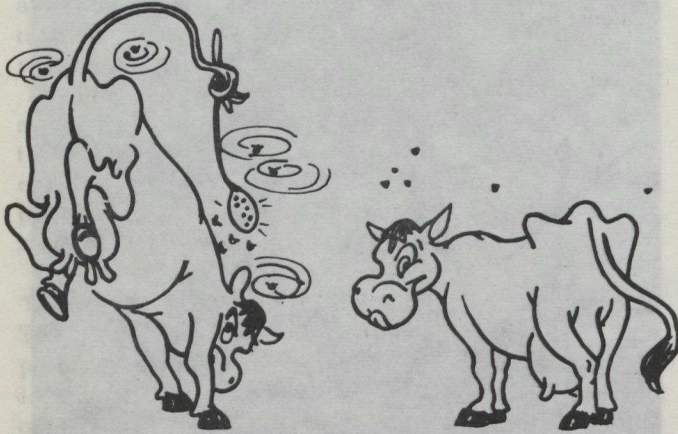
In the Baie des Chaleurs at Restigouche, Quebec, an underwater archaeological project has already been under way for two years. It is the site of the 17-day Battle of the Restigouche, the last North American naval encounter between British and French for possession of colonial Canada. In 1760, three French frigates were sunk as a result of that engagement, and archaeologists are bringing to light a considerable quantity of artifacts in unexpectedly good condition. Present plans call for erection of an interpretation centre at Restigouche to tell the story of the ill-fated frigates *Bienfaisant*, *Machault* and *Marquis de Malauze*, and the men and goods they carried to the New World over 200 years ago.

Other sites on which additional work will begin are Fort Chambly, Fort Lennox, Coteau-du-Lac, Laurier House, Carillon Barracks, and Fort Chateaugay — all within less than 30 miles of Montreal; Quebec City walls, gates and Artillery Park — each a part of the old city's historic fortifications; Fort Témiscamingue in western Quebec; and the commemorative Jacques Cartier cross at Gaspé.

CATTLE PARASITES STUDIED

Studies are under way at the Canada Agriculture Research Station at Lethbridge, Alberta, to devise methods of making cattle more tolerant of parasites.

Parasites, such as horn flies, often bother cattle enough to reduce weight gains and profit margins significantly.



Cattle-fly fight.

Dr. W.O. Haufe, a parasitologist at the Research Station, says that Lethbridge experiments have shown that tolerance for the horn fly does develop in cattle, and that infestations of the pest may not hurt beef production under some environmental conditions. He says that this tolerance to parasites may develop rapidly under some types of farm management.

"We are taking a much closer look at this area," says Dr. Haufe, "hoping that we will come up with a more complete understanding of parasite tolerance in livestock."

The results of this research could very well be the development of new management techniques that would enable beef-producers to reduce substantially the amount and frequency of chemical treatments required for profitable beef production.

GERMAN SAVANTS VISIT CANADA

A group from Germany that included scientists and engineers from government, industry and universities visited Canada from August 30 to September 8. They discussed possibilities for Canadian-German collaboration in four areas — oceanography, data-processing, environmental research and polar research — with their Canadian counterparts.

This was the first of a series of visits to Canada by such groups from Germany for the purpose of exploring a number of areas of mutual interest ranging over the entire field of science and technology. It took place within the framework of the recent agreement between the Governments of Canada and the Federal Republic of Germany on scientific and technical co-operation, signed by Mr. Jean-Luc Pepin,

Minister of Industry, Trade and Commerce, at Bonn on April 16.

During the past two years, Canada has also sent missions to the Soviet Union and Belgium and has signed agreements for collaboration in the field of science and technology with those countries.

GOLD RUSH ROAD EXTENDED

Mr. Jean Chrétien, Minister of Indian Affairs and Northern Development, and Mr. Arthur Laing, Minister of Public Works, announced recently that a contract for over \$420,000 had been awarded to a firm in Whitehorse for the completion of the Yukon section of the road from Carcross to Skagway (Alaska).

This highway runs southeast from Carcross along the shore of Tagish Lake and southwest along the western shore of Windy Arm to the British Columbia and Yukon border — a distance of 15 miles.

When the remaining sections are complete, the road will run south from the B.C.-Yukon border for 18 miles, touching the western shore of Tutshi Lake, turn east for ten miles and then south to Skagway along the Skagway River — a total distance of 59 miles.

From Carcross the existing road runs to the northeast for 35 miles to meet the Alaska Highway.

The completed route will be the first road link between the historic cities of Whitehorse and Skagway, traversing regions that became famous during the Klondike Gold Rush of 1898. It will provide access by car to some of the most scenic areas in Canada's Northwest.

Skagway, a deep-water, ice-free port, is serviced at present only by the White Pass and Yukon Railroad, constructed during 1898-1900 to handle the needs of the Gold Rush. It links Skagway with Carcross and Whitehorse in the Yukon.

NEW INTELSAT AGREEMENTS

The Secretary of State for External Affairs, Mr. Mitchell Sharp, and the Minister of Communications, Mr. Robert Stanbury, recently announced that Canada had signed new agreements regarding the International Telecommunications Satellite Organization (INTELSAT). The Deputy Minister of Communications, Mr. Allan E. Gotlieb, signed the intergovernmental agreement in Washington defining the permanent new structure of INTELSAT and laying down the basic principles by which countries wishing to be associated with the establishment and development of a world-wide commercial telecommunications satellite system are to abide. The operating agreement was signed by Mr. Jean-Claude Delorme, President and General Manager of the Canadian Overseas Telecommunications Corporation; under its terms, the operating companies designated for the purpose by their respective governments undertake to share in

the financing, management and use of the INTELSAT system.

These two new agreements replace the interim arrangements arrived at in 1964 by the Organization's ten founding members, of which Canada was one. The present membership is 79, 40 of them receiving telephone, telex, data-transmission and, occasionally, television service from INTELSAT satellites in synchronous orbit over the Atlantic, Pacific and Indian Oceans. Fifty-four countries are expected to be using the system by the end of 1972, and 62 by the end of 1973. Under the new arrangements, the American Comsat Corporation will continue to be responsible for the technical aspects of management over an interim period of six years, after which an international manager will assume this function.

The Canadian Overseas Telecommunications Corporation has been using the Atlantic Ocean segment of the INTELSAT system since October 1966. Through its two earth stations at Mill Village, Nova Scotia, the Corporation has established links with 19 countries in that part of the world. Facilities now being built at Cowichan Lake, British Columbia, will become operational in 1972, and will then provide direct links with countries on the Pacific "rim". The COTC is the fifth-largest user of the INTELSAT system.

FEWER PHOSPHATES IN DETERGENTS

Canadian manufacturers are complying with government regulations on phosphate-content in detergents, according to tests carried out by the federal Department of the Environment.

A chart issued recently by Minister of the Environment Jack Davis gives the before-and-after picture of Canadian detergents, dating from August last year, when government regulations went into effect.

The Phosphorus Concentration Control Regulations, which became law at that time, stated that a maximum of 20 percent phosphate-concentration could be carried in detergents on the Canadian market.

Phosphates have been shown to enrich water and contribute to massive growths of aquatic vegetation. Decay of this vegetation depletes the water of oxygen. This makes it uninhabitable for some fish, and unfit for recreation.

Before the regulation, phosphate-content in Canadian detergents ranged from 1 to 38 per cent. The latest tests show a 1-to-20 percent content in 70 brands, with three brands testing 21.0, 21.5, and 22.1 percent content of phosphates. Where the content is more than 20 per cent, additional samples are being analyzed to determine whether firms will be prosecuted for non-compliance.

Samples were also analyzed by x-ray diffraction to obtain information on substitutes for phosphorus and on other constituents used in laundry detergents.

Because some manufacturers use nitrilotriacetic

acid (NTA) as a substitute for phosphorus in laundry detergents, percentage content of this substance is also shown in the data collected.

Through this information and the identification of chemical additives scientists will be able to evaluate their potential effect on the environment. The tests were carried out in the Water Quality Division laboratories of the Inland Water Branch of the Department of the Environment.

Environment Minister Davis said that the present 20 percent maximum for phosphate in laundry detergents would be cut to 5 per cent by December 31, 1972.

AGRICULTURE AND THE ENVIRONMENT

Chemical fertilizers used by farmers do not contribute to pollution of lakes and streams says R.A. Milne, a soil scientist with the Canada Agriculture Research Station at Lethbridge, Alberta. But the results of studies carried out by Mr. Milne have isolated soil-erosion and liquid runoff from livestock feedlots as factors in the problem.

Chemical fertilizers have been accused of contributing to increased levels of nitrogen and phosphorus in waterways. These nutrients spur growth of aquatic plants, with the result that a lake or stream may eventually become choked with weeds. Mr. Milne, however, believes the charges to be unfounded. His findings followed studies of the movement of chemical plant nutrients in the soil and the extent to which nitrogen and phosphorus find their way to surface-water and to ground-water. "The results of the studies show that the movement of these nutrients has not contributed to pollution," he declares. "Any phosphorus that was not used by the plants was held firmly in the soil and the soluble nitrates were either taken up quickly by the plants or converted to other forms that do not cause pollution."

Effluent from feedlots has been considered a potential pollutant. But this isn't always the case. In the studies, the soil and ground-water under and near feedlots were found to have a high phosphorus and nitrogen content. But rarely did these nutrients spread in the ground for a distance of more than 400 feet. Mr. Milne attributes this to adsorption of the phosphorus by the soil and the transformation of nitrates into less soluble forms of nitrogen.

The danger from feedlots arises when liquids are allowed to run off into streams, temporarily raising their levels of nitrogen and phosphorus. To prevent this, the runoff should be diverted away from a stream and allowed to seep into the soil. In winter, a storage basin should be used to help the runoff until it can be disposed of when the ground thaws.

Manure from feedlots can be spread in fields for disposal without incurring a risk of pollution, Mr. Milne reports. In the studies, it was found that even in heavily-manured fields the accumulation of nutrients in the soil and ground-water was negligible.

FEDERAL EMPLOYMENT

The Federal Government had 378,986 employees on December 31, 1970, compared to 368,967 two years earlier. October-December payrolls increased to \$771.3 million from \$653.3 million in 1968. Employment in departments and departmental corporations increased to 243,006 from 230,154; payrolls rose to \$466.9 million from \$389.3 million. In all other corporations and agencies, employment decreased to 135,980 from 138,813, while payrolls increased to \$304.3 million from \$664.0 million.

LABORATORY WORK, NATIONAL RESEARCH COUNCIL

(Continued from P. 2)

Current developments in this area include a ridged-waveguide glueline dryer used in the manufacture of business forms, a multiple-ridged-waveguide for use in processing wieners and sausages, an instrument for monitoring content at the output of a continuous butter-making machine, a microwave dryer for 9.5-inch-wide photographic film, a "single-sided" moisture sensor for use on continuous web materials and a "single-sided" applicator for drying of such materials.

The Division's entire program in microwave heating is being conducted in close-co-operation with industry, through Canadian Patents and Development Limited, and shows considerable promise in many areas of industrial processing and manufacturing.

NEW SOURCE OF PROTEIN

At the Prairie Regional Laboratory in Saskatoon, attempts are being made to increase the production of field peas as a source of protein.

An analysis of the predominant varieties of field peas grown in a number of areas in Western Canada showed that these samples average 24 to 25 percent protein and contain about 55 percent starch. There were significant variations with stations and with years and a significant variation with variety, indicating that higher protein types can be developed.

Nutritional studies at the University of Saskatchewan showed that peas were an adequate protein supplement in swine rations without additional methionine. However, feeding a pea-protein-concentrate to mice gave inferior results because of the methionine deficiency. This was corrected with the addition of methionine.

Collaborative work in the area of human foods

from pea-flour or pea-products also is under way. This includes incorporation of pea-flour or protein-concentrate into bread and spaghetti and the preparation of textured meat analogues from the protein-concentrate.

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WIND-LOADS

A new technique for measuring the effect of wind on high-rise buildings has been developed jointly by the National Aeronautical Establishment and the Division of Building Research. Tests using the technique indicate that existing low-speed aeronautical wind-tunnels can be successfully adapted for study of surface wind effects in and around building structures.

Slab-like high-rise buildings deflect part of the wind and in so doing push it downward, increasing pedestrian discomfort, for example. Wind-speed increases with height and people on the top floor of a 600-foot building may feel some sway in winds of 60 miles an hour. More important, high winds can cause structural damage to high-rise buildings and local failures - cracking of walls, plaster and outside cladding. Because of the increasing number of high-rise buildings now being constructed, engineers, architects, builders, glass-manufacturers and others have never been so concerned over wind-loading as they are today.

The first stage of this research involved wind-pressure measurements on buildings in Montreal of 33 and 45 storeys in height. These measurements serve as a basis for the evaluation of the results of wind-tunnel studies and for analytical methods of determining wind-loads on tall slender buildings.

The second stage of this research will be to develop the wind-tunnel as a tool or design aid for investigating the whole range of problems stemming from wind effects on high-rise buildings. The wind-load information obtained in the studies will be of major value in the future design of such buildings and their location within a community.

The Division of Building Research also is developing a method for predicting the conditions that will prevail in a building if a particular size and type of air-conditioning is installed and operated on a given schedule. This information will be of immediate use to designers when they are selecting air-conditioning equipment. The work also is the first stage of a long-range program to develop improved methods for predicting the annual energy requirements for heating and cooling buildings.