Meetings

Great Lakes Research

The Great Lakes make up one of the most important inland waterways in North America and play a significant role in the economic and personal lives of both Canadians and Americans. In order to discuss recent research on the lakes the 7th conference on Great Lakes Research was held at the University of Toronto, 6–7 April 1964.

Interest in the effects of interaction of lakes and air is increasing; meteorological investigations include over-water micrometeorology (F. C. Elder, E. Ryznar, and D. J. Portman), effects of the lake breezes (R. E. Munn and T. L. Richards), and other lake weather phenomena (R. B. Sykes).

Some of the meteorological work has direct bearing on the water supply problem which is acute at the present time in some of the Great Lakes. In discussing the problem of precipitation over the lakes, G. C. Williams reassessed the frequently quoted Chicago crib precipitation records. Attempts to determine the year-to-year variation in evaporation by water budget (J. A. Derecki) and mass transfer techniques (T. L. Richards and G. K. Rodgers) have also been made. E. Megerian described the latest techniques developed by the U.S. Lake Survey for forecasting the levels of the Great Lakes.

Experiments with diffusing dye under steady and steadily changing conditions have contributed to the knowledge of circulation of lake water (G. T. Csanady). J. L. Verber submitted strong evidence for the existence of rotary currents of inertial period and internal waves in the waters of Lake Michigan.

Of the papers dealing with the chemistry of the lakes, that of J. R. Kramer was of major interest. His estimates of the chemical composition of various Great Lakes are based on the solubilities of common minerals of the basin and account for the concentrations of most constituents except chloride and sulfate. Human activity is probably responsible for the high concentration of chloride and sulfate. Further evidence that the concentration of dissolved solids is increasing in Lake Michigan was presented by C. F. Powers; sulfates, chlorides and total solids have increased. Trace elements in the sediments of Lake Superior were dealt with by D. G. Nussman.

In discussing biological aspects of the lakes, C. C. Davis reported plankton counts made by the staff of the Cleveland waterworks. This study from 1919 to 1962 shows a definite increase in the amount of phytoplankton in Lake Erie during that period. C. M. Herman reported on the extensive mortalities of gulls and loons which took place on Lake Michigan in late 1963. While toxin of type E botulism has been identified in a number of the dead birds, there is no indication that this contributed to the losses. Gulls are remarkably resistant to culture-produced type E botulism.

Two important physiological studies were noted. Mrs. C. Sparling reported that about 20 species of algae native to Lake Ontario gave off a portion of the carbon resulting from photosynthesis, but when carbon was not limiting, the excreted amount was less than 1 percent of that resulting from photosynthesis; thus these findings do not invalidate the carbon-14 method of determining primary productivity. W. Chavin described the extreme sensitivity of fish when they are handled during experiments. Adrenal cortical tissue and epinephrine-secreting cells are depleted of ascorbic acid and cholesterol within minutes. The thyroid is extremely sensitive to radioiodine; its function may be greatly impaired by retained doses of 0.001 curie. Pituitary cytology is altered by extremely small doses of radioiodide.

During the sessions emphasis was placed on the international aspects of work on the lakes. G. E. McCallum and L. B. Dworsky pointed up the need for cooperation in executing an effective development program. The historical development of international and interstate agreements pertaining to Great Lakes resources was outlined by N. V. Olds. The need for this coordination in the research field has already been recognized and acted upon in the formation of the informal international Great Lakes Study Group (G. B. Langford). Another important step has been the establishment by the U.S. Lake Survey in Detroit of a regional data center (L. W. Curry).

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Circulatory Responses to Exercise

Muscular activity is one of the most common stimuli which, under normal conditions, is invariably associated with increased cardiac activity. Such activity is usually proportionate to the increased metabolic requirement produced by the exercise. Mechanisms of this change in cardiac output and the control mechanisms in the body that are responsible for regulation of cardiac output in relation to metabolic requirements were discussed during a symposium of the American Physiological Society at the annual meeting of the Federation of American Societies for Experimental Biology, Chicago, Illinois, 13 April 1964.

Earl Wood pointed out that the gross physiology of the multiple factors and mechanisms which produce variations in cardiac output are rather well known and understood. However, there are practically no data available concerning the actual controlling mechanisms which regulate cardiac activity in relation to the metabolic needs of the body.

Modern investigative activities in contemporary physiology are tending more and more to use one of two approaches: the molecular approach or the so-called systems approach.

The molecular approach in physiology is becoming progressively more

active and is very productive. William Huckabee examined the relationship of cardiac output to the metabolic processes in the active muscles. He discussed the use of chemical substances, such as cyanide, arsenate, methylene blue, and dinitrophenol, to study the alterations in cardiac output that result from interference with normal metabolism.

In the cardiovascular field, the systems approach attempts to analyze in intact man or animals the sensing and resulting compensatory and control reactions which control blood flow at a level required to optimally meet bodily requirements. This approach, by its very nature, requires study of the man or animal involved in as untouched a state as possible. The multifaceted nature of the cardiovascular system requires recording of multiple variables in order that the investigator can get a picture of the state of the system as a whole. Such a knowledge of the practically or academically important facets of the system requires collection of much data. This can usually be accomplished without too much difficulty. However analysis of the moment-to-moment relationships of continuous recordings of many variables is a tremendous problem which, up to recent years, has usually bogged down such approaches.

The advent of electronic data processing, such as analog-to-digital and digital-to-analog conversion techniques, coupled with the use of analog and digital computers, will perhaps eliminate this stumbling block. Thus, the systems approach is becoming progressively more practical.

Most of the discussions at the symposium dealt with the systems approach. Homer Warner's presentation is an example of this approach in its more fullblown form. Warner mentioned that the rapid dilatation of the muscle vessels at the onset of exercise is accompanied by a transient decrease in arterial blood pressure. He demonstrated in dogs that this decrease activates the pressure receptors in the neck arteries; the receptors trigger cardiac acceleration and thereby facilitate the rapid increase in cardiac output. Using a computer to calculate beat-to-beat pressure flow ratios, he showed that when they were maintained constant by compression of the abdominal aorta during exercise, the exercise was no longer accompanied by an increased cardiac output.

Robert Marshall described the cardiac responses to exercise in normal man. In changing from the supine to the relaxed standing position there is an acceleration of the heart, a modest decrease in cardiac output, and, therefore, a considerable decrease in stroke volume. The mildest exercise in this position is sufficient to increase the stroke volume toward the values obtained when the subject is at rest and in the supine position. With increasingly severe exercise in the upright position, the heart rate continues to increase up to a maximum of about 180 beats per minute; the stroke volume only increases slightly. Athletes at rest and at equivalent grades of exercise have a slower rate and a greater stroke volume than nonathletes. However, the relative importance of changes in heart rate and stroke volume to the increased output is identical to that of sedentary subjects even at near maximal activity. During exercise there is no major shift of blood to the heart and lungs from the systemic circulation.

Eugene Braunwald showed that the cardiac activity is related to metabolic needs and that, under experimental conditions for a given work load, the same output can be achieved by various combinations of heart rate and stroke volume. He emphasized that some patients with heart disease may have normal hemodynamic values in the resting state and showed the advantages of exercise as a stressful stimulus to make manifest the disability. When there is damage to the muscle fibers of the left ventricle, the heart may pump out as much blood during mild exercise as it does in a normal person. Using markers attached to the wall of the left ventricle, he estimated the changes in the dimension of this chamber with each heart beat at rest and with exercise. Unlike healthy subjects, patients with myocardial damage achieve a greater force of cardiac contraction by increasing the filling pressure of the left ventricle, thereby causing a greater stretch of the muscle fibers before the onset of contraction.

With the onset of exercise, the vessels that control the flow to the muscles of the exercising limbs dilate almost instantaneously because of a local but unknown mechanism. In the nonexercising limbs, these vessels are reflexly constricted so that as the blood pressure rises with increasingly severe exercise, the flow through the nonexercising parts stays the same or decreases slightly. Thus, the increase in cardiac output with exercise is distributed to the active muscles.

John Shepherd also showed that exercise is accompanied by a reflex increase in tone of the capacitance venous system both in the exercising and nonexercising parts and that this increase is graded to the severity of the exercise. Since the greater part of the blood volume is contained in this system, its decreased compliance facilitates the return of blood to the heart during exercise.

Although the function of the heart is normally regulated by the autonomic nerves, it can function surprisingly well without them. David Donald reported that dogs exercising in the laboratory achieved the same cardiac output and oxygen consumption before and after cardiac denervation. In fact, the racing greyhound, after complete denervation, can, over the standard racing distance of ½ kilometer, achieve speeds 95 percent of those obtained prior to denervation. Since the increase in heart rate was limited, stroke volume caused a much greater increase in output in denerved dogs than in normal dogs.

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Air Pollution

Health problems caused by air pollution were discussed at a symposium held during the American Medical Association's Congress on Environmental Health Problems, Chicago, Illinois, 1–2 May 1964.

Air pollution, according to Vernon G. MacKenzie (U.S. Public Health Service), is a variable dependent on climatic conditions, source and extent of pollutants, and the chemical nature and reactions of materials in the atmosphere. Of particular medical interest are the oxidants, sulfur dioxide and various oxides of nitrogen released from stacks, and benzo[α]pyrene and other hydrocarbons from incomplete combustion. William S. Spicer (University of Maryland) and Reginald H. Smart (Los Angeles) described the special situations involved in excess mortality at Donora, Pennsylvania, and London. Spicer discussed Tokyo-Yokohama asthma, which has been shown to occur in previous nonasthmatic persons who move into this area. They almost immediately begin to experience difficult breathing. The source of pollu-