reading or punching a row; and a destination providing an external signal to the operator of the machine (a buzzer).

Reading-in and punching of cards are each carried out at the rate of a hundred cards a minute. Each card has 12 rows, and each row can be punched with one word occupying any 32 columns out of an available 80, as determined by a plugboard. Numbers can be read by the machine from cards punched in standard decimal form, converted to binary form internally by appropriate instruction sequences, and the binary results of calculation reconverted to decimal form and punched, all in the same run.

A number of trial instruction sequences, prepared and used before the multiplier had been installed, included the following:

(1) Determination of the square root of any 31-digit binary number, to 31 digits. 14 instructions; time 60–90 millisec., depending on the number.

(2) Integration of $1/(1 + x^2)$ from 0 to 1 in 256 equal steps by Simpson's Rule. 57 instructions; time 10 sec., 40 millisec. per step.

(3) Integration of Bessel's equation for $J_0(x)$ from 0 to $\frac{1}{4}$ in 4,096 equal steps. 96 instructions; time 52 sec., about 13 millisec. per step.

(4) Determination of the smallest prime factor of any integer less than 4,000,000. This involves up to 1,000 divisions, each of which occupies 6 millisec. for a dividend of 22 binary digits. 31 instructions; time less than 7 sec. With 27 further instructions, preliminary decimal-binary and final binary-decimal conversion can be carried out, the whole taking an insignificantly longer time.

(5) Calculation of the position of a set of light rays after passage through any compound lens having prescribed refractive indices and a given number of spherical surfaces. The surfaces were dealt with in separate runs, all rays being computed at each run. 128 instructions; computing time 1 sec. per ray per surface, which is reduced to 0·2 sec. when the automatic multiplier is used.

The work described above has been carried out as part of the research programme of the National Physical Laboratory, and this article is published by permission of the Director of the Laboratory.

M. WOODGER

INDUSTRIAL RELATIONS IN CANADA

THE present state of industrial relations in Canada is described in a recent issue of the journal of the Institute of Personnel Management by Miss E. B. Sharpe, deputy director of the Institute (32, No. 311; September–October 1950).

Labour and social legislation are a Provincial and not a Dominion responsibility, although the trend is towards similarity in pattern because big differences in wages and conditions might create unfair competitive conditions between industries located in different Provinces. This trend was stimulated by the emergency powers temporarily vested in the Dominion government during the War, and is encouraged now by annual conferences of representatives from Provincial departments of labour convened to compare the administrative aspects of labour legislation.

The trade union movement is of fairly recent development, and there are still large areas of industry where standards are protected more by legislation on hours, minimum wages, holidays with pay and other working conditions than by collective agreements.

The labour movement of Canada is very closely linked with that of the United States. To-day the movement includes the Trades and Labour Congress of Canada, many of the constituent unions of which are affiliated to the American Federation of Labour; the Canadian Congress of Labour which is similarly linked with the Congress of Industrial Organizations; the International Railway Brotherhoods; and the Catholic Syndicates of Quebec, who feel a closer kinship with French and Belgian unions and are often in conflict with the rest.

In 1947 the Dominion Relations Act was passed which regulates relationships in inter-provincial commerce and services. In essentials this follows the pattern of the Provincial Labour Relations Act, so that an outline of the principal provisions of the Act in Ontario can be accepted as accurate in the main for the country as a whole. The Labour Relations Act includes the following principles:

(1) Collective bargaining shall be compulsory.

(2) The right to strike shall be deferred until after conciliation has been fully explored.

(3) Certain practices on the part of both employer and union are declared to be "unfair".

(4) Members of management down to and including supervisory staff shall be excluded from legal recognition as part of the trade union movement.

Of current issues in industrial relations, the pensions plan has loomed large since it was ruled a legitimate issue of collective bargaining by the U.S. National Labour Relations Board in the steel dispute about a year ago. Two other issues arouse much feeling in Canadian unions and underline the newness and insecurity which the trade unions still feel. One is the demand for a seniority clause in contracts and the other for a union security clause. The former is sought as a protection against arbitrary lay-off or discharge but can also, if not clearly thought out and worded, hamper efficiency by limiting managements' right to promote and transfer for reasons of ability, skill, health and the like; the latter is often sought as a protection against infiltration by rival unions seeking to get a transfer of certification from the "sitting tenant" to themselves. Union security clauses vary from 'closed shop' (where only union members can be engaged and where workers must remain members to keep their jobs) and 'union shop' (where non-members may be engaged but must become members after a certain period) to a variety of maintenance provisions; of these, the 'check-off' (the deduction by the company from an employee's pay to cover his union subscriptions), which is irrevocable for the duration of the contract, is at present being frequently demanded.

In general, it is true to say that the trade union movement in Canada is more accepted and less belligerent than in the United States. The movement is mainly active in collective bargaining and has not interested itself particularly in joint consultation or other forms of participation in management.

An outstanding piece of social legislation is the Workmen's Compensation Act of Ontario, which is followed in pattern, though not quite so liberally in benefits, by the other Provinces. Originating in 1915, the objects of this legislation are to eliminate litigation with all its attendant uncertainties, delays, expense, and frequent bad psychological effects on the injured workman and to give security of pay-

ments and pensions rather than lump sums to the permanently disabled. Administrative costs of the Workmen's Compensation Board run at only five per cent of the levies made on employers, with the result that a high level of benefits can be maintained. There is general satisfaction with the system under which industries are classified according to hazard and each class is liable for the cost of accidents occurring in it.

All questions of eligibility for benefit and amounts of payments are determined by the Workmen's Compensation Board. All accidents must be reported to the Board, which thereafter pays cash benefits ranging, according to disability, up to 75 per cent of average earnings on a maximum of average earnings of 3,000 dollars. In the case of permanent disability, pensions are granted, and, in the case of death, pensions to widows and orphans. In addition, the Board carries the cost of all medical, surgical, hospital and nursing treatment, bills being submitted direct to it. The Board satisfies itself as to the adequacy of the treatment available, and frequently brings injured workmen in from distant parts of the Provinces to Toronto or other cities if specialist services are called for. The Ontario Board has acquired its own nursing and rehabilitation centre near Toronto in 1947, where realistic occupational tests are given to workmen before discharge.

Accident prevention is encouraged by the formation of accident prevention associations of employers in their own class, under the general supervision of the Board. These associations may make safety rules and employ safety inspectors and bring the pressure of public opinion on individual employers whose record is bad and who tend to increase the levy on the industry as a whole.

In order to encourage the employment of the blind, in 1931 an amending Act transferred liability for compensation beyond 50 dollars to an injured blind workman from the Board to the general revenue of the Province, but from that time to the present less than half a dozen claims have been paid in this way, thus bearing out a contention of the Canadian National Institute for the Blind that the blind workman is a safe workman. In return for the benefits of this Act the workman has no right of litigation against the employer or the Board.

Miss Sharpe also describes the work done by personnel officers in industries in Canada.

T. H. Hawkins

AGRICULTURAL AND HORTICULTURAL RESEARCH STATION, LONG ASHTON, BRISTOL

ANNUAL REPORT FOR 1949

Some forty-five papers were published during 1949 by the staff of the Agricultural and Horticultural Research Station (National Fruit and Cider Institute), Long Ashton, Bristol. The annual report of the Station for that year* includes a further twenty-four detailed papers. The practical calibre of the research at Long Ashton is well known, so this large volume of work can only indicate the high efficiency of the Station.

J. D. Cuthbertson and Rita M. Stickley have assessed the yield of cider fruit on bush trees at several centres during 1945–49. The variety Dabinett gave good yields at all the centres with detailed records. G. T. Spinks, who is editor of the report, describes the performance of several new crosses of fruit trees. Pear trees pruned for open centres crop better than those with delayed open centres (E. W. Hobbis and E. Catlow). It seems natural, since fruit-tree roots penetrate the subsoil, to place fertilizers in the lower layers, and J. Tolhurst and C. Bould have initiated work on this question, using a soil injector for the purpose. Prof. T. Wallace, director of the Station, has, with his colleagues C. Bould, D. J. D. Nicholas, J. M. S. Potter and J. A. H. Tolhurst, studied the effects of zinc- and copper-deficiency of fruit trees. Symptoms are well illustrated by photographs, and tentative treatments by branch injection and spraying are being investigated. Interrelations of iron and potassium in the metabolism of the potato plant are discussed by E. W. Jones and E. J. Hewitt, who further discuss the effect of molybdenum-deficiency on some brassica crops.

A group of papers by R. S. Willison, L. H. Luckwill and S. H. Crowdy deals with the importance of virus diseases of fruit trees. These appear to be more severe than is generally recognized, and 'rubbery wood' of apples seems to be the most important. R. J. W. Byrde has found that phenyl mercury chloride (0·0035 per cent), 'Phygon XL' (0·1 per cent) and copper 8-quinolinoleate (0·1 per cent) were effective as June sprays against brown rot of plums. Phenyl mercury chloride and sodium and calcium arsenites were also effective as eradicant fungicides when applied to mummified plums. S. H. Bennett reports high toxicity to *Aphis pomæ* following soil applications of the systemic insecticides *bis*-(dimethylamino) phosphonous anhydride, *bis*-(β-fluoroethoxy) methane and *bis*-(dimethylamino) fluorophosphine oxide. A revision of fruit-spraying programmes, including modern fungicides and insecticides, is given by H. G. H. Kearns and R. W. Marsh, while H. G. H. Kearns and N. G. Morgan describe the automatic spraying of top fruit with a spray mast. They have also designed a light-weight spray nozzle for small- and large-volume spraying.

In the section on cider and fruit juices, L. F. Burroughs and S. W. Challinor continue their fundamental investigations into the role of nitrogen in fermentation. Their third report considers some of the changes in phosphorus associated with the nitrogen. B. T. P. Barker has investigated the yeast fermentation of cider and, with E. J. Hewitt and D. G. D. Nicholas, the molybdenum content of ciders in relation to the incidence of cider sickness. Margaret E. Kieser, A. Pollard and Audrey M. Stone have two papers on the pectic enzyme activity on the clarification of apple juice, and on the effect of manurial treatment on the composition of black currants and their products. Alice Crang and Lorna Kendall have found that temperatures of 150–185° F. (according to the variety) are necessary to inactivate the enzymes which cause browning of plums in bottling. The oxidase system in apples is inactivated between 150–160° F. Finally, G. E. Clothier has some interesting meteorological observations on fluctuations in air temperature at Long Ashton since 1920.

* University of Bristol. Annual Report of the Agricultural and Horticultural Research Station (the National Fruit and Cider Institute), Long Ashton, Bristol, 1949. Pp. 174+8 plates. (Bristol: The University, 1950.) 12s.