instrument making, experimental foundry, foundry testing laboratory, electrical repair shop, melting and heat-treatment furnaces, mechanical working equipment such as rolling mill, hammer, draw-bench, etc., refractories, laboratories with associated furnaces, ore-dressing and mineral benefication laboratories, crushing room, etc. Some of the heavier machinery and pilot plant as originally envisaged have not for the present been ordered; but when funds are available these will be mounted in the bays awaiting them.

After the Laboratory had been declared open, the guests went on a tour of inspection. An interesting exhibit which was placed not in the museum but installed in the foreground, and which attracted special notice, was a full-sized copy of the 2,200-year-old Asoka Pillar at Benares. The capital of this Pillar has been adopted by republican India as its crest and its symbol. The Jamshedpur pillar bears the following legend: "This replica of the Asoka Pillar cast for the workers of the National Metallurgical Laboratory of India, was installed on the 26th November, 1950, on the opening of the Laboratory by Jawaharlal Nehru, Prime Minister of India, as a symbol of the science and industry of India in the past, a token of the present and an inspiration for the future".

Another interesting exhibit was a reproduction of the famous iron pillar of Delhi.

NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING, SHINFIELD

REPORT FOR 1949

WE were recently reminded in a lecture to the Royal Society that the National Institute for Research in Dairying began, in 1912, with a staff of two men and a boy, with an annual income of £1,600 and with its accommodation in the two extremes of discomfort—an attic and a cellar. This report for 1949* shows, in its first pages, a staff of about seventy scientifically qualified people with a similar number of technical assistants, and, in addition, considerable administrative and maintenance staffs. There are seven scientific departments, a statistics section, a library and an experimental dairy, and the Institute has its own farms and dairy herd. There is also a laboratory for cod liver oil standardization, and associated with the Institute are the Commonwealth Bureau of Dairy Science and the Reading Cattle Breeding Centre. The last pages of the report, dealing with membership, subscriptions and donations, indicate that further expansion is envisaged, and this is not surprising considering the size of the dairying industry and the amount of its turnover.

The dairy husbandry section manages the farms and is faced with the inevitable difficulties (enhanced by a self-contained herd) of combining farm management with the provision of research facilities and the demand for advisory work. The department has, in addition, its own investigations.

A brief article cannot attempt to describe all the work. Moreover, although the report is presented under departmental headings, the subjects referred to here are not credited to particular departments since so much of the work necessarily involves collaboration between departments and between the Institute and other bodies. This article will only try to show and exemplify the scope of the work of the Institute.

Dealing with food itself, the value of certain fodder crops (kale, maize for silage and fodder beet) for dairy stock continues to be investigated; but not all the results have yet been statistically analysed. The demonstration in 1948 of œstrogen in British pasture is being followed by the study of œstrogenic activity in certain grasses and clovers and of its practical significance, a matter on which little or nothing is known at present.

Experiments on the rate of passage of food through the animal show that the lesser digestion of crude fibre in ground hay (compared with that of unground hay) is not due to differences of rate of passage but possibly to differences in the rate of digestion in the reticulo-rumen. The study of the rate of digestion has been attempted by using as a reference substance something that is wholly undigested. Chromium sesquioxide was unsatisfactory because of its irregular rate of passage, and the lignin ratio method had to be discounted when it was suspected that lignin is digested quite appreciably. This is now the subject of further study.

It has been found that cows receiving most water in relation to dry matter effect the greatest digestion of fibre on a hay diet, and the water content of material in the reticulo-rumen does seem to affect the digestibility of fibre. The digestion of protein and of fat, the role of micro-organisms in nutrition, and the synthesis of vitamins in the animal are among other nutritional studies.

There is a good deal of work on the physiology of the mammary gland and of milking, and on the influence of hormones in lactation. In work on milk secretion it has been found that mammary gland slices from non-ruminants use acetate very quickly and with a low respiratory quotient—indicating no appreciable fatty-acid formation. Other workers, however, have shown that large amounts of carbon from acetate pass into fat in the mammary gland of the rabbit. This discrepancy between experiments *in vitro* and *in vivo* seems to have been solved by adding glucose in the experiment *in vitro* (it would be present in the gland *in vivo*) when acetate is used with a high respiratory quotient.

Developments of earlier work involving thyroid-active iodinated casein have been made easier by the fact that the hormone L-thyroxine has become available in a pure state at a reasonable cost. Yield increases up to half a gallon a day per cow have been found, and the effect on the composition of the milk is being studied.

Several investigations concern machine milking. The rate of milking is very variable, and the maximum number of lb. in one minute during milking varies among most cows between 4·0 and 11·5, although figures for a few cows lie well outside each end of this range. The absorption of fat by teat cup liners is much reduced when the liners are well brushed in hot detergent, and the use of boiling caustic soda for removing fat from liners is being investigated.

There is a lot of work being done on the bacteriological quality of milk and milk products. This includes, in addition to the continuation of work on mastitis, the examination of flora before and after keeping-quality tests, the effect of penicillin on the bacterial content of milk and various bacteriological problems of butter and cheese. An extensive

* University of Reading: National Institute for Research in Dairying. Report for the year 1949. Pp. 80. (Reading: National Institute for Research in Dairying, Shinfield, 1950.)

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study of streptococci and lactobacilli and their classification is also being undertaken.

There are a number of researches on the chemical composition and physical properties of dairy products; but space forbids the mention of but one or two interesting things about the variation in the composition of milk among the different breeds. When the breed data are set out with increasing non-fatty solids, it is found that in addition to the known increase in protein there is also an increase in lactose. It seems, incidentally, that some of our lack of knowledge about carbohydrate quantities arises from the determination of them by difference instead of by a direct method as was adopted here. Another point is that variations in percentages of protein in the milk of different breeds falls almost entirely on the casein.

Sows' milk is the subject of a good deal of work in this report, particularly in connexion with vitamins.

There is a list of fifty-eight papers published by members of the Institute staff during the year ended September 1949.

COPPER METABOLISM

SYMPOSIUM AT THE McCOLLUM–PRATT INSTITUTE

IN 1947 Mr. John Lee Pratt, of Fredericksburg, Virginia, provided a generous gift to the Johns Hopkins University with the request that it be used to further the study of trace elements in nutrition. Personal experience of farming North Virginian terrain, depleted by centuries of heavy cropping, had thoroughly convinced him of the important part played by trace elements in the nutrition of plants and animals, and prompted him to seek a way of extending knowledge of the functions which micro-nutrients assume in living organisms.

Thus the McCollum–Pratt Institute came into being, its title appropriately combining the name of the donor with that of Prof. E. V. McCollum, doyen of American nutritional scientists, whose wise counsel in the beginning of this venture ensured that those charged with the quest should enjoy a wide freedom of approach to the many problems which await solution. Splendid opportunities for advanced study of the nutritional physiology and biochemistry of micro-nutrients are offered there under the direction of Prof. W. D. McElroy and his colleagues, Drs. R. Ballentine, S. P. Colowick, A. Dawson, H. Little and N. Kaplan.

An important term of reference of the Institute is "to serve as a centre at which world authorities on the subject of micro-nutrients would convene from time to time to discuss problems in the field", and to this end a symposium on copper metabolism was arranged in mid-June when more than fifty chemists and physiologists from the United States, Australia and New Zealand assembled at the Johns Hopkins's Homewood Campus, Baltimore, to discuss various aspects of copper metabolism; many of those who participated were guests of the Institute.

The broad field covered by the seventeen papers formally presented during the six sessions of the symposium provided a framework of existing knowledge that clearly expressed the extent and importance of the subject around which the discussions were centred; and, perhaps what is more important, the contributions rendered even more manifest the gaps in our knowledge. Stimulating discussion helped further to clarify the main problems.

The proceedings opened with a review of the physical chemistry of the copper atom, of its size, its affinities, the radius and disposition of its outer electron orbits, and other properties which determine its valency and ability to form covalent complexes. The copper–protein complexes were then considered and what is known of the copper-containing enzymes reviewed. The sessions on the second day were devoted to various aspects of copper metabolism in animals, and those of the third day to copper metabolism in plants and to those relationships between soils and plant growth which determine the assimilation and utilization of copper.

The breadth of the subject precludes the provision here of a satisfactory review either of the formal papers or of the discussions. A summary of them has been published*, and the full proceedings, published by the Johns Hopkins Press, are soon to appear.

The scope of the symposium may be gathered from the following list of the formal papers presented: copper complexing reactions, by A. H. Corwin (Johns Hopkins University); ascorbic acid oxidase, by C. R. Dawson (Columbia University); copper proteins involved in tyrosine oxidation, by Frank Mallette (Johns Hopkins University); phenol oxidases and plant respiration, by John M. Nelson (Columbia University); browning reactions involving copper proteins, by John B. Thompson (Trace Metal Research Laboratory, Chicago); the occurrence, evolution and properties of hæmocyanin, by Alfred C. Redfield (Woods Hole Oceanographic Institute); the use of radioactive copper in nutritional studies, by C. L. Comar (University of Tennessee); problems associated with copper deficiency in ruminants, by H. R. Marston (Commonwealth Scientific and Industrial Research Organization, University of Adelaide); influence of copper on the metabolism of phosphorus and molybdenum, by George K. Davis (University of Florida); copper and molybdenum in relation to diseases of cattle and sheep in New Zealand, by I. J. Cunningham (Wallaceville Animal Research Station, New Zealand); copper metabolism in human subjects, by G. E. Cartwright (University of Utah); metabolism of copper in the invertebrates, by Vincent Dethier (Johns Hopkins University); chemical nature of the copper complexes in peat soils and plants, by Jeffrey E. Dawson (Cornell University); trace elements and phosphate in herbage plant nutrition, by H. C. Trumble (United Nations Food and Agriculture Organization); mineral nutrients in native forages in relation to land forms and soil conditions of eastern North Carolina, by Kenneth C. Beeson and G. Matrone (United States Department of Agriculture, Ithaca, N.Y.); the copper nutrition of green plants and fungi, by Robert A. Steinberg (United States Department of Agriculture, Beltsville, Md.); functional aspects of copper nutrition in plants, by D. I. Arnon (University of California, Berkeley).

The symposium was a good one, and served well to fulfil the hopes of the founder of McCollum–Pratt Institute and of those who were responsible for translating his wishes into practical effect. The publication of the full proceedings will provide a valuable reference for those interested in the subject of copper metabolism.

H. R. MARSTON

* A Symposium on Copper Metabolism. Animal, Plant and Soil Relationships. By Dr. Bently Glass. Contribution No. 5 of the McCollum–Pratt Institute. (Baltimore: Johns Hopkins University, 1950.)

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