recreation, which they frequent. This is perhaps insufficiently considered by some council members of scientific societies who, for whatever reasons, being unable or not wishing themselves to take part in such meetings, lend their influence to abandonment or postponement.

A more fundamental objection to the continuance or resumption of the winter scientific program is raised in some quarters, as it was also in the War of 1914–18, that scientific meetings are intrinsically unjustifiable in war-time, being a misuse of hours that ought to be devoted to definite war work. This view ignores the fact that there are still many scientific workers, capable of helping to overcome our enemies, and anxious to be thus used, whose services have not been called upon, or have even been declined when offered. But even as regards those whose time is actively occupied in scientific war work, the criticism seems unanswerable. Neither manual nor intellectual workers can work all their waking hours; some leisure and refreshment of mind are necessary to enable a man to do his best work; and the solution of a pressing war problem may be facilitated, not retarded, by a break in the routine hours of labor, and by meeting with colleagues who share similar peace-time scientific interests, whether or not they are likewise now engaged in war service.

Almost all the general arguments that justify the expenditure of time and travel involved in attendance at scientific meetings in peace-time remain valid also in war-time. Just as a Christian finds no less need now than in normal days to assemble in church with his fellow worshippers, so the man of science still needs to maintain his contacts with fellow workers and with scientific progress outside his own special activity. War is not exclusively a matter of the organization and execution of material defense and attack; the mind no less than the body and the spirit must be kept in sound condition in order to continue to develop these material measures.

The officers of scientific societies, however, doubtless find other obstacles to meeting than those of risk and travel difficulties. The work of scientific technicians is now largely directed to war problems the solutions of which must for the present be kept secret; and so many workers in pure science are now drafted into the technical defense services that the output of pure research which can be safely published in war-time is much reduced. These factors are in one way a help to societies, in reducing the pressure on their resources of money (and of paper) for publications; but unless the societies are to fall into a state of suspended animation that may seriously prejudice their future revival, some degree of publication must be continued. The volume and perhaps even the standard of the papers published and read may be somewhat reduced, but the sources are scarcely likely to dry up entirely; and a shortage of papers for reading at meetings can be eeked out partly by a moderate reduction in the length of the meetings, and also by arranging discussions, a course which has been so successfully followed by the Royal Society in recent years.

REPORTS

THE SOYBEAN CROP IN THE UNITED STATES

PRODUCTION and processing of the soybean in the United States has grown to a multi-million-dollar industry. To-day a ubiquitous plant, the soybean is useful as food for human consumption, feed for live stock and in manufacture of many useful goods. As a component in scores of manufactured products such as paints, soap, plastics, linoleum and waterproof materials, the soybean has gained an important place in the American industrial scene.

Forty-seven U. S. manufacturing establishments last year were engaged primarily in the production of soybean oil, cake and meal, according to the 1939 Census of Manufactures. In 1937, only 26 establishments were reported in this industry. The value of products of the soybean processing industry was $43,946,647, manufacturers reported to the Census Bureau, compared with the 1937 figure of $24,312,433, an increase of 80.8 per cent. The factories covered in the 1939 report gave employment to 1,481 wage-earners, who drew wages amounting to $1,889,457 and to salaried personnel numbering 199 who drew $663,469 in salaries.

The soybean first was introduced to American farmers in 1898. In 1909, the Census of Agriculutre shows, this country produced only 16,835 bushels of soybeans. Cultivation was reported on 339 farms.

Twenty-five years later, in 1934, according to the latest available figures from the Census of Agriculture, the output had soared to 23,014,703 bushels, grown on 148,124 farms, and accounted for more than $25,000,000 cash income for farmers. A considerable part of this increase of more than a thousand-fold took place during the depression years, for production was only 8,661,188 bushels in 1929. In addition, the value of the crop used for livestock feed amounts to many millions of dollars more. According to the Department of Agriculture, the cash farm income from soybeans in 1937 was $28,030,000 and by 1938 it had risen to $31,933,000.

Soybean oil made from this Oriental immigrant to our farms is used primarily in shortening and oleomargarine. Of the 369,760,000 pounds of soybean oil consumed in American factories during 1939, census reports show that 201,599,000 pounds were used in the manufacture of shortening. Another 70,822,000 pounds became an ingredient of oleomargarine.

The oil also is used in manufacturing candles, celluloid, core oil, disinfectants, electrical insulation, enamels, fuel, glycerin, insecticides, linoleum, lubricants, oilcloth, paints, printing ink, rubber substitutes, varnish, waterproof goods and food products such as butter substitutes, cooking oil, lard substitutes and salad oils and medicinal oil.

Lecithin is derived from soybean oil and is used as an emulsifier and in the manufacture of candies, chocolate, cocoa, margarine, medicines and in dyeing of textiles. (Egg yolk was the chief source before.)

Dried soybean flour is used in baked products, breakfast foods, candies, diabetic foods, health drinks, ice-cream cones, ice-cream powder, infant foods, macaroni products and as filler in meat products.

Soy sauce and sprouts are produced from dried beans.

Vegetable milk derived from dried soybeans is converted into casein, which is used in paints, size for paper, textile dressing and waterproofing. The meal is used for foods, fertilizers and manufacture of glue and celluloid substitutes.

More than a hundred named varieties of soybeans are grown in the United States, according to the Department of Agriculture. The cultivated soybean is derived from a variety which grows wild in eastern Asia.

The first record of the plant is in the writings of Emperor Shang Nung of China in 2838 B.C. In Chinese mythology, it was first planted by Hou Tsi, one of the Chinese gods of agriculture, and has for centuries ranked as one of the five sacred grains necessary to Chinese civilization—perhaps one of the oldest crops grown by man.

Europe knew of soybeans in the seventeenth century, and they were tried in Germany, England, France and Hungary, but were not commercially important until recent years. In 1898, the U. S. Department of Agriculture began introducing soybeans on a considerable scale.

In the United States, the soybean is grown chiefly in the cornbelt states. Illinois, Indiana, Iowa, Missouri and Ohio lead. Manchuria is the biggest soybean producer in the world. Chosen, Japan and South China rank high, too. In the Far East, foods based on the soybean supply the protein which is obtained from meats in the diet of western people.

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SPECIAL ARTICLES

RED CELL VOLUME CIRCULATING AND TOTAL AS DETERMINED BY RADIO IRON

RADIOACTIVE iron can be given to the anemic dog by mouth or by vein, and by its use we have recorded a rapid construction of new hemoglobin which contains the radio-iron within the newly formed red cells.[1, 3, 4] These red cells are now marked or *labelled by the isotope* and do not give up this iron until the cell breaks up.[2] During the long life of these red cells labelled with radio-iron, they can be used to determine the circulating mass of red cells in another dog whose own cells contain none of the isotope. The red cells containing the radio-iron are given by vein to the dog under study and the degree of dilution noted after varying periods allowed for mixing of the ordinary and labelled red cells (Table I). It is significant that the red cell mass in circulation *determined by this method* averages about 75 per cent. of the value as *computed* by the jugular hematocrit from the plasma volume (dye method).

It is now generally admitted that the dye methods, when properly done, give plasma volume determinations which are accurate, usually within an error of 5 per cent. Jugular hematocrits in the normal adult dog are usually about 50 per cent. If the plasma volume is about 4.8–5.0 per cent. of the body weight, then the *calculated red cell volume* is obviously the same, if one assumes a uniform mixing of red cells with plasma throughout the circulatory tree. It was pointed out many years ago[5] that in the capillaries and arterioles there is much more plasma than red cells—the "axial stream" in small arterioles and venules, and the "still space" in small vessels and capillaries. By means of dye (plasma volume) and carbon monoxide (hemoglobin volume) and Welker method (hemoglobin volume) done in the same dog,[5] it was concluded that the plasma volume was 4.8–5.0 per cent. of the body weight and the red cell mass 3.8–4.0 per cent. of the body weight. These values are in har-

[1] P. F. Hahn, W. F. Bale, E. O. Lawrence and G. H. Whipple, *Jour. Exp. Med.*, 69: 739, 1939.

[2] P. F. Hahn, W. F. Bale, J. F. Ross, R. A. Hettig and G. H. Whipple, SCIENCE, 92: 131, 1940.

[3] P. F. Hahn, J. F. Ross, W. F. Bale and G. H. Whipple, *Jour. Exp. Med.*, 71: 731, 1940.

[4] L. L. Miller and P. F. Hahn, *Jour. Biol. Chem.*, 134: 585, 1940.

[5] H. P. Smith, H. R. Arnold and G. H. Whipple, *Am. Jour. Physiol.*, 56: 336, 1921.