not impair the visibility of the mycelium. In completed preparations the mycelium, spores, amoebæ or bacteroidal tissues are a brilliant red and host tissues green. This combination gives clear differentiation for visual microscopic study but for photomicrography the use of filters is necessary.

If sections are somewhat resistant to staining good results are obtained by first mordaunting them in a 1 per cent. solution of potassium permanganate in water for 2 to 5 minutes, afterwards washing in water and passing through graded alcohols to 85 per cent. The mordant must be freshly prepared as it will not keep.

Excellent preparations have been obtained with the following phytopathological material: *Plasmodiophora brassicæ*, legume tubercles, *Albugo candida, Phytophthora infestans, Plasmopara viticola, Exoascus pruni, Mycosphaerella rubina, Venturia inaequalis, Cronartium ribicola, Peridermium balsameum, Uromyces caryophyllinus, Puccinia malvacearum, Puccinia antirrhini, Puccinia graminis*, etc.

It is hoped that others may find the method of some value.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION O—AGRICULTURE

The sessions of Section O, held in the Soldan High School, St. Louis, Mo., December 29 and 30th, 1919, were devoted to the discussion of the general subject: "The Relation of the Use of Power and Labor-saving Machinery to Agricultural Progress." For the sake of effective presentation, the general subject was considered in four of its important relations, namely, the influence of farm machinery on production, labor and wages; the influence of power and machinery on social and physical conditions surrounding farm life; the application of power to save labor; and future needs and developments.

In discussing the first of these topics, Mr. Arnold P. Yerkes, of the International Harvester Company, referred to the evolution of farm machinery and pointed out that the first real farm machine was invented less than half a century ago. Such farm tools and implements as were used a hundred years ago were of the one-piece variety and could not be properly designated as machines. They were very nearly identical with those that had been used by farmers for two or three thousand years. The invention of the reaper, in itself a rather simple machine, was quickly followed by other inventions represented by at least 100 distinct implements used on American farms at the present time. "During this period of invention and development of farm machines, American Agriculture has undergone a tremendous change. The old farming methods, which involved a great deal of hand labor, have given way for the most part to the use of machinery. An entirely new era of agriculture has been brought about and the new order has been made possible only through the invention of machines which reduced the amount of labor and the percentage of the population required to produce foodstuffs, thus enabling transportation and other industries to develop simultaneously with agriculture."

The invention and use of farm machinery has had at least two effects on labor. There has been a saving of labor by the increase in the efficiency of the individual and the consequent reduction in the number of men required to accomplish a given task. There has been, further, a substitution of animal and mechanical energy for human energy and the making of farm work less irksome and exhausting. For these reasons the employer of farm labor lays less stress than formerly on mere physical development and is willing to pay more for technical skill, initiative and manual expertness. "Incidentally these changes, brought about by the use of machinery, have resulted in a decided change in the type of farm hands upon American farms as whole. A few years ago immigrants who had had experience on the small farms in Europe made what were considered first-class farm hands, since they had a fair knowledge of a type of farming which did not differ materially from that found in this country. At that time many of the immigrants sought employment on farms in America and found it. But with the increased use of farm machinery this class of labor became less and less satisfactory because very few of the immigrants had any knowledge whatever of farm machinery, and, as many of them could not understand the English language, it was difficult to teach them. The practise of hiring these "green" immigrants therefore became less common."

Farm machinery, according to Mr. Yerkes, has not only increased the output per worker, but has made possible the more rapid extension of the cultivated area, and the increased production per acre thanks to the more thorough tillage of the soil and the more uniform methods of fertilization, planting and harvesting. On the whole, the use of farm machinery may be said to have increased the efficiency of man labor on American farms approximately eight times. In not a few instances the increase in man power efficiency has been even more striking. It should be remembered in this connection that the manufacture of machinery takes up a very considerable amount of labor, and that a certain allowance is to be made for it in calculating our labor resources.

"Notwithstanding the almost marvelous progress which has been made in less than a century in developing farm machinery of all kinds, there is every indication that the progress in the future seems likely to equal, if not surpass, that which has already been accomplished. It is realized that this may sound like an extravagant statement, nevertheless calm consideration of the whole subject must invariably lead one to the conclusion that this is entirely possible. Just as the invention of the reaper and its subsequent development produced a complete revolution in the methods of grain raising, so the invention and development of the internal combustion engine seems destined to work another revolution in general farming."

In his consideration of the second topic on the program Mr. F. W. Peck, of the Office of Farm Management, pointed out that farming differs from most of the other industrial pursuits in that it compels the performance of a relatively large amount of work in a limited space of time. In spite of the great range of conditions that one finds on American farms the question of labor efficiency is nearly always paramount. There is, therefore, an obvious relation of farm power to labor efficiency in American agriculture. The economic factors involved in the study of farm power relate to: (1) the requirements for power in farming; (2) the kind of power most readily available; (3) the form of power in its relation to man; (4) the influence of any given form of power on the organization and operation of the farm.

A study of the utilization of horse labor on three farms of different type showed that on a dairy farm in Wisconsin 6 horses were kept for 143 crop acres; on the Illinois corn and hog farm 9 horses were kept for 182 crop acres; and on the Iowa seed, grain and stock farm 12 horses were kept for 261 crop acres. Similar studies were conducted on large grain farms in North Dakota and Washington. In a general way it was found that on most farms hauling operations require more than half of all the horse power used; that plowing, harrowing and disking require from 15 per cent. on the small cotton and corn farm to 64 per cent. on the large Dakota grain farms. "It is safe to say that in most instances the seasonal and weather conditions limit the hours within which most operations must be performed, with the result that the work can not be expanded as might be desired."

In commenting on the same subject Mr. C. J. Galpin, of the office of Farm Management, said in his paper: "The machine is profoundly affecting the farmer's physical and mental life, as it is all human life. With every advance in machine power for the farmstead, both in the house and on the land, a shift occurs in the strain upon the farm family. Mechanical power takes more and more the brunt of gravity, and the big human muscle engine more and more falls into disuse, while the second series of finer, smaller muscle engines come more and more into play in farm work. . . . The machine-farmer becomes a new cerebral type, whose very struggle with the earth summons him to an employment of his hereditary intellectual mechanism, and a consequent intellectual life. Ever since the days of bits in the horse's mouth and reins to guide the horse, down to the present age of gas-driven tractor and motor car, the machine-farmer type has been in process of evolution. However, the hoe-farmer, both man and woman, can be found in every land, in every part of America, true to primitive type. Between these two types lies the mass of landworkers in the United States."

Under the topic "Application of Power to Save Labor" Mr. Wayne Dinsmore, secretary of the American Percheron Society, Chicago, Ill., contributed a discussion on "Animal Power"; Dean A. A. Potter, of the Kansas Agricultural College, on "Tractor Power" and Mr. Lee, of the Domestic Engineering Company, Dayton, Ohio, on "Electric Power." It was stated by Mr. Dinsmore that the mechanical motive power units in use in 1919 did not exceed 200,000. In other words, they had displaced but 2.2 per cent. of the horses and mules on the farms of the United States. According to the investigations of W. F. Handschin, of the University of Illinois, horses furnished the most economical source of farm motive power on all farms under 260 acres in area. But even on larger farms 75 per cent. of the work

could be done most economically by the use of horses. "Animal power is to-day our chief reliance in saving labor on farms, and so far as we can judge always will be. The more effective utilization of animal motive power units, and the application of labor saving methods therewith, should therefore receive especial consideration from our colleges, experiment stations and agricultural engineers."

The increasing of labor efficiency on the farm through the use of animal power involves the study of four leading factors: namely, the use of a greater number of horses per man; the application of more efficient methods in the use of animal power; the employment of more efficient types of horses; and the devising of new applications in utilizing animal power. It is worth while to note that the light two-horse teams used in New England plow scarcely more than one acre per day. In Pennsylvania and Ohio three-horse teams are often used and the acreage plowed by them will average two to two and a half per day. In Iowa and Illinois most farmers use four and five horse teams and plow four and a half to five acres per day; while in the PaLouse Country in Oregon, Washington and Idaho eight and ten horse teams are common and their performance is equivalent to eight to eight and a half acres per day. "To put the matter in another way, the men in the West were doing their work with half as much labor as Illinois' farmers and one eighth as much labor as New England farmers."

Dean Potter referred in his remarks to the part played by large scale production methods in the development of the American industries. These methods are, however, possible only where mechanical power and devices operated by mechanical power are available. In the use of horse power one man can control at most five or six power units, whereas in the use of mechanical power he can control many more units. A questionnaire sent out to Kansas farmers disclosed many interesting facts as to the cost of eparation, depreciation, efficiency of smaller and larger tractors, etc.

Considerable stress was laid by Mr. Lee on the opportunities that exist for using on the farm small electric motors of one half to three quarter horse power. Numerous tasks in the farm outbuildings and in the farm home could be performed by means of such motors, as for instance the operation of cream separators, sewing machines, pumps, vacuum cleaners, clippers, etc. Mr. Lee also referred to the need for investigation and training as bearing on the more effective use of labor-saving devices in the farm home, as well as in the outbuildings and on the land.

The last topic on the program, "Future Needs and Developments," was discussed by Mr. E. A. White, of the Holt Manufacturing Company, Peoria, Ill. Mr. White estimated that there are in use on the farms of the United States about 30 million horse power units made up of 16 million animal units, 5 million gasoline and kerosene tractor units, 4 million steam engine units and more than 3 million windmill and electric motor units. On the other hand, the manufacturing establishments of the United States control only about 18½ millions of mechanical horse power units. If nothing else, the magnitude of the agricultural industry demands the expansion in the use of animal and mechanical power where this would be warranted by economic conditions. It also demands a more intimate knowledge of the need for power, the efficient use of power and the improvement in the devices employed, as well as the training of the human agents to whom, in the last analysis, we must look for the effective use of both power and machinery.

At the business meeting Dr. E. W. Allen, chief of the Office of Experiment Stations, was nominated vice-president. The General Committee of the Association later confirmed this nomination. The other officers for the ensuing year are: Dr. A. F. Woods, retiring vice-president; Dr. A. C. True, member of council; Mr. George M. Rommel, member of general committee; Sectional Committee, Dr. C. P. Gillette (four years); Dr. John Lee Coulter (three years); Dr. A. F. Woods (two years); Dean Alfred Vivian (one year); Dr. Kenyon L. Butterfield (one year); Dr. J. G. Lipman, secretary (four years).

Jacob G. Lipman,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter