ROTHAMSTED RESEARCH

Power for Cultivation and Haulage on the Farm

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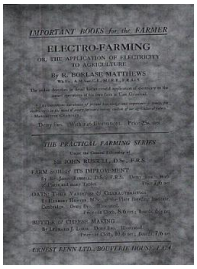

General Summary

B. A. Keen

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GENERAL SUMMARY OF PAPERS AND DISCUSSION

By B. A. KEEN, D.Sc., F.Inst.P.

(1) Six forms of power are in use, to varying degrees, on the present-day farm: horses, and engines whose motive power is (*a*) steam, (*b*) gas, (*c*) petrol or paraffin, (*d*) low-grade fuel, (*e*) electricity.

(2) None of the mechanical forms of power is likely to replace the horse in the near future. The horse is very adaptable; a team can be split up and distributed to different kinds of work. The main functions of mechanical power are to provide a reserve of power for heavy and urgent work in cultivations and harvest, and to release horses for haulage work. The general characteristics of each form of power are discussed in the following paragraphs.

(3) *Steam.*—This is the most flexible form of power. Increased load does not "stall" the engine, but merely reduces its speed. It has long been established for deep and rapid ploughings and cultivations, in the familiar cable outfits. The work is done almost entirely by contract, few farmers having enough large areas to justify owning a set. Some difference of opinion exists as to whether the heavy weight of the engines is really necessary; and haulage of water and coal to the engines, and the time spent in getting up steam, are regarded by the farmer as disadvantageous. The development of steam wagons for general road haulage has not yet spread to agriculture.

(4) *Gas.*—Its use is confined to stationary engines, for driving barn machinery, etc. Very few gas engines are in use, and their number is decreasing.

(5) *Petrol or Paraffin.*—Engines of this type constitute by far the greatest number in use on the farm, and their number is constantly increasing, both in the form of stationary engines and tractors. Modern designs are much more economical of fuel and oil than those introduced just after the War, and stoppages due to mechanical defects have been largely overcome. Stationary engines are used for barn machinery, although the tractor is commonly employed for the heavier belt-work, in addition to its use in hauling binders and cultivation implements. Its use for road haulage has hardly begun as yet.

(6) *Low-grade Fuel.*—Heavy oils and low-grade fuel can be successfully utilized in the Diesel type of engine with the double reduction of fuel costs and depreciation, because of the simpler

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form of engine, fewer moving parts, and lower temperature of ignition. The use of Diesel-type engines for cable-tackle sets is now an accomplished fact, and a successful form of light tractor also is said to be in use.

(7) *Electricity.*—The electric motor is by far the simplest form of prime mover. There are only the two main bearings and the brush-holders requiring occasional attention, and no mechanical aptitude on the part of the worker is necessary. The necessity for a cable that has to be wound and unwound as the implement passes across the field is a drawback for cultivation work, and a grave difficulty is the necessity for a storage battery or petrol engine for independent motive power.

(8) It appears that steam-power will continue in use for heavy cultivation work, but may be seriously challenged by the Diesel engine; on the other hand, the steam wagon may be developed for haulage of farm produce to market. The paraffin or petrol tractor will for some time be the most general form of farm power for belt-work, cultivations, harvest operations, and perhaps road haulage. Electric-power can increase only with a spread of electrification of the rural areas, and the heavy cost of overhead lines, due to stringent safety precautions, is a serious obstacle. Calculations indicate that the total rural load would be economic, while electric light in the homes and in the farm-buildings would add to the comfort of the workers, and improve their efficiency. The petrol-electric system, that aims at combining the advantages of electric drive with the independence from fixed cables of the petrol engine, appears worthy of serious attention.

(9) There is general agreement on the design and specification of the general-purpose tractor—*i.e.* the machine for the average farm, where one only, or at the most two, would be employed. It should be of the light type, weight about 30 cwt., centre of gravity near centre of wheel-base and as low as possible; 22-30 h.p.; revolutions not exceeding 1200 per minute; strong and efficient radiator; gear drive fan and water pump; governed engine; magneto ignition; forced lubrication; strongly designed crank-case; accessibility to all parts needing adjustments; dust-proof ball or roller bearings; gears machine-cut and heat-treated, and of the highest grade material; rear axle of strong design, and front axle sprung and pivoted; two forward speeds and reverse, and efficient brakes on rear wheels for road haulage; fitted with oil filter and air clarifier; adjustable draw-bar, pulley for belt-work, and independent power take-off for direct coupling to machinery; speed and power to drive full-size thrashing machine; facilities for rapid conversion of wheels from farm work to road haulage, and *vice versa*; protection for driver from dust, etc., and a comfortable seat.

(10) For larger farms, especially those on heavy land, the

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general-purpose machine is not so suitable as two separate types: one a heavy tractor for three- or four-furrow ploughing, and the second of lighter design for cultivating, belt-work, etc.

(11) The general-purpose tractor is used for about 300-700 hours yearly, as against 1700 hours or more for the horse. The average cost is about 3s. per hour of work; the corresponding figure for the horse is 5¼d. This comparison does not take into account the extra speed and power of the tractor, enabling it to do more work per hour. On a cost-per-acre basis, where these factors are included, the tractor is cheaper than horses for ploughing, but dearer for all other forms of cultivation.

(12) Where the tractor is given a full load, therefore, its cost of operation compares very favourably with horse-power. The present forms of tractor implements—with the possible exception of ploughs—do not give the tractor a full load, and the practice of hauling implements in tandem—*e.g.* two binders, or harrows following cultivators—is not always possible, and certainly not convenient, with present designs.

(13) At present the tractor finds its chief outlet in ploughing after harvest, spring ploughing and cultivations, haulage of binders and driving of thrashers. It is of the utmost value, especially in times of pressure, and even if the cost of operation were much higher than it actually is, it would amply repay this by its ability to get work done at critical times.

(14) The design of tractor-drawn implements, with few exceptions, has not kept pace with the development of the tractor. This is perhaps the chief factor limiting its more extended use on the farm.

(15) There are suggestions from practical men that the tractor plough should be improved: a two-furrow one-way type is advocated, linked on to the rear of the tractor and not hooked on to the draw-bar. The linkage would have to be such that a reasonably constant ploughing depth was maintained on uneven land. The ordinary skim-coulter also is said to be unsatisfactory. The disc harrow is said to be very suitable for tractor work. The killing of weeds is a most important object in cultivation operations, and if implements were designed with this aim more specifically in view it is possible that the actual number of operations now considered necessary to produce a tilth could be reduced.

(16) The use of combined tools, of the rotary cultivator type, is now well established for light market-garden soils. For ordinary agriculture they are still in the experimental stage. Since the aim of this machine is to produce seed-bed in one operation, the problems of soil tilth are of special importance. The use of a light machine that, with suitable attachments, could hoe and cultivate between the rows of root crops is a possible development of considerable promise.

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(17) The use of the tractor for road haulage of farm produce is, apart from the general question of suitable rural roads, dependent upon (*a*) some simple and rapid attachment for conversion of land wheels to road wheels, or *vice versa*; (*b*) increased speed. Since rubber-shod wheels are practically standard equipment for road vehicles, and since, for land work, a proper grip is essential to prevent slipping and loss of effort, it appears that both rubber blocks, and strakes or spuds, must be provided, in a readily interchangeable form. Although there are some promising designs, they are still in the experimental stage. The track-laying or caterpillar track has not yet found extended favour in this country; neither has the four-wheel drive. The latter is worthy of fresh attention from designers.

Increased speed of work would be of great use for cultivations as well as road haulage. It has been shown that, as far as the soil resistance alone is concerned, the extra draw-bar pull needed increases much more slowly than the speed of work. Although, in addition to this, there would be increased power needed to propel the tractor itself at the higher speed, it appears that the limit of compromise between speed and durability has not yet been reached.

(18) The traditional policy of laying down land to grass in periods of agricultural depression may need revision, in view of the great developments in the imported-meat trade. One alternative would be an intensification, in suitable areas, of arable farming in which special attention would be devoted to vegetable products of a semi-market-garden type, whose culture would call for the extended use of power farming methods.

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