me to make observations which have formed the basis of the present Treatise." The war was to him not merely a sphere for the exercise of his surgical skill, but also an opportunity for observing and studying conditions of which he had hitherto had no experience. What has this war been to the surgeons of the present day? It may truly be said that very many of them, and in all parts of the world, have entered into this work imbued with the spirit of our great master. To them also it has not only afforded immense opportunities of helping their fellow countrymen, but has also provided problems for study and for solution. The spirit has been one of progress and of development, and of unwillingness to rest content with conditions that might be bettered or with methods which proved unsuitable. It is not too much to claim that each year of war has seen better surgical measures devised and consequently better results obtained. The sufferings of the wounded have been lessened, the dangers they run have been diminished, and lives and useful limbs have been saved in constantly increasing numbers. Surgeons have not been content merely to guess at possible answers to the never-ending questions suggested by the complications of war. They have devised new methods to meet new conditions and have put them to the test of experience; and when they have failed they have tried and tried again until they have compelled success.

In this great tragedy of war the Royal College of Surgeons of England has played no unimportant part. Hundreds of its Fellows and thousands of its Members have willingly pressed forward for service. Some of them, like our President, have occupied with credit and honour the most prominent and important positions, and others of them, often less prominent no doubt, have not only given their services, but have also given their lives. The position I have had the honour to hold in the Army Medical Service has afforded me very abundant opportunities of appraising the performances of others, and I am full of admiration both for the skill and ability of our surgeons and for the splendid work done by the Royal Army Medical Corps in rescuing the wounded in conditions of unprecedented difficulty and danger, and in organizing the hospitals for the subsequent treatment and restoration to health of the British soldier.

CAPACITY FOR WORK IN AMPUTATIONS OF THE LOWER EXTREMITY.

BY

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The accompanying diagram is intended to demonstrate in a graphic manner how capacity for work varies in amputations in the lower limb. Textbooks on operative surgery afford little information on this important aspect of a subject which is now an economic as well as an operative problem.

"Capacity for Work."

The term "capacity for work" ought to mean not merely the ability to do a certain class of work, but rather the ability to keep on doing it from day to day. A man's value in the general labour market depends as much on his being able to "keep time" as on the actual amount of work which he can do. In regard to discharged soldiers, this question is put to the medical officer: "By how much is the man's earning capacity lessened by his amputation?" The answer to this question does not depend alone on the length of the natural as compared with the artificial limb, for whilst some low amputations are bad, giving a low capacity for work, other comparatively high amputations are good, allowing the man to become a very efficient and steady worker.

Before considering the special features upon which capacity for work depends, let the functions required of an amputation of the leg with its prosthesis be for a moment considered.

1. *Support*.—This demands an investigation of how the weight of the body is transmitted to the ground through

the natural and the artificial limb. The best form of support is that obtained through a direct end-bearing stump. Indirect or lateral bearings at some time or other cause fraying and ulceration of the skin, and require much more care on the part of the patient if broken time is to be avoided.

2. *Stability*.—This varies directly with the length of the natural limb, and with the length of the segment in which the amputation has been performed. With short stumps the grasp of the socket may not be sufficient, and must be improved by a splice in the form of a laced socket, or in thigh stumps a pelvic band. In some cases stability has to be attained by stiffening of the joints of the artificial limb at the hip or knee, but this interferes with the gait.

3. *Progression*.—This depends on the use of natural rather than artificial joints, good muscular power in the lever which activates the artificial limb, a long lever, and painless bearings. In short stumps we find progression accompanied by fatigue. This could be diminished by decreasing the weight of the artificial limb. The excuse of limb makers that the natural limb weighs much more than the artificial one is really irrelevant, for the muscular power of acting muscles is greatly diminished by disuse, by interference with their insertions, and only a few muscles are effective at all.

4. *Appearance*.—Appearance is of no importance as far as function is concerned. Compared with a limb giving comfortable support, efficient stability, good progression, and lightness, appearance counts for nothing. The French have long since recognized this by supplying a peg leg with a broad base for special workers like farm hands who have to be on foot all day.

Estimation of Capacity for Work.

Having laid down these general principles, what further considerations influence "capacity for work"? They are:

1. The length of the natural as compared with the artificial limb.

2. The specific value of the ideal amputation at the particular level.

3. The type of prosthesis most suitable for the particular stump. Prostheses for some amputations are constantly requiring repairs whilst others last for years.

4. The special conditions which prevail in the case under review—that is, how far the particular amputation falls below the ideal amputation at the same level.

All these points ought to be considered in estimating the capacity for work of a man who has had an amputation in the lower limb. The fourth point will be governed by the disposition of the flaps, position of the scar, the presence or absence of pain, adhesions between bone and skin, condition of joints, and by whether the surgeon has succeeded in obtaining an end-bearing stump. These points will demand consideration in every individual case, and therefore cannot be reckoned with in attempting to map out a curve of "capacity for work" in amputations of the leg in general.

I have tried to represent in a graphic manner the fact that capacity for work does not vary in a regular manner as we pass up the limb, though it will be seen by reference to the graph, and conceded on general principles, that the longer the natural as compared with the artificial limb the greater the capacity for work. The secondary irregularities on the curve are due, therefore, to variations included under heads 2 and 3—namely, the value of the ideal amputation, and the type of artificial limb or appliance supplied for amputations at the given level.

Following the graph from left to right it will be seen that amputation of the great toe is, in my experience, followed by some slight fall in capacity for work, though amputation of the other toes may be performed with impunity, the operation not being followed by diminution in the man's capacity for "keeping time."

With a Lisfranc amputation there is a further drop in the capacity curve, which, however, falls much more with the Chopart operation. The French orthopaedists, especially Trèves, have shown that of all the amputations in front of the ankle the Chopart is the worst. Trèves points out that every centimetre that can be saved in amputations on the foot increases the value of the anterior *point d'appui*, and therefore increases the efficiency.

Graphic representation of capacity for work in amputations of the leg.

An amputation in front of the scaphoid is an improvement on the Chopart; one through the shaft of the metatarsals is better than a Lisfranc, and so on till we reach the toes.

To explain why the capacity curve falls so low in a Chopart amputation we take the two heads already mentioned, and we find (1) that even the ideal amputation interferes radically with the mechanics of the foot by removing completely the anterior pillar of the arch; the scar, at first placed anteriorly, or even above, the ends of the bones, will work its way downwards; the bones themselves are gradually drawn upwards by the tendo Achillis, and this gives rise to an increasing potential equinus, nearly always associated with some varus; and (2) the prosthesis for Chopart's amputation requires very frequent alteration and repair owing to changes in shape of the stump and to the very nature of the prosthesis itself.

With Syme's amputation we find the curve rising abruptly, indicating that the ideal performance of this amputation leaves a stump which is, from the point of view of function, as nearly as possible perfect. It gives (a) a complete and permanent end-bearing; (b) there is a long lever affording perfect stability; and (c) the preservation of the natural knee gives almost, if not indeed quite, perfect gait. The only criticism to be offered is that the artificial ankle, owing to the presence of the side bars, is rather bulky and *disgracieuse*.

Proceeding upwards to the lower third of the leg we find the curve dropping. According to Huggins, an amputation should never be done at this level, because of the atrophic condition of the skin which tends to ulcerate, so precluding the possibility of a good end-bearing. The absence of an end-bearing entails a lateral bearing at the level of the tibial tuberosities with the disadvantages of irritation, blistering, and often sepsis of the skin. The presence of the fibula causes a bunion, often painful, and pressure on the external popliteal nerve, as it winds round the neck of the fibula, will demand at some time or other surgical intervention.

In the middle third of the leg the graph is gradually falling as we shorten the lever till we come to the "seat of election" problematically so called. This point must be regarded as the extreme "limit of shortness" in below-the-knee amputations. The curve above this point rapidly drops, reaching its lowest point in the Stephen Smith disarticulation through the knee-joint. This is decidedly bad as a definitive operation, because (a) a complete end-bearing is never possible; (b) the skin over the condyles is stretched, thin, and very prone to ulcerate, even apart from pressure; and (c) the fitting of an artificial limb is

handicapped by the very shape of the stump, consisting as it does of a large bulb on the end of an attenuated shank.

In the lower half of the thigh there is a gradual fall in capacity for work, dependent on the shortening of the lever formed by the stump. But with a perfect Stokes-Gritti operation there are advantages over the slightly longer Carden amputation, in that it gives a complete and permanent end-bearing, and the presence of a layer of compact bone, rather than a sawn surface, prevents any risk of adhesions between the bone and the skin over it. Above the mid-thigh there is, in addition to shortness, the disturbing factor of the pelvic band, which frequently gets out of order and calls for repairs. Therefore we find a rapidly diminishing capacity for work above this point till the "limit of shortness" in thigh stumps activated by the stump in an ordinary bucket is reached. Huggins lays it down that this point must be not less than three inches below the lesser trochanter. In amputations between this point and the lesser trochanter no satisfactory fitting can be supplied, and they are, therefore, the worst of all amputations, and should never be performed as definitive operations. At the level of the small trochanter it again becomes possible to fit an artificial limb through the intervention of a hip platform. The thigh bone, being flexed by the psoas, does not interfere with the fitting, though an amputation carried through the great trochanter or the femoral neck, or a disarticulation through the hip-joint itself, gives a slightly better result.

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A SPANISH medical mission headed by Professor Martinez Vargas, dean of the faculty of Barcelona, and comprising a number of professors, hospital physicians and surgeons, and heads of laboratories, recently visited the Hôtel-Dieu, Cochin, Saint Louis and Buffon hospitals in Paris, the military medical school at Val-de-Grâce, the Colonial hospital at Nogent, the Spanish hospital at Neuilly, the Canadian hospitals at Saint Cloud and Joinville, the physiotherapeutic services at the Grand-Palais, various laboratories, the Pasteur Institute and hospital, the Edith Cavell school, and the general workshops of the health service. The mission was received by the Société de Médecine, at a meeting presided over by the Minister of Health and attended by representatives of all the medical societies of Paris and the profession of France, and the Allied and neutral countries.