THE SURGEON IN INDUSTRY*

BY

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The development of pure medicine as opposed to surgery in the realm of industry has been in the practice of the science of prevention. It has not been part of the industrial medical officer's work to undertake the alleviation or cure of those ills that are manifest in the personnel. By keeping a careful watch on his wards' health he is able to recognize the first signs of disease. The sufferer is referred to his doctor or to hospital for treatment, whilst the industrial medical officer concentrates on his task of preventing a recurrence of the disease in the establishment, not necessarily in the patient. When the industrial medical officer has dealt with surgical matters it has generally been in developing the technique of first aid for minor or major injuries.

In the last few years, particularly since 1939, a wider range of treatment has been given for injuries and a closer connexion established between the industrial medical officer and the hospital orthopaedic departments—so much so, indeed, that in a few special industries treatment begun in hospital has been continued in the factory by the industrial medical officer under the supervision of the orthopaedic surgeon.

But the general surgeon and other specialists have remained almost wholly out of touch with industry: this raises the query whether or not the time has come when there should be a place in the hierarchy of specialists for the consulting industrial surgeon. Before attempting to answer this question I would stress as emphatically as I possibly can that the meeting-places of industry and surgery are not confined to the realm of traumatology. Whatever the disease condition—whether cancer, colic, or carbuncle—its aetiology and treatment are profoundly influenced by industrial circumstances.

General surgery must be awakened not only to its responsibilities to industry but to the immensity and variety of the opportunities for research and development which it is neglecting. In renewing his contact with industry the surgeon has much to learn and much to teach, and industry and surgery in collaboration have much to contribute to the health and happiness of the nation. In one brief lecture I cannot fully develop the theme—to learn, to teach, to help—and after mentioning certain principles I will try to make my meaning clear by a few examples.

In a Hunterian Lecture entitled "The Treatment of the Injured Workman" I offered the suggestion that, "whereas the criterion of recovery is restoration of working capacity, the goal of treatment is power"—power of performance and power of endurance. In setting himself this goal the surgeon must therefore have a very clear idea of what constitutes capacity for work; what in his patient is the cause of incapacity; how he can set about the restoration of capacity; and how recurrence is to be prevented. These

questions can be answered only after a careful study of industrial conditions and by closest collaboration with industry's personnel.

Prolapsed Intervertebral Disk

One of the greatest disasters that have befallen harassed industry in these latter years has been the unprecedented prolapse of countless intervertebral disks. Once upon a time men strained the muscles in their backs or, catching cold, developed lumbago, and after a few days in bed with loins well rubbed by a dutiful wife returned to work rather ashamed than otherwise of their human frailty. But now every pain in the back is an interesting case fraught with grave risk—to be belt-buckled, plaster-padded, or, glory of glories, explored.

When the surgeon and patient alike have become exhausted by months and months of modern orthodox treatment each and every one of these "backs" is warned of the fearful consequences of muscular effort. Against this particular evil he is given a magic charm—a "certificate for light work." If the compounder of this charm were interrogated he would probably reveal that all he knew of heavy work was that it was something calculated to cause grievous bodily harm and therefore only to be taken in very small doses.

In this subject, as in so many others, it is apparent that clinical medicine is out of sympathy with industrial requirements and accomplishes little in bridging the gulf between the labour manager with his insoluble problems of placement and the disk-contented surgeon with no problem of placement. It is for this reason that I have chosen the subject of the fashionable and errant nucleus pulposus as my illustration. I do not propose to dwell on methods of diagnosis or treatment, but only to examine the possibilities of bridging the gulf.

The span of this bridge must be erected on two foundations—on the one side of the gulf "Why?" on the other side "How?" The surgeon, with the help of his industrial colleagues, must determine why the injury occurred; and industry, helped by the surgeon, must determine how it is to be avoided.

Why the Injury Occurred

In those cases of prolapsed intervertebral disk in which working conditions may fairly be stated to have played a part it will generally be accepted that the precipitating cause of the prolapse was injury. An investigation of a number of cases in which I have felt that the diagnosis was established and in which trauma was a factor has convinced me that the prolapse has occurred when the back was bent and the sufferer was making a voluntary effort to straighten it against resistance. The resistance is nearly always applied indirectly through the arms and is manifest in an attempt to lift. Herein lies the essential difference between the mechanics of the fractured vertebral body and

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the prolapsed intervertebral disk. In each the critical position is one of flexion of the spine; but the fracture of the vertebral body is produced by forced overflexion, and the prolapse of the intervertebral disk by extension and rotation against resistance. The injury occurs in both at the site of the maximum movement during the maximum pressure. In a typical example, a man is standing in a slightly stooping position when a heavy weight falls on his shoulders, forcing him forwards, overflexing the spine, and causing a crush fracture of the first lumbar vertebra; or, alternatively, the weight misses the man and he stoops, inclining slightly to one side, grasps the weight with both hands and strains to lift it, thus extending and rotating the back, and suffers prolapse of the disk between the fifth lumbar vertebra and the sacrum.

At once it is apparent that the commonest sites for the bone and disk lesions are at opposite ends of the lumbar spine. There is an equally obvious difference in the method of their production. The force producing the bone injury takes the patient by surprise; in the disk injury the force is deliberately produced by voluntary muscular effort.

In those rare instances of fracture of the body of a lumbar vertebra in which the force is applied relatively slowly, as when a man is standing with his back to a stack of bales which collapses, gradually forcing him downwards, the injury is found most frequently in the fourth lumbar vertebra. In this case the man has just had time to brace himself to resist the force before overflexion of the spine has occurred. From this example it will be seen that the lower part of the lumbar spine is vulnerable to both flexion and extension strains when the victim is aware of the traumatizing force, and the upper part of the lumbar spine is vulnerable when he is taken unawares.

If a healthy individual is asked to bend and touch his toes and recover to the erect position, he will be found to maintain regular breathing, probably exhaling during bending and inhaling on straightening the back. But when a man is asked to raise a heavy weight he bends freely but rises against the resistance of the lifted weight. In these circumstances the man usually exhales bending; then there is a preliminary intake of breath, the breath is held at the initiation of the lift, and is released after inertia has been overcome and the movement of extension of the spine has begun.

When the body is braced for a big effort, as lifting a heavy weight, the shoulder girdle is fixed by the external respiratory muscles and the breath is held. The diaphragm is firmly fixed, and this is possible only when the bony attachments of its crura are stationary. The first three lumbar vertebrae are therefore held immobile and movement of the lower back, whether of forced flexion or of voluntary extension, occurs first in the lower lumbar region.

The man who was slowly forced to his knees by the collapsing stack of bales braced himself to resist the overwhelming weight, and, although he succeeded in fixing and therefore preventing overflexion of the first three lumbar vertebrae, suffered fracture of the relatively movable fourth. In the case of the man who attempted to lift the weight, the first three lumbar vertebrae were also held immobile at the initiation of the lifting strain, and the movement of extension occurred between the sacrum and the fourth lumbar vertebra, thus causing maximum pressure on the lowest two disks in the lumbar series.

The mechanism of production of the prolapsed disk as I understand it may be summarized in four stages: (1) Positioning: flexion of the whole lumbar spine with the separation of the posterior contiguous margins of the neighbouring vertebrae. (2) Preparation: fixation of the upper three lumbar vertebrae in flexion. (3) Overcoming

inertia: direct pressure on the lower disks, causing them to bulge slightly beyond the posterior margins of the vertebral bodies. (4) Raising: extension and rotation of the fourth and fifth lumbar vertebral bodies, causing the posterior margin of the bone to nip the bulging disk in a grinding movement with maximum pressure exerted to one side of the midline according to whether the man is inclined to the right or to the left.

It is often very difficult to obtain from a patient a coherent account of the mechanics of his injury. In many cases the workman has "thought back," and his account is no more than an imagination piece. It is essential, therefore, that investigation shall be carried out on the spot and not from the hospital notes. In these notes it is often recorded that the patient strained his back while lifting but never that at the initiation of the movement of lift the spine was in the position not only of flexion but also of slight rotation and lateral flexion, and that in rising the spine was therefore brought back to the straight position by a corkscrew motion.

How to Avoid the Injury

Obviously this leads to the conclusion that there is one particular type of strain that produces the prolapse of an intervertebral disk and, conversely, that it is nonsense to suggest that all heavy work places the nucleus pulposus in jeopardy.

Can the dangerous strain be eliminated or circumvented? Industry already has something to offer by way of solution. When the nature of the work renders back strain particularly prevalent methods have been adopted by custom which have been found to minimize the risks. One of the best examples is that of the coal-miner lifting a tub. The inexperienced man would risk straining his back each time he attempted its performance. Imagine him facing the tub, stooping with back well bent, putting his hands beneath the chassis, straining to lift, and inviting a disk injury. Generations of miners have learned to avoid this risk by the simple expedient of turning the back to the tub and lifting with the hands behind them. In this position the knees can be well flexed. The lumbar spine is held immobile until the actual lift has been initiated by the thigh muscles, and it is only when all the lumbar spine is mobilized by the release of the respiratory muscles that the back is somewhat straightened.

Individuals occasionally learn tricks which afford them some protection from recurrence of their symptoms. A mine-worker (a pan-turner) found that he could avoid pain if all his lifts were made in two stages: he would lift a short distance and then, after a moment's pause, complete the lift. After watching him at this manoeuvre I was able to satisfy myself that the initiation of the lift movement was produced solely at the hip and knee with a completely fixed spinal column and with the breath held, that during the momentary pause breathing restarted, and that full recovery to the erect position took place with even movement of the spinal column, thus distributing any strain upon the disks.

But industry's method of selection, by trial and error, of suitable work for the "back" case is obviously unsatisfactory, and a scientific approach through careful physical functional analysis both of the man and of the machine offers the only practical solution to successful placement. There are three main lines of research.

1. *How to Prevent Threatened Injury in the Performance of a Specific Act.*—The majority of back strains will be avoided if the workman is properly instructed in the art of lifting. Inertia should be overcome and the movement of lifting initiated by the thigh muscles; but if the workman is so placed that he is unable to bend his knees when stooping to grasp the

weight, the lift is initiated through movement at the hip and spinal joints.

2. *How to Avoid the Act which is Calculated to Cause Injury.*—It may not be easy to place in a heavy gang a man wearing the label of light work, but there should not be the same difficulty about placing him in the heavy gang with instructions to the foreman that, although he should do his full share of hard work, he should not be employed in lifting from knee level or lower. Many a man who has suffered a prolapsed intervertebral disk could resume his work at machine or bench without symptoms or fear of relapse if objects which he previously lifted from ground level could be stacked at a height of from two or three feet (60 to 90 cm.).

3. *The Correct Selection of Personnel for the Specific Act.*—At present selection tests are used by the industrial psychologist to determine both adaptability and accident proneness. The anatomist has also made a selection of types that are able to perform certain specialized manœuvres more readily and more efficiently than others. This method of selection was used in

perfection in treatment could be obtained only at the sacrifice of human form.

At the age of 15 a boy had his right hand severely mangled in machinery. The first, second, and fourth fingers were lost at the time, the skin was stripped from the palm and from the remaining half of the third finger, the thumb was split and its metacarpal shared the fate of the others in the hand—being splintered. It was decided to rebuild the hand by plastic surgery. The first stage after cleansing was to bury the hand in the abdominal wall to secure the necessary skin flaps. This was successful, and gradually the process of reconstruction went on. Operation succeeded operation; the stump of the third finger was covered with skin, the second metacarpal was excised, a rotation osteotomy was performed on the fourth metacarpal. Three years went by, during which this boy alternated between the squalor of a city slum and the relative splendour of a lavishly equipped country hospital. Now he possesses something which resembles in appearance the congenital "lobster-claw" hand: one claw is immovable and insensitive, the other

FIG. 1

FIG. 2

FIG. 3

FIG. 1.—Lumbar spine in the act of raising a weight with the breath held, showing upper three lumbar vertebrae fixed in flexion but the fifth lumbar vertebra extended with backward tilt on to the sacrum, tending to nip the disk. FIG. 2.—Same as Fig. 1, centred over the fifth lumbar vertebra. FIG. 3.—The same lumbar spine as Fig. 1, rising to exactly the same position but with the diaphragm free and showing even spacing between the fifth lumbar vertebra and the sacrum.

the war for picking naval anti-aircraft gunners. But no detailed research has yet been undertaken to determine accident proneness in relation to physique and particular function. It has, for instance, been stated that the long thin type of man represents the "disk" type—i.e., that these individuals are prone to prolapse of an intervertebral disk. But this is certainly not borne out in the cases that I have seen, which include tall and short, slim and burly. It is not impossible that some relation may be found between the length of reach and the patient's height which may have a bearing on the problem. Perhaps a matter of some interest is that in cases of sudden prolapse of an intervertebral disk it is unusual to find x-ray evidence of other changes in the vertebral column. The buttressing of the vertebrae, sometimes spoken of as hypertrophic osteoarthritis, which is found in the spinal columns of many men who have undergone years of heavy work, is seldom seen in these cases.

With "Why" and "How" established, and the foundations well and truly laid, only the span of good will is necessary to bridge the gulf.

The Surgeon's Lost Touch

Surgery's lost touch with industry has been responsible for much unhappiness and much disability by concentrating on local morbidity instead of on general function. The surgeon seeks perfection in treatment, and his first concern is to restore the mutilated human body to conformity with accepted standards. But if he were to keep steadily in his mind that the ultimate aim of treatment is restoration of capacity for work it would sometimes be found that

has feeble and tremulous movement, though so restricted in range as to be quite useless. A sheet of paper placed between the claws flutters away to the ground; a pencil can be thrust between them and held but not grasped. The young man is now attending the physiotherapy department of the city hospital, marking time before readmission to his "country residence" for the next operation in the series.

Now what of the patient himself? He was of fairly good physique, now rather run to fat, but, as his father puts it, he is "no scholar." School, in fact, "did not agree with him," and his entry into industry at the age of 14 marked for him escape from the thralldom of uncomprehended letters. He was eager to declare his manhood, to "muscle in" with his fellows into the strife that was his birthright. Three long years have now gone by, three years of daily contemplation of a pitiful and puny limb, hideous alike in its appearance and in its uselessness. Had that hand been amputated at once a modern prosthesis would have enabled the boy to return to his work in a few weeks, still rejoicing in his strength and brim-full of the enthusiasm of youth. But now what is left but a tale of lost incentive, lost interest, and lost opportunity?

Choice of Treatment

Perhaps the selection of the right form of treatment for the individual patient needs a wider knowledge and a greater experience than any other of the surgeon's duties. One of the most important considerations in restoring working capacity is how long the patient can afford to be away from work without suffering such loss of skill, dexterity, or training as will render him temporarily or permanently

unfit for his pre-accident work although the treatment for his surgical condition has been apparently successfully concluded.

The time factor is of importance in the selection of treatment, but of even greater importance is the patient's own psychology. In the case of the boy with the mutilated hand, a psychological study would have revealed at the outset that his happiness and success in life depend upon his ability to perform simple tasks requiring muscle work but a minimum of reasoning power or intellectual effort. He is not of the type that absorbs instruction easily or is able to profit by lessons in craftsmanship. He belongs essentially to that class of worker designated unskilled labour. Had he been of a different type, of average or more-than-average intellectual capacity, the long years of treatment might have been devoted to preparatory training for some skilled trade or profession, greatly to his and the community's advantage. But for this boy these years were obviously wasted and little could be done to mitigate the bitterness and frustration of thwarted ambition.

After selection of the type of treatment to be given there may still be a variety of different ways of carrying it through. For example, if the patient is suffering from thrombo-angiitis obliterans the selected treatment may be resection of the lumbar sympathetic ganglia, but there are two different methods of surgical approach to the ganglia. First the transperitoneal method through a midline or paramedial abdominal incision; and, secondly, the retroperitoneal method through the loin. This latter is undoubtedly the easier operation to perform, but the risks and difficulties of the former may be justified in certain cases in which section of the loin muscles is likely to interfere with capacity for work. This is but one of many examples in which the surgeon's choice is no more than a guess if he remains in ignorance of industrial conditions.

In theory there can be no difference between the relative importance of treatment for different diseases and different injuries. Each and every one is a challenge to the surgeon, to be met with all the skill and resource at his command. But in practice it has long been the custom to differentiate between major and minor injuries and also to make similar distinction between diseases. The skilled surgeon has tended more and more to restrict his activities to the treatment of selected groups of cases and to delegate to his less experienced colleagues the treatment of minor maladies and minor injuries.

Now this modern surgical perspective is the result of the intrinsic study of morbidity coupled, it is to be feared, with the necessity for the reward for labour. Contact with industry, with its demands for man-power and man-hours, will force the surgeon into a new perspective. The treatment of fractured necks of femurs is not the most important thing in life. In terms of human suffering and human happiness fractured fingers must take pride of place. The fractured femur is a rare occurrence in industry, and if every case became a total loss this would represent only a tithe of the loss and suffering occasioned by the thousands of fractured fingers which occur each year. I am not going to suggest that the fractured femur must be neglected for the fractured phalanx, but that equal care and skill shall be lavished on both. The function of the femur is to sustain the body weight, and the surgeon need seldom modify his technique in treatment to meet industrial requirements. But the function of the finger is far more complicated, and no surgeon can attempt to make the best of his treatment unless he is cognizant of the full industrial requirements of the injured finger. It may be that there are fractures of the proximal and middle phalanges of the little finger with involvement of the first interphalangeal

joint. In such an injury it is not improbable that ankylosis would occur at the damaged joint. If the joint were fixed in extension instead of semiflexion the patient would be handicapped in the performance of such work as required the maximum span of the hand—e.g., use of a lever. But this position of the little finger would not incommode the mannequin, who might be seriously inconvenienced by the little finger fixed in semiflexion because of her inability to put on gloves without splitting them.

In dealing with the choice of treatment and its method of performance I have touched only on the surgeon's immediate responsibilities as they are reflected from industry, but to bring treatment to a successful conclusion much closer contact is necessary. In cases of accidents to the industrial worker it might fairly be stated that *treatment starts before injury*.

The Five Fears

In dealing with the problem of the treatment of the injured workman I must stress the importance of the elimination of the five fears—fear of pain, fear of deformity, fear of financial hardship, fear of industrial degradation, and fear of litigation. The elimination of each one of these fears is the direct concern of the surgeon, although the final responsibility may rest elsewhere. Fear is conceived in ignorance and is dispelled by knowledge. And if propaganda, precept, and example are made to play their proper part much of the fear of injury may be eliminated. If every potential patient is convinced that his particular injury will be the especial care of a surgical specialist, that during the time of his sickness and convalescence he and his family will be properly cared for, that his future will be assured and he will not be lost in that backwater of unwanted men, light work, and that he will not have to spend weary months in straitened circumstances fighting for what he believes to be his right, then indeed treatment will have started before injury.

Co-operation in Treatment

To secure this happy state team work is necessary and may be accomplished only if the yoke of responsibility is shared by the managing director and the hospital consulting surgeon. The armies mobilized in the battle against disease and injury are as much in need of direction from a unified command as ever were the armies engaged in internecine warfare. To this end, then, the influence of the hospital surgeon must pervade every phase of treatment—starting within industry, continuing in home or hospital, and being carried through to its conclusion again in industry. In fact, he must become not only the surgeon in hospital but the surgeon in industry.

The design and equipment of the factory surgery must be a matter of prime concern to the consulting surgeon, whose ultimate responsibility is the treatment of patients who pass through that surgery to hospital. Unless the treatment carried out there is in exact conformity with his ideas of hospital treatment, the surgeon may find himself fighting a rearguard action in the face of infection and deformity instead of continuing the general advance towards full recovery. As a simple example—a guillotine amputation of the pulp of a finger may best be treated by an immediate skin graft, but if the finger has been soaked in strong antiseptic, a familiar form of treatment in many surgeries, the chance of a successful grafting in hospital is very much diminished.

Whereas the factory doctor's consulting-room must be the centre of the teaching and practice of pure industrial medicine, the factory surgery should be an outpost of the hospital. Its personnel, medical officers and nurses, must follow the same routine in treatment as their colleagues in

hospital, and this of course is possible only if the two departments are in constant touch with each other. During the last war the Medical Director of the Ministry of Supply, who was responsible for industrial health in the Government Ordnance Departments, arranged that medical officers and nurses from the factory surgeries should attend courses at a selected hospital in order to keep them in touch with those methods of treatment that were acceptable to the consulting surgeon who, under the Director, was responsible for the treatment of injuries. Similar liaison between the consulting surgeon and the department of the industrial medical officer is essential throughout industry if the optimum treatment is to be afforded to its personnel.

But if the benefits of this close co-operation between the surgery and the hospital are not to be nullified in the case of the injured, still earlier precautions must be taken. Someone must make a stand against the tyranny of tradition, and, as surgeons are not usually lacking in courage, let the consulting surgeon be the first to defy the law and burn the first-aid box.

Rehabilitation

Now after the first stage of surgical treatment is over, further treatment is concentrated on rebuilding the general health and physique of the patient and in restoring and perhaps retraining his muscles to enable them to meet the requirements of his daily work. In many cases the immediate return to pre-accident work is made possible because of the surgeon's particular knowledge of the job and his willingness to modify his treatment to meet its requirements. As a simple example, a waterproof dressing on an injured finger worn during working hours may be sufficient variation from hospital routine. In some cases the later phase of treatment is carried out in the so-called rehabilitation departments of the hospital—or, when the industry is large enough and where the directorate is sufficiently informed, in the rehabilitation department of that industry. In other cases rehabilitation is best given by returning the patient to alternative work under the supervision of the industrial medical officer.

Aim of Treatment

Treatment in a rehabilitation department may take the form of diversional exercises, occupational therapy, or vocational therapy, but the aim of treatment is the same—restoration of the ability to perform certain manoeuvres with the strength, speed, and dexterity with which they were performed before injury. The surgeon will be failing in his duty if he does not inquire as carefully into the nature and duration of these exercises as he would into the circumstances of treatment of the more acute stages of disease. In hospital one all too often sees mixed classes of workmen engaged upon routine exercises, some of which are calculated to retard the recovery of the individual rather than to promote it. The selection and development of types of exercise for particular jobs are as important as is the selection of exercises for particular injuries and diseases. The majority of work is an athletic pursuit, and the prescribing of routine exercises for rehabilitation for all work is as likely to be successful as would be uniform training for a boxer, a professional golfer, and a boat-race crew.

In industry rehabilitation may be carried out in the rehabilitation workshop. This is nearly always a production unit whose output is essential. The unit, however, is run under sheltered workshop conditions and under the direct supervision of the industrial medical officer. It contains machines that are adapted to meet the requirements of specific injuries, and various bench jobs which provide such special exercises as may be prescribed. Here are

machines incorporating in their design special devices for inducing specific joint or muscle action not necessary for normal production.

In general, extremely good results are obtained by the intelligent use of the rehabilitation workshop, but there are many pitfalls. One that is not uncommon is the over-exercising of joints by means of gadgets which necessitate a wider range of movement than is demanded by the patient's normal job. For example, a lever that can be fully operated only by producing eighty or more degrees of dorsiflexion and palmar flexion of the wrist may be ideal in redeveloping suppleness and muscle control in the typist or pianist but is calculated rather to retard recovery in the case of the heavy labourer whose normal wrist excursion may be reduced to some thirty or forty degrees. It must always be remembered that the greater the power demanded of the muscles crossing a joint the less is the range of movement in that joint.

Skilled work is all built up of conditioned reflex actions operating along well-beaten nervous paths. Injury and disease tend to interrupt those paths, and their redevelopment may be facilitated by the choice of suitable exercises calling forth the same co-ordination of eye and brain and limb. Conversely, an exercise that is calculated to cut across the chosen reflex path will delay the recovery of skilled action. The lower the reflex arc in the nervous system the less the fatigue from its accomplishment. It follows, therefore, that maximum benefit with the minimum fatigue will be obtained from exercises which are based upon fundamental reflexes or simple conditioned reflexes. Rhythm must never be neglected, and complicated exercises which call for independent use of each arm and each leg, and which ignore such elementary laws as that of negative successive induction, cause unnecessary mental and physical strain and obscure still further the paths of old-established conditioned reflexes.

Enough has already been written on the advantages of the exercise of selected work over treatment by massage and physiotherapy, but the pendulum must not be allowed to swing to the other extreme: both massage and physiotherapy are invaluable in treatment. But it is still a debatable point whether they belong essentially to the hospital department or whether they should be carried into industry. Undoubtedly selected cases are enabled to continue at work because of a few minutes of special treatment that may be available at their place of employment. An example of this is the wax bath, which helps to loosen up stiff fingers in very cold weather.

Unfortunately it sometimes happens that from the very start of treatment the surgeon knows that it will be impossible to return the patient to his former method of work. In such circumstances it may be possible for him to develop alternative function; and here again nothing but a profound knowledge of industry or industrial conditions will enable the surgeon to plan his treatment ahead.

I have already pointed out one of the risks of exercises which are calculated to produce an extreme range of joint movement, but in selected cases they have a definite place in treatment and in the development of alternative function. An example of this is the production of extra movement in the left wrist of the plasterer who as a result of an old injury has limited extension at the elbow. Extreme wrist movement might enable him to accomplish that smoothness of finish to a ceiling which is usually produced by rotation of the forearm and shoulder with the elbow fully extended.

Further Collaboration

It is now necessary to examine the possibilities of further collaboration. In the case of very large factories employing

thousands of men and women it may be possible to arrange for the surgeon to meet the industrial medical officers and executives regularly there in consultation and see for himself the conditions in which disease and accident arise and follow through the results of his treatment from rehabilitation shop onwards. The majority of industrial workers, however, are employed in small units, and obviously all cannot be visited weekly or even monthly; the surgeon may therefore have to be content with a general knowledge of work and working conditions, but he must always be prepared to make a special investigation when the health of his patient demands it.

As I have intimated earlier, the benefits of the liaison of industry and surgery are not limited to the physical health of the industrial casualties. Together they have much to contribute to the general happiness of mankind, together they may be called upon as the guardians of the public weal.

Of the "five fears" the fear of financial hardship was the first the legislature attempted to relieve. Attempts have now been made to banish the fear of litigation. Last year new workmen's compensation laws were introduced in which the responsibility for the payment of compensation devolved upon the State. When England first introduced workmen's compensation to the world it was a genuine attempt to secure for the injured workman a subsistence allowance during the period in which he remained incapacitated for earning. The payment of his weekly compensation bore a definite relation to his earning capacity and therefore operated as a true, although often insufficient, subsistence allowance. The new workmen's compensation laws ignore the principle of earning capacity and base payment upon the physical standard of the average man. Thus if a workman loses a foot it is calculated that his physical standard has been reduced by 30%, and after a limited number of weeks of benefit he becomes entitled to a pension of 30%. If his work be clerical he may still earn his full pre-accident wage and enjoy the additional pension for his physical injury. But what if he be a stevedore with no prospect of returning to his work? The memory that in former times he would have been entitled to 100% workmen's compensation until such time as his weekly pay-packet came within measurable distance of his old earnings can only plunge him into a more profound state of misery and fear.

I am not proposing to argue whether the principle of workmen's compensation is right or wrong or, indeed, whether it is an anachronism in these days of national insurance; but when the law was being altered it was the duty of the surgeon to point out that, far from allaying the patient's fear, this fear of financial hardship was likely to operate still more effectively in retarding the recovery of his patients. Who but the surgeon can assess that fear, and who but he has the knowledge and the authority to point out the absolute ineffectualness of basing workmen's compensation upon the average man? The "average man," conceived and born in Whitehall, is neither tinker, tailor, soldier, nor sailor; in fact, this average man has never done a day's work in his life, and yet he is set up as the 100% standard by which the casualties of industry are to be judged and pensioned.

The voice of the Royal College of Surgeons should have been raised in protest; it should have thundered at Westminster and reverberated throughout the land. Instead it remained silent. Was it silent through ignorance of industrial conditions, or could it have been that it did not recognize its responsibilities?

I have endeavoured to show that in the proper understanding and performance of his work the surgeon must maintain a close alliance with industry; that his patient's

welfare and happiness are as necessary to the successful conclusion of treatment as is the application of his operative technique; that all the treatment he has to offer is both empirical and incomplete unless he studies to understand the conditions of his patient's work and the physical strains which are involved; that the greatest benefit he has to bestow on his patient is that independence of spirit that can come only with the power to work on equal terms with his fellows; that he has a duty to place his expert knowledge at the disposal of industry for the better organization of its work and the disposal of its man-power; and, finally, that the hospital and the factory are but small parts of the world that mark the sphere of his influence.

I now repeat my question—Is there a place in the hierarchy of specialists for the consulting industrial surgeon? I leave you to supply the answer, remembering that in this age of social service industry is the threshold of social surgery.

5,000 CONSECUTIVE DELIVERIES WITHOUT A MATERNAL DEATH DUE TO PREGNANCY

BY

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In the Halifax Municipal Obstetric Service there were between Sept. 12, 1946, and Oct. 5, 1948, 5,000 consecutive deliveries after the twenty-eighth week without a maternal death due to pregnancy. This number includes all women after the twenty-eighth week of pregnancy (a) who were admitted to the Halifax General Hospital from inside or outside the borough, whether to the general medical and surgical wards, the maternity department, or the special unit for the reception of septic cases, and (b) who were delivered in their own homes by the Halifax Domiciliary Service or independent midwives. It will be seen from this that the cases are drawn from the widest possible sources. No emergency has ever been refused admission. In this series there was one death from acute myeloblastic leukaemia and therefore not attributable to pregnancy.

Rufus Thomas (1940a) described the Croydon Obstetric Service and published the magnificent series of 3,144 consecutive deliveries conducted by this service between Jan. 3, 1938, and June 4, 1939, without a maternal death due to pregnancy. In this number there were two deaths—one from pneumococcal pneumonia and therefore not counted as a death due to pregnancy, and the other from post-partum haemorrhage on June 8, 1938 (Thomas, 1940b). This case was considered to be outside the scope of the paper, as the patient had been delivered at home by an independent midwife and admitted after delivery. It was and, so far as I know, remains the largest consecutive number of cases with the lowest maternal mortality ever reported in this country or any other. This was indeed safe obstetrics, and with Croydon as a model and Thomas's work as inspiration it has been my personal ambition and the object and policy of the Halifax General Hospital at least to equal this achievement. Although the Croydon figure has been exceeded in Halifax by 1,856 deliveries it must be remembered that Thomas did not have the help of the later and more effective sulphonamides, blood and