and circumference to the area of radiation of each of my needles. The size of these blocks of wood represents an area of 1 cm. in all directions. By arranging these blocks of wood I can estimate very nearly the number of needles I shall require, their position, and their distances from one another.

FIG. 3.—The second tier of needles arranged at right angles to those in Fig. 2, and the position of the needle in the central position among the upper ducts.

Figs. 2 and 3 represent the position of the needles in a recent attempt I have made to radiate the whole of a large breast that contained an inoperable carcinoma. The breast was so large that all my needles were employed upon the breast alone. The disease that had spread into other regions was radiated at a later time. As experience proceeds I am more and more tempted to fix the position of the needles by a preliminary insertion of cannulae. Fig. 2 represents the distribution of the bottom layer of the blocks, and Fig. 3 the distribution of the upper layer and the position of the needle inserted via the nipple (see B, Fig. 1). The blocks representing the distribution of the needles to the tumour in the breast are not shown.

Turning to interstitial radiation alone in the treatment of an excisable carcinoma in the breast, the problem seems to me to resolve itself into two chief questions: (1) Can a whole breast be efficiently radiated by this method? (2) Will time prove whether the regressions of the tumours are permanent?

Turning to the treatment of an excisable tumour, there can be no doubt that the properly conducted operation removes the disease, the breast, and a great deal more tissue than is necessary if the disease be completely limited to the breast, a state of affairs that is unrecognizable clinically. So far as subsequent microscopical examinations, together with clinical histories, can prove the existence of such localized carcinomata, I consider that tumours of this kind have been completely excised.

Finally, I desire to pay my tribute of gratitude to the pioneer work of Mr. G. L. Keynes,⁷ to which I have already alluded, and to the work of the staff of Westminster Hospital.⁸ I owe Dr. W. Cramer my thanks for his kind assistance in the experimental evidence contained in this article.

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THE MECHANISM AND TREATMENT OF PROSTATIC OBSTRUCTION.*

BY

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THE French urologist Legueu recently remarked that in the domain of urology the mechanical element plays an unimportant role, and that it is to the dynamic element that we must devote our attention if we wish to understand why an organ has ceased to function satisfactorily. There is no better example of this than that supplied by a study of the pathology of hydronephrosis. For years we have been trying to explain cases of hydronephrosis mechanically, and often we have been sorely puzzled because, although we could find a mechanical obstruction to the passage of urine in a great number of cases, there were others in which, search as we might, no obstruction could be discovered. Abnormal renal vessels, adhesions around the ureter, and ureteric strictures were pressed into the service without avail; there still remained cases of hydronephrosis that could not be explained. And then, with a change in our mental attitude and an increase of refinement in our methods of examination, it became apparent that the structural alterations in the kidney, known as hydronephrosis, might be the effect of a disordered function of that organ. By pyeloscopy it was shown that a disturbance of the peristaltic reflex, that propels the urine from calyces to pelvis, and pelvis to ureter, might lead on to the development of a hydronephrosis, and that, in the words of Legueu, dynamics rather than mechanical obstruction explained its etiology.

It has occurred to me that it might be interesting to apply the lesson that we have learnt from hydronephrosis to the study of prostatic obstruction. Is it possible that in addition to the mechanical there is also a dynamic or neurogenetic factor in the causation of retention following prostatic enlargement? The subject is too intricate to allow of its full discussion in this short paper, but it will nevertheless be of interest to touch on a few salient

points. As an introduction it will be advisable to deal first with the mechanical theory of prostatic obstruction.

The Mechanical Theory.

On one point all authorities agree—namely, that no relation exists between the degree of enlargement of the prostate and the severity of the symptoms it occasions. Formerly an attempt was made to explain this anomaly by blaming the middle lobe. It was said that when retention was caused by a prostate which on rectal examination felt only slightly enlarged, the retention was the result of a hypertrophied middle lobe that was pressed down on the internal meatus in the manner of a ball-valve. But a more careful study of cases of prostatic obstruction has shown that the middle lobe is of less importance than was formerly supposed, and that in a great many cases of retention it does not exist. Moreover, as Swift Joly has pointed out, the type of micturition that occurs when an undoubted ball-valve exists, say, in the shape of a pedunculated papilloma growing at the bladder neck, is quite different from that observed in cases of prostatic obstruction. In these true ball-valve cases micturition is either impossible or else unimpaired; there is never, as with prostatic enlargement, only a moderate degree of difficulty.

The ball-valve explanation of retention being unsatisfactory it is necessary to find another. Many theories have from time to time been put forward, but to my mind the most satisfactory is that published by Swift Joly in the *Proceedings* of the Royal Society of Medicine of 1923-24. This theory aims at explaining the retention that follows enlargement of the prostate by the ordinary laws of hydrostatics, but in order that it may work two conditions must be present. The first condition that must be satisfied is that there exists an intravesical projection of the growth which raises the internal meatus above the level of the bladder base; the second, that the tissues are sufficiently soft and free from infiltration to allow of their being moulded by slight alterations of intravesical pressure. Granted these conditions, Swift Joly explains retention by the action of urinary pressure on the intravesical projection. He points out that the increase of pressure caused by contraction of the bladder is exerted at right angles to its walls. It is therefore directed downwards and inwards towards its axis—that is to say, towards the

* A paper read before the West Lancashire Branch of the British Medical Association.

urethra. This pressure can be resolved mathematically into two components—a horizontal and a vertical, the horizontal acting at right angles to the course of the urethra and the vertical parallel to it. The horizontal component is directed from all sides towards the upper part of the urethra and tends to close this tube. In Swift Joly's words, "It has exactly the same effect as if an elastic band was stretched round the intravesical projection of the prostate, and the amount of compression that the urethra sustains is directly proportional to the tension and thickness of the band, and inversely proportional to the resistance of the prostatic tissue to distortion." The constricting force, of course, depends on two factors—namely, the intensity of the intravesical pressure and the size of the intravesical projection.

So far we have considered the intravesical projection in its simplest form—namely, as a cone-shaped swelling with the urethra opening at its apex. But this is not the usual form of intravesical prostate. As a rule the urethra opens into a hollow in the cone, which Joly aptly likens to the crater of a volcano. Now since there is fluid on each side of the rim of this crater the constricting force is partially balanced by the presence of the fluid within the crater itself. It is therefore only the closed urethra below the level of the crater that is subjected to the full action of the constricting force. For this reason the effectiveness of an intravesical projection in causing retention depends on the height of the closed portion of the outlet (see Fig.).

FIG. 1.

FIG. 2.

Swift Joly's Theory of Prostatic Obstruction.

FIG. 1.—Intravesical projection, open variety.

FIG. 2.—Intravesical projection, closed variety. A, Longitudinal component acting along urethra. B, Transverse component acting across and compressing the urethra.

Swift Joly's ingenious theory of the mechanism of prostatic obstruction explains many of the anomalies we encounter. It helps us to understand why the size of the prostate is of so little importance compared with its form, and it does this without having recourse to a middle lobe. It also shows that it is the height of the intravesical projection that is the important factor in the production of difficulty, and more particularly the height of the "closed" portion of the projection. If the lobes of the prostate are separated by such deep clefts that much of the intravesical projection remains open, the greater part of it will be ineffective and little difficulty will result. If the bladder outlet is surrounded by a continuous ring of prostatic tissue and is easily closed by lateral pressure the difficulty will be great.

Will Joly's mechanical theory of prostatic obstruction explain all the cases we meet with in practice, or will it be necessary, as Legueu asserts, to fall back on a dynamic factor? Before attempting to answer this question it will be advisable to describe as briefly as possible the dynamic theory of prostatic obstruction.

The Dynamic or Spasm Theory of Obstruction.

As long ago as 1902 Janet called attention to the fact that the act of micturition is subject to certain inhibitions that may be regarded as normal. It is well known that to a man with the penis in a state of erection micturition is impossible. This is not due to the fact that the prostate is congested and swollen (there are many conditions associated with congestion of the prostate in which micturition is only slightly interfered with), but to a spasm of the sphincters and an inhibition of bladder contraction. In addition to this genital inhibition there exists also a reciprocal inhibitory action between the bladder and the rectum. A loaded rectum causes difficulty in micturition, and, conversely, a distended bladder difficulty in defaecation,

the action being through the central nervous system, and not, as has sometimes been supposed, by direct pressure. These reciprocal inhibitory actions are normal phenomena, and serve to illustrate how easily micturition may be rendered difficult or impossible by the action of afferent impulses on the centres in the cord. Li Virgli, who is the chief exponent of the dynamic theory, has made use of these inhibition phenomena to explain the difficulty in micturition that is associated with an enlarged prostate. To him the enlarged prostate is the starting point of afferent impulses which produce reflex spasm of the internal sphincter. According to his view the retention produced by prostatic enlargement could be cured by any procedure that threw out of action the sphincter, even if it left the prostate *in statu quo*.

When we examine this spasm theory critically we find it difficult to accept as a complete explanation of the retention caused by prostatic enlargement. In the first place, the retention of hydronephrosis, with which we started, does not provide a true parallel to that which accompanies enlargement of the prostate. In the case of the kidney no mechanical explanation of the dilatation of the renal pelvis is available, whereas for the bladder we have a satisfactory theory of obstruction. Moreover, as Joly has pointed out, a persistent spasm of the bladder sphincter should lead to organic changes in that structure which have not been found to be present. The spasm theory is merely an attempt to provide an explanation of certain anomalies for which we have already obtained a satisfactory explanation along mechanical lines.

But although spasm cannot alone be responsible for the retention of prostatic enlargement, it may still be regarded as a contributory factor in its production. Everyone who has had under his care a patient showing signs of prostatic obstruction must have been struck by the wide variations that occur from time to time in the severity of the symptoms. Not only does the difficulty of micturition vary at different hours of the day, but it is subject to periods of improvement and aggravation. It is probable that the vascular state of the prostate accounts for some of these fluctuations, and that the increased difficulty that is usually noted on rising in the morning is due to congestion following long repose in the recumbent position; but it is unlikely that changes in vascularity are alone responsible for all the variations in the severity of the symptoms. A medical patient of mine told me recently that he had found that there existed a definite connexion between the hydrogen-ion concentration of his urine and the frequency and difficulty of his micturition. He found that he could obtain relief when suffering from increased frequency by taking large quantities of alkalis. In his opinion an acid tide was the cause of his nocturnal frequency, and in order to combat it he took 20 grains of sodium bicarbonate before retiring to rest. If his observations are correct, the most likely explanation of the phenomenon is that the more highly acid urine provoked a spasm of the sphincters. That spasm may be a factor in the causation of symptoms is also supported by the experience of some urologists that a temporary improvement in the micturition of a prostatic may be obtained by the instillation of cocaine or novocain into the posterior urethra. Warm baths may also act by relaxing spasm as well as by diminishing prostatic congestion. It is also possible that the amelioration in symptoms that sometimes follows the use of such treatment as diathermy applied through a rectal electrode, moderate doses of x rays, and high-frequency currents is the result of an action on the spasm rather than on the size of the prostate. Certainly in those cases that have come my way which have responded to these measures I have never been able to detect any alteration in the appearance or dimension of the prostate after treatment.

The most probable explanation of retention in cases of prostatic enlargement is therefore that there exists a constant mechanical factor in the enlargement of the prostate, a variable one in its state of vascularity, and a third variable neurogenetic factor in the tendency to spasm of the internal sphincter. With this working hypothesis in our minds we will now turn to the question of treatment.

Treatment.

The treatment of any disease, if it is to be rational, must be based on a clear appreciation of its pathology. It is for this reason, and because I have the impression that although prostatic surgery has made great progress during the last twenty years it runs the danger of becoming too stereotyped, that I have discussed at some length the mechanics and dynamics of retention. There is a tendency in some quarters to regard the fact that the gland is enlarged as the all-important point, and as a consequence its removal as the primary object of treatment. In my opinion this view of prostatic enlargement and its treatment is a narrow one, and I shall try to look at the subject from a slightly different angle.

A patient with commencing prostatic obstruction is not unlike one with mitral stenosis. The bladder, like the heart, responds to the obstruction by hypertrophy of its walls. For a time complete compensation may be maintained. There is always, however, the danger that a gradual dilatation may occur, or else that some accident may precipitate a complete breakdown in function. For this reason the patient who is suffering from mitral stenosis or prostatic obstruction must be put on a careful regime, and kept under constant medical supervision, so that the earliest signs of dilatation may be detected, and the accidents that are likely to aggravate his troubles guarded against as much as is possible. It is therefore dilatation of the bladder and embarrassment of the kidneys, rather than enlargement of the prostate, that should preoccupy the medical man who is called upon to look after a patient with an enlarged prostate.

Fortunately, the man with prostatic obstruction is in a better position than the sufferer from mitral stenosis, in that his lesion is amenable to surgery, and a failure to intervene when this is indicated is a fault in treatment even more disastrous than that of intervening when it is not strictly necessary. To some medical men the surgery of prostatic trouble is synonymous with the word "prostatectomy," for the success of that operation has so impressed us that we tend to regard it as the beginning and end of treatment. Now, although for a large number of our patients total removal of the obstructing gland is the best and possibly the only measure available, there are others who neither require, nor should be subjected to, this ordeal. It is therefore our duty to avoid the temptation to fall back on a stereotyped treatment and to sort out those cases which can only be cured by prostatectomy from those that are amenable to less drastic measures.

To furnish a complete catalogue of the types of prostate that may cause obstruction would be to expand this paper to impossible lengths. However, it will be a sufficient approximation to the truth if we divide obstructing prostates into six big groups, the first five of which are glandular in origin, and the last fibrous.

1. Cases showing considerable enlargement of the lateral lobes.
2. Cases in which there is a marked intravesical projection of the so-called middle lobe.
3. Cases that are a combination of 1 and 2.
4. Cases in which cystoscopy reveals an obstruction of the bladder neck by smaller masses that in all probability originate in the subcervical and subtrigonal mucous glands described by Albarran.
5. Malignant prostates.
6. Fibrous bar formations.

It is obvious that no standardized treatment can be meted out to such varied needs, and that, in the hackneyed words of the textbooks, each must be treated on its own merits. Of malignant prostates I intend to say nothing, except that the chief indication is to deal with the obstruction and to treat the growth by means of radium. For Classes 1 and 3, where the total enlargement is considerable, prostatectomy is usually indicated, since any other measure is likely to produce an effect that is temporary or incomplete. In Class 2 total prostatectomy may also be the operation of choice, but I have had cases in which a permanent cure has been obtained by removing only the enlarged middle lobe and leaving the rest of the prostate *in situ*. It will be remembered that, according to Joly's theory, it is the height of the closed portion of the intravesical projection that is the determining factor in causing

obstruction. For this reason it is of great importance in such an operation to remove not only the free portion of the middle lobe that projects into the bladder but also a V-shaped segment at its base. If the projection is a large one this is best done by open operation, and in order that the V may be cut right down to the beginning of the urethra without causing haemorrhage, a cold cautery knife may be used with great advantage. If the projection is inconsiderable the whole operation may be done by means of a large electrode working through an operating cysto-urethroscope.

Cases belonging to Class 4, in which cystoscopy reveals the presence of glandular elevations on the posterior portion of the vesical outlet, are particularly suitable to per-urethral methods. Perhaps there are no patients in the whole of genito-urinary practice that have been a greater puzzle to the surgeon who is not an expert in cystoscopy and urethroscopy than those belonging to Classes 4 and 6. They complain of all the symptoms that are usually associated with prostatic enlargement, and yet, when examined per rectum, no increase in the size of the gland can be detected. It was for this type of case that the French invented the term "prostatisme sans prostate"; but the name is a bad one, for although rectal examination may reveal no enlargement, cystoscopy always shows changes at the vesical outlet. The region to which the cystoscopist must pay chief attention, if he is to find the clue to diagnosis, is the posterior half of the internal meatus. Normally, when viewed through a cystoscope the sphincteric margin presents a regular, slightly concave outline in its upper and lateral parts, but below, where it merges with the trigone, it lacks definition. In other words, the shape of the normal margin is that of a horseshoe stood up on its points. In the type of case we are considering the posterior portion of the margin (that which lies between the horseshoe points) instead of being concave is convex. This is due to the existence of a definite ridge which marks off the surface that slopes down into the urethra from that which merges with the trigone. This ridge is present whether it be glandular as in Class 4, or fibrous as in Class 6, and the steeper the slope down into the bladder the more likely is there to be difficulty in micturition. A differentiation between Classes 4 and 6 may be difficult, but in the fibrous type of "bar" the thickening of the posterior lip is smooth and uninterrupted, and the distance between it and the verumontanum diminished. Other points useful in differentiating fibrous from glandular bars are the frequency in the former of a history of old prostatitis, and the commencement of the trouble at an earlier age than is usual with prostatitis. A urinary infection is frequently associated with it.

There can be no doubt about the importance of being able to recognize these cases of prostatic "bar." The surgeon who fails to diagnose them, and attempts by suprapubic operation to carry out an enucleation, finds that he has set himself an impossible task. After a vain struggle to find an enucleable layer he is finally compelled to dig the gland out piecemeal with scissors. And yet, if the condition is recognized before operation and suitable measures employed, the results of treatment are excellent. In the glandular type the ridge is best destroyed by diathermy, applied either through an operating cysto-urethroscope or else by means of the diathermy punch. In the fibrous type the same treatment may be used, but not infrequently the condition yields to such simple measures as dilatation of the bladder neck by means of bougies, instillations into the posterior urethra, and prostatic massage. In any case, whether dilatation or diathermy be used, the patient is saved all the distress of a major operation, and his sojourn in hospital is cut down from a month to a week.

An objection may be raised that although these cases of obstruction from minor forms of enlargement exist, they are so rare that total prostatectomy is the only operation that need be considered. In my experience this is not so, for on looking through my records I find that an increasing number of cases of prostatic obstruction are becoming amenable to perurethral methods of treatment. It is for this reason, and because of the excellence of the results obtainable at a minimum cost to the patient, that I have insisted that the treatment of prostatic obstruction has

become too stereotyped. A distrust of tinkering and a desire to be thorough is characteristic of British surgery, but the mortality rate of total prostatectomy is still too high to allow of our being content with our present position.

Another argument, in addition to that of "tinkering," has been urged against operations that do not entail the complete removal of the prostate—namely, that some 14 per cent. of seemingly innocent enlargements contain foci of malignancy. But this argument presupposes that prostatectomy eliminates the possibility of subsequent malignant disease, which it does not. Enucleation leaves behind sufficient prostatic tissue to allow of a recurrence of malignant disease, and although the risk may be diminished by the operation, it is never eliminated. Moreover, the increased danger of prostatectomy more than counterbalances any slight addition to the risk of malignant disease that a partial operation may have entailed.

PUERPERAL SEPSIS.

AN INVESTIGATION REGARDING CONTAGION, AND THROAT CARRIERS OF THE STREPTOCOCCUS HAEMOLYTICUS.

BY

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THE respective parts played in the production of puerperal sepsis by contagion and infection from throat carriers of haemolytic streptococci have been investigated at the Princess Mary Maternity Hospital, Newcastle-on-Tyne. Outbreaks of pyrexia and definite sepsis occurring from time to time among "clean" cases, caused much anxiety and demanded investigation.

In addition to its own booked cases, the hospital receives patients from a very large area, sent in by doctors on account of puerperal sepsis, difficulties arising during or immediately after labour, abortions, and so on. Many of these cases, when admitted, are "suspect" as regards infection, and many are frankly septic. The figures for 1929 were: puerperal sepsis, 108; "suspect," 302; abortions, 280. Patients requiring Caesarean section are not included, nor are those patients suffering from pyelitis and other medical conditions which were admitted during pregnancy from the ante-natal department, or sent in by doctors. Many of the "abortion" cases were septic or developed temperatures after admission.

The existing system had certain obvious defects. (1) All cases, whether suspect or septic (except Caesarean sections) were delivered in the labour ward. (2) The isolation department, consisting of 9 beds, was unequal to the demand made upon it. In consequence septic cases occasionally, and suspect cases as a rule, were nursed in the general wards. Precautions were taken to isolate them as much as possible from the other patients.

The following changes were effected on May 1st, 1929. (1) A room was set apart where each patient, on admission, was examined and classified as "clean," "suspect," or "septic." (2) The operating theatre was converted into a labour ward for suspect and septic cases, the labour ward being reserved for clean cases only. (3) The isolation department was increased by 15 beds, making a total of 24, by including one of the general wards in that department. The isolation of suspect and septic cases, their nursing staff, baby room, and annexe, was complete. Improvement was noticed at once.

The terms "septic," "suspect," and "clean" must be clearly defined.

Septic.—This term is too limited in its application, for

Conclusions.

In the foregoing paper I have attempted to make a broad survey of the mechanism of prostatic obstruction and to pick out some of those points which have appeared to me to be of importance. I have tried to show that whilst a dynamic theory may account for the retention of a hydronephrosis, spasm of the vesical sphincter is a contributory rather than a primary factor in the causation of a prostatic retention. The explanation of retention that I have found most satisfying is that there exists a constant mechanical obstruction acting along the lines suggested by Swift Joly which is supplemented by the variable factors of congestion and spasm.

In discussing treatment I have emphasized the importance of treating each type of prostate on its own merits, and have called attention to the value, in selected cases, of such operations as the removal of a middle lobe and of perurethral diathermy.

inflammation may be afebrile and extragenital; therefore such conditions as pyelitis, inflamed breasts, vaginal discharges, bronchitis, discharging sinuses, boils, and all patients admitted with high temperatures, must be regarded as infective.

Suspect.—This term is usually applied to patients admitted in labour who have been examined, or on whom attempts have been made to deliver with forceps before admission; it may be used too loosely. Many patients sent in by doctors have not been examined before admission and are not suspect. The responsibility for their safety rests with the hospital.

Clean.—These patients have no infective process, either local or general. The majority quoted in the results had been admitted from the ante-natal department, but a number had been sent in by doctors. They consist of two groups:

Group A patients are normal medically and obstetrically, and have had the routine vaginal examinations and possibly a forceps delivery or perineal repair.

Group B patients are handicapped by one of the following conditions:

Medical: Disease of the heart, lungs, kidneys, ductless glands.

Surgical: Loss of blood, ante-partum or post-partum.

Obstetrical: Induction of labour, internal version, plugging, manual removal of placenta.

Anatomical: Slight degrees of pelvic contraction.

Group A cases are the most reliable, and *Group B* cases the most sensitive index of the efficiency of a hospital routine.

A study of cases which are already suspect or septic has very little value in such an investigation. The following standards were established before analysing the results.

1. Cases in Groups A and B were delivered in hospital after the twenty-eighth week of pregnancy, and, with only a few exceptions, at term.

2. Only notifiable temperatures were recorded—for example, 100.4° F., sustained for twenty-four hours, or occurring twice in twenty-four hours (excluding the day of delivery). Temperatures were recorded up to the twenty-first day if residence in hospital was prolonged after the routine tenth day.

3. The diagnosis of sepsis was made either by direct clinical evidence or by a process of exclusion; thus all temperatures not definitely diagnosed as due to some extragenital lesion were attributed to sepsis.

The accompanying charts show the incidence of septic temperatures for Groups A and B, independently and combined. The results are based on two-monthly records, the average number of cases in each record being as follows. In 1928: Group A, 167; Group B, 37. In 1929: Group A, 173; Group B, 36. The percentage sepsis among the two groups during 1928 is shown in Charts 1 and 2. On May

CHART 1.—Percentage sepsis among cases in Groups A and B during 1928.

CHART 2.—Percentage sepsis among Groups A and B combined during 1928.