that so common in the most dependent portions of the lungs of weakly subjects confined to bed, which gives rise to that transitory crepitation heard with the first few deep inspirations?

Prognosis.—It appears that there is a definite relation between the number of bacilli and the intensity of the phthisical process, so that the examination of the sputum may afford information of much prognostic value.

Treatment.—We now come to the most important part of our subject—that of treatment. What is the practical teaching of Koch's discovery with reference to the prevention and cure of phthisis? If our pathological conclusions be even only partially true, they clearly indicate, I think, the necessity of carefully distinguishing between the bacillus and the conditions which favour its influence, and of directing our treatment to both. We must endeavour to prevent the access of the organism, and, if possible, to destroy it after it has effected an entrance; and we must also strive to maintain a healthy condition of the pulmonary tissues, and thus prevent the occurrence of that tendency to apical stagnation which appears to be such an important, if not essential, factor in the disease. The latter of these indications is, I believe, as important as the former; and it is, perhaps, rather in danger of being lost sight of in the very natural eagerness with which attention is now being directed towards the bacillus.

Firstly, then, with regard to the condition of the lung which favours the influence of the bacillus. Here it is only necessary to remark that, whatever promotes a vigorous state of health will, by improving the condition of the blood, the nutrition of the vessels, the activity of the circulation, and the exercise of the respiratory function, tend to prevent that stagnation and transudation in the highest portions of the lungs, the etiological importance of which we have so especially insisted upon. The value of treatment which has for its object the fulfilment of these indications in the prevention of phthisis it is, I believe, difficult to over-estimate; and its usefulness is almost equally valuable when the disease is established. I cannot but think that, in the meantime, such treatment promises better results than any attempts to attack the specific organisms.

Secondly, the tubercle-bacillus. The consideration of this naturally divides itself under two heads: (a) the prevention of its access, and (b) attempts to destroy it when the disease is developed.

(a) The prevention of the access of the bacillus. The present position of our knowledge appears to point to the desirability of adopting measures for the disinfection and destruction of the sputa of patients suffering from phthisis; and perhaps, also, of the alvine secretions, when there is any evidence of tuberculous disease of the bowel. It also raises the question as to how far it is desirable to allow individuals who are not consumptive, but who inherit a phthisical tendency, and especially when such individuals are out of health, to *intimately* associate with those who are suffering from the disease. If our pathology continues to move on the same lines, this subject may become one requiring the consideration of those who manage our hospitals.

(b) The destruction of the bacillus after the disease is established. Attempts to do this are made principally by means of antiseptic inhalations. This is the fashionable, though perhaps somewhat misdirected, therapeutics of the day. A respirator charged with some antiseptic, such as creasote or carbolic acid, is now being largely used in the treatment of phthisis. Although I should be very sorry to unfairly criticise such treatment, I cannot but think that the evidence that its usefulness is in any way dependent upon its destruction of the bacilli, or of any infective substance which they may originate, is wanting. It seems to me much more probable that such inhalations, when beneficial, are so mainly through the favourable influence which they exercise upon the mucous membrane and secretion; and when, as is so often the case, they are combined with chloroform, they will also act as direct sedatives. What we want are cases of early and progressive phthisis in which antiseptic treatment alone, without adjuncts, is followed by marked improvement. When it can be shown, *e.g.*, that the pyrexia of early phthisis is reduced by such treatment, we shall have evidence pointing to the influence of the germicides upon the bacillus of considerable value. We are now making some observations in this direction, but, at present, with negative results. Whilst, therefore, I do not wish to be understood to discourage the treatment of phthisis by antiseptic inhalations, I think we must be careful as to the interpretation we put on our results. The treatment of phthisis and of other pulmonary diseases by means of a medicated atmosphere has been greatly stimulated by Koch's discovery. Such treatment has undoubtedly been too much neglected in the past, and its prosecution promises the best results. But, in the meantime, I think we

have no evidence that we are able by such means to influence the tubercle bacillus; although, if Koch's investigations be true, the discovery of some agent which, by destroying it, will arrest its injurious influence, is obviously the greatest desideratum.

REMARKS ON CHRONIC OVARITIS.*

By HENRY GERVIS, M.D., F.R.C.P.,

Obstetric Physician to St. Thomas's Hospital, Examiner in Obstetric Medicine at the University of London.

THE disease I have selected for consideration in the short paper I have the honour to read this evening is not only one of the most tedious and intractable of all the ailments we meet with in connection with the uterine system, but, putting aside those which are more directly dangerous to life, there is none which more unfits a woman for her social duties, or more affects her general well-being, than chronic ovaritis in its severer forms. To all of us, whether engaged in general or special practice, it must have been a matter of common observation how frequently one or other of the ovaries, or both, are sympathetically affected in connection with almost any form of uterine disease. The majority of women suffering from endometritis, from flexions, from subinvolution, or any other of the commoner varieties of uterine malady, begin sooner or later to complain of pain in one or other ovarian region, referred sometimes to the neighbourhood of the groin, sometimes to the hip, sometimes to the upper part of the thigh. It is also a matter of common observation, that of the two ovaries it is more frequently the left which first, at all events, becomes the seat of congestion and pain. That this is so, is believed to be due partly to the fact of the left ovarian vein opening into the renal instead of into the vena cava, as on the right side, and so more readily lending itself to obstruction; and partly to the adjacency of the frequently distended sigmoid flexure and rectum, promoting by their pressure, when distended, the same result. And this occasional and sympathetic congestion, periodically heightened by the process of ovulation, it is, which, after a while, tends to pass more definitely into subacute or chronic ovaritis. Acute ovaritis (which we are not now discussing), I may remark in passing, is comparatively rare, and, when met with, is generally in connection with the puerperal condition, either childbirth or miscarriage, and then associated with other pelvic inflammations, and often septic in character. Very occasionally, also, it arises from cold, from a first sexual intercourse, especially if this occurs at the menstrual period, in connection with the exanthemata, or as a result of gonorrhoea. Chronic ovaritis, on the other hand, which is our present subject, I look upon as in the large majority of cases secondary to pre-existing uterine disease. But not always. Quite recently, for example, the following case was under my care at St. Thomas's. A young woman was sent to us whose history was briefly this. She was thirty-six years of age, and her menstruation had been normal up to Christmas last. At that time her general health was less well than usual, and she was exposed in her situation, as nursery governess, to a good deal of extra fatigue in connection with illness in the family. Shortly afterwards, she began to suffer pain before and during her period, and much debility afterwards, and these symptoms had gradually increased up to the date of her admission. Walking had become painful, and ultimately she was only comfortable when resting. In this state she sought medical advice, and the case was diagnosed as retroflexion of the uterus, and a Hodge's pessary introduced. I may note, in passing, that this error is not an uncommon one. I have known several instances in which the enlarged ovary prolapsed, and close to the side of or behind the uterus, in Douglas's pouch, has been mistaken for the fundus of the retroflexed uterus. The pessary, in the case I am referring to, although the diagnosis was erroneous, gave some relief; at least it helped her to get about, and so she was glad of its aid, but otherwise the pain was scarcely mitigated. Under these circumstances, she came to the hospital. Careful examination could detect nothing wrong with the uterus, and indeed this might have been *a priori* expected, from her history of previous painless menstruation. But on the left side, low down in Douglas's Pouch, and pretty close to the uterus, was a rounded tender body, extremely sensitive, and not moving with the uterus, which was at once recognised as a congested and prolapsed ovary, and

* Read before the East Surrey District of the South-Eastern Branch.

the cause of her sufferings. In addition to the cases of uncomplicated subacute ovaritis, of which this is a type, there are the cases of acute ovaritis, with or without coincident uterine disease, to which we have alluded, which drift on into a subacute or chronic form. But both these classes of cases are the exception. When this patient, *e.g.*, was in the ward, a few weeks ago, there were seven other cases of chronic ovaritis under treatment at the same time: three of these were associated with flexions, two with endometritis, and two with parametritis, in one of which the uterus was retroflexed; and in the other, from the amount of exudation present, it was difficult to speak certainly of the antecedent condition of the uterus. But, in all these, the uterine malady, definitely, and by longer or shorter intervals, preceded the ovarian disturbance. Such, at least, is my view of the usual etiology of chronic ovaritis. The symptoms are fairly distinct. The principal one is pain in, and radiating from, one or other ovarian region; more or less severe; sometimes dull; sometimes acute; sometimes very acute. At first, this pain is occasional only, but apt to be pretty regularly provoked by the recurrence of ovulation, getting worse before the catamenia, and lessening afterwards. After a while it becomes continuous, but increased by standing or walking; especially is this the case if the ovary be prolapsed and congested; and, if it be the left ovary which is affected, it is apt to be aggravated before and during the action of the bowels. I have known, indeed, the pain which accompanies the action of the bowels so dreaded, that patients have avoided an action for two or three weeks together to escape the suffering it entailed. In the early stages of ovaritis, there is generally a tendency to menorrhagia; as the case advances, and as tissue changes take place in the ovary, the tendency often, but not always, is to the flow becoming scanty. But this, as well as the amount and character of the dysmenorrhœa, is much influenced by the nature of the associated uterine disease. Among the general symptoms always noticed with the progress of the case, are various neurotic disturbances and nervous irritability, the result of nerve exhaustion. The physical diagnosis is based on the fact, that the swollen and tender ovary may be detected by vaginal, rectal, or bimanual examination; and that its shape and peculiar tenderness are both characteristic. Its shape is that of an oval body, in fact of the ovary itself, increased in all its dimensions to twice or four times its ordinary bulk; and the sickening pain, produced by pressure, resembles the similar pain which may occur in connection with its analogue in the male, orchitis. Should the ovary be prolapsed, and when increased in weight it is very apt to become so, its detection is still more easy. I may add that, not only is the left ovary more liable, as we have seen, to ovaritis than the right, but, when prolapsed, it is generally the lower and more readily detected; and that because Douglas's pouch dips down somewhat lower on the left side than it does on the right.

I incidentally alluded to the importance of distinguishing the fundus of the retroflexed uterus from the ovary; but the careful use of the sound will generally prevent, or rectify, the mistake, by establishing the fact that the uterine axis is normal in direction, and that the uterus may be moved without moving the body behind. Occasionally, however, both uterus and ovary are involved together in perimetritic, or parametritic exudation, and the difficulty of then making out the ovary is much enhanced. But, even here, the character of the pain, and the peculiar sensitiveness, on examination, at one spot corresponding to the ovary, and the additional swelling and pain which occur at that spot during ovulation, are fairly characteristic points. Among other symptoms which help the diagnosis, are a not infrequent diffused fulness in the iliac region corresponding to the affected ovary, a fulness often spoken of by the patient and her friends as a "tumour," and also some rigidity of the abdominal muscles in the same neighbourhood; mammary and inframammary pain on the affected side are also common. One other remark I would make before passing to the consideration of the pathology and treatment of this disease, is the marked tendency there is in these cases to attacks of pelvic peritonitis; the constantly hyperæmic ovaries, inducing an associated peritoneal hyperæmia, which comparatively slight accidents, such as cold, or sexual imprudence, or over exertion, may aggravate into distinct peritonitis, more or less extensive, sometimes limited to the pelvis, and, at others, spreading to the abdominal peritoneum. As regards the pathology, two forms of ovaritis are recognised; but I must add that, clinically, the distinction cannot be made out. These forms are based upon the ovarian tissue affected, and are seen best in patients dying from septicæmia, with acute ovaritis. They are called respectively the follicular and the interstitial. In the follicular form, the follicles are increased in size, and their contents may be cloudy, flocculent, or puriform. In the interstitial form, the connective tissue is much

proliferated, and diffuse suppuration or abscess may occur. Both varieties may coexist. In chronic ovaritis, the ovaries may either become cystic as a chronic development of the follicular variety, or cirrhotic by inflammatory condensation of the connective tissue, constituting a sclerosis of the stroma, as a result of the interstitial variety. The cystic is the more common; the sclerotic more frequent in association with repeated attacks of peri ovaritis.

Lastly, as regards the treatment. The first proposition I would venture upon is that, as in the majority of instances, the uterine disease precedes the ovarian, and is to it pretty much in the relation of cause and effect; it is essential to rectify the uterine malady before amelioration of the ovarian symptoms can be expected, or, at all events, to ensure that the two shall proceed together. While a patient, *e.g.*, has endometritis, and consequent congestive dysmenorrhœa, or cervical obstruction, either actual as from stenosis, or virtual as from flexion, and so obstructive dysmenorrhœa, it is hopeless to expect, by any treatment, improvement in the condition of the ovaries. Indeed, in numerous cases which I have seen, the restoration of the uterus to a healthy condition has been followed by a speedy mitigation of the ovarian symptoms, and that without any special treatment of the ovaries at all. But in others, of course, both the uterine trouble and the ovarian hyperæmia and irritation have been so chronic, and such tissue changes have taken place in the ovaries, whether follicular or parenchymatous, that even when the uterus is cured, the ovaries remain the seat and source of a constant suffering. And then, too, there is the smaller class of cases in which there has been no antecedent uterine disease, as in the case some particulars of which I have narrated, and those, also, in which subacute and chronic ovaritis has followed some direct acute attack. Taking these last, as being the most hopeful, first, supposing that there is either no uterine complication, or that any such has been rectified, the measures that in this stage, which may be spoken of as the subacute, will prove most useful, include rest, more or less complete, according to the severity of the case, and with the lower part of the body somewhat raised, either by a pillow under the hips, or by having the foot of the bed elevated; the application of small blisters to the inguinal region, either allowed to heal or kept open for two or three days at a time by poulticing. The application of one or two leeches either to the cervix or to the perinæum on the side of the affected ovary. The injection of hot water twice daily into the vagina, at a moderately high temperature, say 100°-110°, the introduction into the vagina high up of pledgets of cotton wool soaked in glycerine, by which a considerable watery drain of the uterus is effected and congestion much relieved; the maintenance of the bowels in a somewhat relaxed condition, to avert all pressure on the ovaries from their distension, as well as to deplete the portal venous system; the administration of the iodide and bromide of potassium or ammonium, with quinine and salicine, or the use of sedatives according to circumstances. The recently acute and subacute cases will often yield to treatment of this character; the treatment in fact of ordinary subacute glandular inflammation, varied, of course, according to the incidents of the case, any special symptoms being specially dealt with.

In cases of the next class, those in which the antecedent uterine disease has been of longer duration, and in which some amount of tissue change in the ovary itself has possibly occurred, and in which even when the uterus has been put into a healthy condition, the tenderness and ovarialgia remain, remedies are unfortunately less reliable. There is in these cases nearly always pain, generally less after the night's rest than when the day has advanced; sometimes a dull aching pain, sometimes a sharp stabbing pain, sometimes spoken of as like a perpetual toothache in the side; whatever the character, it is increased by standing or exertion; and if the ovary be prolapsed as well as inflamed, increased greatly by the action of the bowels, and by marital relations. In these, the difficulty of cure is much greater. They often persist for years, and too frequently drift into the third or practically hopeless class. The patient's general health is sometimes pretty good, but her capacity for family and social duties and her ability to get about become less and less. Sometimes, on the other hand, various hystero-neuroses develop, and much general impairment of health results. Still, a sufficient number of cures occur even in this class to encourage perseverance in the treatment; tissue-changes may not have taken place, and there is always the hope that if the worst symptoms can be relieved, at the menopause, a very distinct improvement may take place. The remedying of any concomitant uterine disorder still holds the first place. Rest, as in the subacute form, is of the highest consequence; but perhaps not entire rest, and that for two reasons; the first, that complete rest indoors affects detrimentally the general health; and secondly

that change of scene is useful in preventing the patient's thoughts from dwelling too exclusively on her pains. Still, stairs, standing, lifting, and long walks must be avoided. The improvement, indeed, of the general health is of particular importance, by attention to general regimen and suitable tonics. Under the former head I would mention the avoidance of any but the lighter stimulants. I am satisfied that, in these cases, the stronger stimulants, except occasionally, are prejudicial. And then, too, unfortunately the relief to pain obtained by the use of brandy and the stronger stimulants, tends to beget a liking which grows and reacts prejudicially upon the whole system. But although but little stimulant is desirable, for both these reasons, the direct and the indirect, plenty of light and easily digestible food is of great consequence. There is often but a poor appetite and impaired digestion in these cases; and, if these can be remedied, a distinct improvement in the ovaritis follows. Indeed, I believe it helps even mechanically to mend matters, and that the ovaries are less liable to prolapse in a pelvis fairly padded, than in one from which all adipose tissue has disappeared. The avoidance of cold, as well as fatigue, is an important point in the treatment. In addition to warm clothing and the avoidance of casual low temperatures, I have often seen much benefit accrue from wintering in one or other of our more sheltered winter-resorts, or, where circumstances permitted, even in Egypt or Madeira. The tonic from which most benefit is generally derived is zinc valerianate with quinine, and this may be combined in a pill with belladonna, morphia, or Indian hemp, as desired. Suppositories of morphia, or of atropia, are also valuable means of relieving pain.

The local treatment includes the use of iodine or small blisters to the inguinal region, or sedative liniments, such as the liniments of aconite, belladonna, or chloroform. Hot sitz baths, douches, 105°-110°; mercurial vaginal suppositories where it appears possible to promote absorption of exudations, or lessen ovarian congestion; and when the ovary is prolapsed, the introduction of an elastic ring pessary, which supports at once both uterus and ovary, often so taking off the dragging and bearing down sensations of which the patient complains, and markedly relieving the dyspareunia so frequently present. A device that I have made use of sometimes, and with benefit, has been what has been called the postural method of treatment. By getting the patient to kneel for definite periods of fifteen to thirty minutes; two or three times a day, in the genupectoral position, the ovaries, unless fixed, will gravitate out of the pelvis, and so lose some of their congestion. And these approaches to a healthy condition repeated frequently lead, it is believed, to the tendency towards health becoming permanent. At all events this position very frequently has the effect of distinctly relieving pain. One other point worthy of attention is the question of utero-gestation; and the cognate one of the permissibility of conjugal relations in the married. Briefly, sexual excitement being obviously undesirable, intercourse must be within the most restrained limits, when from circumstances, complete abstinence is unattainable. In some stages of ovaritis, while ovulation proceeds, conception is of course possible; and there is also no doubt that gestation has, in many cases been distinctly beneficial to cases of chronic ovaritis, indeed, in some cases, I have known a complete and permanent cure result. The explanation being that during gestation the ovaries are having a complete physiological rest; and also that being lifted out of the pelvis by the uterus, as it rises in the abdomen, they are removed from much of the pressure and weight to which, while in the pelvis, they are subjected. But in spite of all such precautions and treatment, a certain number of these cases drift into the third class, the class in which no remedy short of a nearly persistent narcotism appears to give any relief. The patient is always in pain; pain spoken of by some as a burning, scorching pain; by others as a wearing unendurable pain; by others as "torture;" a pain from which nothing but the stronger sedatives, or hypodermic injections of morphia, or large doses of brandy, give any freedom. For the relief of this class I am afraid little but surgical treatment remains, apart from the perpetual administration of sedatives.

In the few words I have to say on Battey's operation I wish to speak in the most guarded manner possible. It is still an operation *sub judice*. It is an operation which before the recent great advance made in the safety of abdominal surgery, by the use of antiseptic methods, would have been scarcely justifiable; for though these extreme cases of ovaritis we are now considering are sources of the utmost misery and suffering, they are compatible with a considerable prolongation of life. It is an operation of which the full particulars should always be put before the patient and her friends, so that she may elect between the risk of the operation and, indeed, its possible want of success, even if she recovers, and continuing to bear her

pains with such mitigation as medicine can give. The objection raised by some to it, that it unsexes a woman, appears to me groundless; it renders her of course incapable of further child-bearing; but though she can be no longer a mother, she can and does continue to be a wife, and with the feelings of a wife unchanged. Much of the objection that has been felt to it has arisen I think from one of the names proposed for it, "normal ovariectomy," as if it were the removal of healthy ovaries. In the connection in which we are now discussing the operation, this term is wholly inappropriate, it is performed solely for the removal of diseased and worse than useless appendages. The chief drawback to it, besides the risk of an occasional unfortunate result, as in all operations, is, I think, the fact, that in some cases even the removal of the ovaries has failed to cure; and that pain continues afterwards. The probability is in these that some central spinal lesion has occurred as a result of the long-continued nerve-irritation, and that the cause of failure in the operation arises from its being too long delayed. But I have known cases in which the cure, though not immediate, has eventually, after six to twelve months, occurred. In most, however, that I have seen, in my own practice and that of others, the relief has been as immediate as it is marked. Into the details of the operation I do not propose to enter; it is essentially an ovariectomy on a small scale, and not the easier for the less magnitude. Indeed, the bringing up of the ovaries to the abdominal wound through an incision in an often rigid abdominal wall is frequently a matter of much difficulty. Strict antisepticism is, of course, observed; and the preparation and subsequent treatment resemble those which are the rule in ovariectomy. I have myself been concerned in four cases. The first was a lady aged 28, who had puerperal ovaritis six years before I first saw her. The acute had passed into the chronic form, and the pain was constant. During these six years she had had the best London advice. For two years after I began to attend her she was practically bedridden; and only when under the influence of chloral, the only sedative which agreed with her, did she experience any relief. After much thought, the operation was decided upon, and performed in July 1881. The relief in this case was not immediate; but within six months of the operation she was satisfactorily well. The second was a lady aged 36, who had been the subject of ovaritis for nine years, also dating from a confinement. She frequently had had, during these years, attacks of localised peritonitis, more or less severe. She, too, at last became bedridden; and, among other symptoms, I may mention that so distressing was the pain induced by the action of the bowels, that her screams could be heard in adjacent houses. Her mind, too, began to be affected, and her emaciation was extreme. Here, the operation, which I did in October 1881, was immediately successful, and she has continued since in perfect health. The third case was that of a single girl, who had suffered from congenital retroflexion and obstructive dysmenorrhoea since the establishment of menstruation; and, though still young, 27, she had, since the occurrence of ovaritis about five years previously, become helplessly weak, emaciated, and haggard. On the principle already adverted to, of rectifying any uterine malady first, I suggested to her medical attendant the desirability of performing the Sims operation for the retroflexion, it being incurable otherwise. This I did, with some relief to the dysmenorrhoea; but the ovarian pain was unabated. After a further interval, and no improvement being obtained, at her earnest entreaty, and with the entire sanction of her parents, I removed the ovaries, and the result has been, as in the former cases, quite satisfactory. In each of these cases, the ovaries were the seat of more or less cystic degeneration, satisfactorily evidencing the need of the operation and the futility of merely medical treatment. In the second, there were some adhesions on the left side, due to peritonitis; but they were not of a serious nature, and in each the recovery after the operation was without incident. My fourth and last case I operated upon in May 1882. She was a married lady, aged 34. Her ovaritis followed a retroflexion which occurred after her last confinement but one, about five years previously. Before I saw her, about two years ago, she had been under the care of the most eminent London obstetricians, but without benefit. When I first attended her, and for the most part afterwards, she was always lying on her face, sitting or the dorsal position being always painful, the left ovary being low down in Douglas's pouch, and pressed upon by the fundus of the retroflexed uterus. In spite of every care, she had recurrent attacks of pelvic inflammation, each followed by an increase of the local symptoms. Her health gradually deteriorated, appetite and digestion failed, and she became practically worn out with constant suffering. Treatment of all kinds was unavailingly tried. Finally, the operation was decided

upon. Unfortunately, it proved one of those cases in which the adhesions were very extensive, and the operation was long and tedious. Still it was satisfactorily accomplished; but she sank from a slight attack of peritonitis on the fourth day. This adverse condition of the pelvic contents could not be ascertained prior to the operation. It was not as if there were masses of inflammatory exudation which could be felt; nothing wrong but the dislocated ovary and retroflexed uterus could be made out, and only exploration of the pelvis at the operation could show how fixed in its faulty position the ovary was.

I must not, Mr. Chairman, enter more largely into the tempting subject of oöphorectomy. The object, indeed, of this unpretending paper will be fulfilled, if it elicit, as I doubt not it will, from gentlemen present, any suggestions as to the better management of cases of chronic ovaritis of either the first, the second, or the hopeless class.

THE TREATMENT OF INCREASED ARTERIAL TENSION.*

By SOLOMON CHARLES SMITH, M.D.,
Surgeon to the Halifax Infirmary.

FROM the earliest times physicians have watched the pulse, and have used it as a means of estimating the nature and progress of disease; the ancients, no doubt, merely from empirical reasons, but the moderns, not simply because experience has connected certain states of pulse with certain conditions of body, but because physiology having shown that the arteries form the main highway from the heart which propels, to the tissues which use the blood, we endeavour, by watching their condition and their varying relation to the blood stream, to gain some knowledge as to the state of affairs at each extremity of the circulation, to estimate by what force the heart is promoting the circuit of the blood at one end, and by what resistance the tissues are hindering it at the other. The pulse is the expression of a somewhat complex series of factors, the principal of which are heart force, peripheral resistance, arterial elasticity, and quantity of circulating fluid; and it is the varying relation between these different elements that produces the various forms of pulse.

The use of the sphygmograph has led to the identification of the "hard," "persistent," "incompressible," "wiry" pulse, and its description as that of increased arterial tension. This particular form of pulse is of great interest from its frequent association with serious diseases. It is so often found in relation with Bright's disease, gout, angina pectoris, hypertrophy of the heart, apoplexy, and various forms of paralysis, that it has come to be considered a symptom of ill omen; and thus, by a mental process, which does not always lead to safe conclusions, has come to be looked upon as a condition which it is desirable to remove; and as modern medicine provides means by which this can, to a certain extent, be done, it is a matter of the greatest interest to inquire in what cases increased arterial tension is an evil to be got rid of, and in what it may be considered a purely conservative effort which should be aided and encouraged. In all the operations of organic life we find such a constant harmonious relation between cause and effect, between force and work, that we cannot conceive of the existence of such an unbalanced, over effort at the heart end of the circulation as permanently to maintain an increased pressure within the arteries, and, in fact, whenever the pressure, under which the circulation is carried on, the so-called arterial tension, is raised, the cause is to be found at the other end of the stream, and arises from obstructed outflow through the arteries and capillaries. But while obstruction to the exit of blood from the arteries is an essential factor in the production of high tension, it is not in itself enough; it can, by preventing the emptying of the vessels, keep up the pressure within them throughout the diastolic portion of the heart cycle; but the tension is not raised unless the heart has power to push the blood more forcibly into these full arteries; and thus, nipping the stream between the peripheral resistance and its own propulsive force, raise the arterial tension and increase the pressure of the blood against the walls of the vessels.

A broad distinction has to be drawn between mere fulness and increased tension. Obstruction only produces fulness, hinders the normal outflow into the capillaries, and leads to a condition in which the balance between force and work must be re-adjusted either by a slowing of the blood-flow, or a quickening of the heart-force.

Adjustment may take place in either of these ways; sometimes with lowered circulation, and enfeebled tissue-life the patient leads a slow, lethargic, burdensome existence; sometimes the recuperative power, the formative energy of the system is such that the heart hypertrophies in response to the increased work thrown upon it, forces the blood more powerfully into the arteries, keeps them in a state of high tension, and by means of this extra pressure drives the nutrient fluid into the resistant tissues, and thus keeping up an almost normal interchange between cell and pabulum produces a condition of apparent health; the arteries may burst, or the heart may fail, but in the meantime the tension is kept up, and by means of that tension the tissues are fed. If, then, we can remove the blood impurities which produce the obstruction, we relieve the tension in the best possible way; but if this blood state be due to a cause which cannot be altered, such as imperfect elimination in consequence of organic kidney disease, or if there be obstruction in the vessels themselves in consequence of thickening or rigidity, we must at all hazards keep up such a blood-pressure as is necessary to overcome the resistance, keep up that arterial tension the maintenance of which is necessary for the maintenance of at any rate active life.

To prevent confusion we must here for a moment consider the physical signs of this condition: if the pulse be hard, prolonged, and not easily compressed; if at each beat it raise the fingers applied to it even when greater pressure is used than generally suffices to stop all pulsation; if the relation of the heart-sounds over the aortic valves be disturbed, the second becoming loud, and the first being almost abolished; if the heart's apex beat lower down and further out than it should do, and gives a diffused heaving impulse, we are justified in saying that the arterial tension is increased—that with some peripheral obstruction to the circulation there is hypertrophy of the heart, and that the arteries between the two are distended by a higher pressure than the normal. Now in these cases it is common to find a particular alteration in the form of the pulse trace, so common that this particular outline has been spoken of as the trace of high tension. The peculiarities of a high tension trace are that the tidal wave is well marked and high, often level with the percussion stroke; that the aortic notch is high up in the trace; and that the dicrotic wave is small, not rising much above the bottom of the aorta notch. Now, according to my view this form of pulse is merely an indication of obstruction to the outflow of blood from the arteries, but is no sure sign of increase of tension; and as a matter of fact it is often found in association with a pulse which can be stopped by even less than the average weight.

The sphygmograph shows fairly accurately the range of variation of blood-pressure during the different portions of the heart-beat, but it shows only the variation not the actual pressure. The tracing is a record of the manner and rate at which the tension is raised to the maximum by the cardiac systole and falls to the minimum at the end of the diastole, but it tells nothing as to whether this oscillation is at the top of a high pressure or a low one. We know, by the trace taken during an intermission, that even the base line represents a considerable tension, but what that tension is, the sphygmograph is unable to say.

It is no doubt a fact, that the so-called trace of high tension is generally found in connection with tense, hard arteries: but as we know that the existence of this arterial tension pre-supposes the presence of peripheral obstruction, the pulse curve found in association with it may as logically be taken to indicate the one condition as the other, and if in even one single case we find this form of sphygmogram produced by a soft and easily compressed pulse, we may be sure that, as it cannot then indicate tension, it probably, even when occurring with a hard pulse, shows the associated peripheral obstruction, rather than the increased arterial tension. I have taken some pains to measure carefully, in ounces, the pressure required to stop the pulse in a considerable number of cases, and have found (rather to my surprise at first) that there is no sort of relation between the weight so required in each case, and the nature of the sphygmographic curve.

As it was certain that the harder the pulse, *i.e.*, the greater the pressure within the artery, the greater would be the force required to stop the pulse by pressing on the artery outside, I naturally supposed that the greater the weight I found was required to stop the pulse, the nearer the trace would correspond to that associated with high tension; but nothing of the sort happened, and I have pretty well satisfied myself that the form of trace which has been so long accepted as indicative of high tension, *i.e.*, one with a large tidal wave, an ill-developed dicrotism, and an aortic notch situated high up near the summit of the curve, is really a sign only of peripheral resistance, and consequent slow emptying of arteries; and that the

*Read before the Leeds and West Riding Medico-Chirurgical Society.