given as required to meet the attendant weakness, their use being regulated by their action on the circulation. Hot linseed poultices were also applied. At the expiration of the term mentioned, and provided other circumstances warranted it, the antimony was given at an extended interval of time, simply as an expectorant, combined with ipecacuanha wine or carbonate of ammonia.

Twenty-six cases of chronic bronchitis and emphysema were relieved by the usual methods of treatment.

Stramonium cigarettes did good after other means failed in the only case of asthma admitted into the wards.

Of fifteen cases of acute pneumonia, two died in the first twenty-four hours after admission, one on the ninth day, the others made a satisfactory recovery. A similar line of treatment was adopted to that mentioned in acute bronchitis, and Dr. Charteris said he believed that in the main the most favourable result would accrue from its adoption. In four of the cases marked benefit followed the application of twelve leeches to the side affected. There could be no doubt the lividity and other alarming symptoms disappeared *pari passu* with the loss of blood. The bleeding on the removal of the leeches was promoted by hot cloths and poultices.

There were seven cases of pleurisy. In two of these empyema was well marked on admission, and it was singular and instructive to note the methods by which the pus was evacuated. In one case, a man aged twenty-four, there was distinct fluctuation and pointing at the junction of the third rib with the sternum. It was resolved to give the man a day's rest and then aspirate. On the visit the following morning he stated "that during the night he felt something give way in his inside, and this was followed by a choking sensation in his throat, and subsequently by the expectoration of a large quantity of purulent matter." On examination it was found that the skin was much less tense over the site mentioned, and it was deemed advisable not to interfere with nature's processes, but to assist these. Pressure by means of a broad elastic band was used over the side, with the view of preventing the lodging of pus in the sac, and at the same time strict rest and nourishing diet were enjoined. Notwithstanding this, on three different occasions at varying intervals the pus reaccumulated, and was expectorated in a similar manner. The man made a good recovery, and is now following his employment as a nurseryman.

The second case had been aspirated twice by the medical man in attendance, and the patient, a young lad of sixteen, was sent to the hospital as a *dernier ressort*. The patient was very exhausted. The right pleura seemed full of fluid. The liver was pushed down, the intercostal spaces bulged out, and the difference of measurement on the two sides was nearly an inch. As death seemed imminent, a free incision with a bistoury was made in the axillary line, where the skin seemed tensest. There was a copious spouting out of pus at first, succeeded by a more steady flow, to the extent of three pints and a half. The operation was performed under strict antiseptic precautions. A drainage-tube was inserted into the wound and a bandage applied over carbolic-acid gauze dressing. Considerable cough and irritation followed the operation, and the pulse was remarkably feeble. Brandy was given in large quantities, the patient taking nearly a bottle per diem, along with three pints of strong beef-tea. For the first fortnight a carbolic-acid solution was syringed into the wound, and the patient by a series of coughs expelled this through the tube. At the expiration of the fortnight the syringing was only done on alternate days. A satisfactory recovery was completed three months after the operation by the removal of the tube, and the patient is now able to move about freely. Hypophosphite of lime and malt extract were the only medicines given. Large quantities of stimulants were administered during the progress of the case, and without these no recovery could by any possibility have taken place.

Thirty-seven cases of phthisis were admitted in various stages of the disease. Of these five died, and in the others some improvement was manifested, or the disease seemed to remain *in statu quo*. Dr. Charteris said he considered a hospital ward the worst place possible for a phthisical patient in the winter, as the whole surroundings were depressing, and one essential part of the treatment—viz., going out of doors—almost impossible. Dr. Charteris said he had increasing confidence in the hypophosphites as the best remedial measures for phthisis in its early stages.

(To be continued.)

Lectures

ON

THE TREATMENT OF STRICTURE OF THE URETHRA, ENLARGED PROSTATE, AND STONE IN THE BLADDER,

WITH SPECIAL REFERENCE TO RECENT PROGRESS.

Delivered at the Medical Society of London, February, 1880.

BY W. F. TEEVAN, B.A., F.R.C.S.,

SURGEON TO THE WEST LONDON AND ST. PETER'S HOSPITALS.

LECTURE III.—PART II.

THE symptoms of stone in the bladder are often very slight and entirely masked by the existence of some chronic irritation with an enlarged prostate, so that on several occasions I have detected calculi in patients who had been treated for cystitis for months and even years. If the act of micturition is associated with pain and blood, and if both be increased by exercise, *there must be a stone*. On the other hand, a calculus may give no evidence of its presence beyond a slight smarting in the urethra. There is no difficulty in finding a large stone, but small calculi are often missed by badly-shaped sounds. The shorter the beak of a sound and the more it approximates to a right angle with the shaft, the more efficient will it be. I consider Mercier's sound (Fig. 11, A), with Sir H. Thompson's cylindrical handle, to be

FIG. 11.

the very best. When the instrument touches a small stone, the two bodies are in contact at points only, for they are both convex, hence the click is very faint, and there is always a tendency for the sound to push away the little calculus. For obviating this and more easily detecting small stones, Mercier devised a hollow sound with a flattened spoon-shaped beak (Fig. 11, B), the concavity of which overlaps the convex surface of the calculus, and as the two opposing bodies have *surfaces* in contact instead of *points* only, a louder note is elicited. I prefer to examine a patient when his bladder is quite empty, for there is no trouble in finding a large stone, whether the viscus be full or not; but if the calculus be small and the vesical cavity full, the surgeon may make a prolonged examination and yet fail to strike the particular spot where the stone lies. When, however, the bladder is empty, a small calculus is brought to its

very neck, and is struck by the sound as it enters. Text-books omit to point out that things *extravesical* as well as *intravesical* may be felt with a sound—the sacrum can always be touched, and very often the spine of each ischium. For a want of this knowledge the bladder has been cut into on several occasions, and, to the great mortification of the operator, no calculus found.

When a stone is found, what is to be done with it? In the present state of our knowledge and experience I regard the use of solvents as so much valuable time wasted. Unfortunately, a calculus is too often treated as such, whether it originated in the kidney or bladder, and stones of equal dimensions, whether renal or vesical, are dealt with in a similar manner. I look upon the treatment of a stone which has formed in the bladder to be different from one which originated in the kidney and descended into the bladder, and the want of discrimination on this point has led to many disappointing results after operation. In one case the calculus is the *cause* of all the trouble; in the other it is merely a *result*. Take a man with a lithic-acid stone which is giving him much pain. What are the facts of the case? The calculus descended from the kidney, and until it entered the bladder that organ was healthy and quiet; the bladder, however, finds that it has a very unpleasant guest, and becomes irritated. Get rid of the intruder and the bladder will quickly resume the even tenour of its way. Not so, however, is the case with the phosphatic stone formed in it. Long before the calculus existed the bladder was in a state of chronic inflammation, the urine was mucopurulent, and the patient could probably only empty his bladder with a catheter. In such a case the stone formed as a matter of course, but it was entirely secondary to the vesical condition, and if removed leaves the patient but little better off, for the aches and pains will persist, the urine will not clear up, and a fresh concretion will rapidly form. If the calculus be of renal origin it ought always to be crushed in the adult, if not too large. In the present state of our knowledge and experience, enlarged and improved as it is by the introduction of Bigelow's operation, it may be said that any stone up to two inches in diameter may be crushed, Bigelow's operation has entirely revolutionised the treatment of stone in the bladder: it is a *new* operation. The principles upon which it is founded are as widely opposed to those upon which ordinary lithotripsy was established as are the two poles to each other. The old method was sometimes spread over a period of months, the new one is the work of a certain number of minutes; and in this respect resembles lithotomy, the advocates of which operation used to urge that one of its great advantages was that, unlike lithotripsy, it rid the patient at once of his trouble. Now this is exactly what Bigelow's operation does. The bladder frets for a few hours at the great liberties taken with it, but not finding any enemy to fight with it rapidly resumes its former wonted quiet. The rule hitherto has been to do as little as possible at the first sitting—feel your way, see how much interference the bladder will tolerate, and, above all, do not let your lithotrite remain in longer than a couple of minutes; leave the fragments to nature to get rid of—unless indeed she cannot do so, in which case you must wash them out, a process “which is quite as irritating as a crushing with the lithotrite.” Bigelow says exactly the opposite—do everything at once and for all, however long it may take you to do—leave nothing to nature to expel; remove it all. But it may be said that surgeons performed lithotripsy at one sitting and removed fragments before Bigelow's time. Most certainly they did, but they operated on the same principle whether they removed a calculus in one sitting or twenty; and all cases of lithotripsy at one sitting were so performed because, as Curtiss has pointed out, “a second sitting was an impossibility.”

Then, again, the means the older lithotritists adopted to remove fragments or débris were looked upon as more objectionable than the evil they sought to obviate, of leaving the pieces of stone behind. In 1846 Heurteloup wrote a work on “*Lithotripsie sans fragments au moyen de deux procédés de l'extraction immédiate, ou de la pulvérisation immédiate des pierres vésicales par les voies naturelles.*” He named his process “*Lithocénosis*” (stone evacuation). Of 124 cases of lithotripsy, 69 were performed by him at one sitting.

In 1853 Amussat published a “*Mémoire sur la Lithotritie en une seule Séance,*” and in our own time Sir W. Fergusson was a great advocate for removing fragments with the lithotrite. That these great surgeons did all this detracts nothing from the value of Bigelow's dis-

covery. Cornay of Rochfort was the first to introduce aspiration into practice in 1843, and he originated the truncated catheter. Next came Sir Philip Crampton, then Mercier, then Clover, and lastly Bigelow. It is only just to say that Dr. E. M. Moore, an American, very nearly anticipated Bigelow in his discovery. Up to Bigelow's time aspiration was only partially successful, for two reasons—the small calibre of the evacuating catheter, which only permitted little particles to escape, and the weakness of the india-rubber bottle. Bigelow has made aspiration perfect, but he probably would not have succeeded had it not been for Otis, who demonstrated what large catheters could be introduced into the bladder. *But even if we had possessed Bigelow's perfect instruments, we should not have dared to perform his operation if he had not shown us the great amount of instrumental interference the bladder will tolerate if we only take care to remove all the fragments at once.* This is the grand point, and to Bigelow solely belongs the great merit of the discovery. I consider that his operation will prove an inestimable boon to mankind; it will save life by bringing within the fold of lithotripsy a large number of cases which otherwise would have been submitted to the knife with a correspondingly increased risk; it will rob lithotripsy of its peril to life in old men who formerly were often worn out by the cystitis set up by the frequent crushings, and it will take from lithotripsy the opprobrium that it often removed the stone, but failed to cure the patient. All the aspirators now in use, Clover's excepted, are unconscious copies of Mercier's, whose aspirator (see Fig. 11, C) consisted of an india-rubber bottle, fitted with a brass tube and stopcock to fix on to the evacuating catheter, and a glass receiver for the fragments to fall into. The original one made by Charrière upwards of twenty years ago is now in the possession of Gouley, who has recently recorded a case in which he used it successfully. Bigelow's aspirator, with the stopcock restored to it by me, is seen at Fig. 11, D. Let us see what are the differences between the two. When Bigelow's aspirator arrived in this country it had no stopcock like Mercier's, which was, I think, a great mistake, for air entered the bladder, got churned up with the water, and caused much annoyance. At first I used to put a cork into the india-rubber tube after filling it to the very brim, but in spite of this I found that air would always enter the evacuating catheter during the process of adjusting the two tubes. I accordingly restored Mercier's stopcock, and have experienced no further annoyance. The great improvement in Bigelow's aspirator above all others consists in placing a long piece of india-rubber tubing between the bottle and the evacuating tube. Everywhere we see art imitating nature in placing pads, springs, or buffers between bodies which would otherwise be brought into rude contact, and to fix an aspirator directly on to a rigid tube without an intervening medium to damp the concussion is contrary to all the laws of mechanics, for the shock which takes place each time the bottle is squeezed is transmitted unimpaired to the metal catheter. Then, again, the india-rubber tube acts as a syphon when the aspirator is at work, so that there are two forces in operation. An objection has been made to it that its length diminishes the power of the aspirator; it is, however, purely theoretical, for evacuation, as performed by Bigelow's aspirator, is simply perfect. The glass-receiver, which in Mercier's is fixed, takes off and on in Bigelow's, which is another improvement, and as it is made longer and narrower the fragments cannot escape when once they have dropped in. To English surgeons Bigelow's lithotrite seems somewhat cumbersome, except for breaking up large stones. Until six years ago Civiale's lithotrite was almost universally employed here. Sir H. Thompson improved it by adding to it his cylindrical handle and particular mechanism for fixing the blades. The three special points in Civiale's instrument were—(1) the jaws were placed at a very oblique angle to the shaft; (2) the male blade had no spur; (3) the female blade had only a small pinhole for the ejection of débris. Mercier condemned Civiale's lithotrite, and said it was “*l'un de plus mauvais,*” and his verdict has been fully justified by the accidents which have occurred to lithotrites made on Civiale's principles. These were due to the vicious lines on which they were built. As the jaws were placed so obliquely to the shaft there was much loss of crushing power, for the body of the male blade could not be brought well home to the stone which it crushed with its tip, and as it had no spur it sometimes broke at its weakest part—the angle. Then, again, the female blade had only a

pinhole for the escape of debris, so that the instrument was liable to become "packed" and incarcerated in the bladder. Six years ago, in THE LANCET, I introduced Mercier's lithotrite to the notice of the profession, with a special mechanism of my own for fixing the blades. The three great points on which it is constructed are—(1) the male blade is fixed as nearly as possible at a right angle to its shaft, thus obtaining great crushing power; (2) the male blade is strengthened at its angle by a spur or prow, which also drives out the debris and prevents "packing"; (3) there is a large opening in the female blade for the escape of debris and the reception of the spur. All these principles have been adopted by Sir H. Thompson in the construction of what he calls his "new lithotrite." Figures C and A in woodcut 12 respectively represent Mercier's and Civiale's

FIG. 12.

lithotrites. Compare the oblique angle at which Civiale's male blade (B) is set to its shaft with the almost right angle of Mercier's (D). Compare the spur (E) at the base of Mercier's male blade with its absence in Civiale's. Compare the pinhole in the female blade (A) of Civiale's with the large opening (C) in that of Mercier's. Bigelow prefers his straight evacuating catheter to the curved one. To obviate the difficulty there sometimes is in introducing the former Gouley has fixed a Mercier's beak to it. It appears to me that the curved tube has one advantage which has been overlooked—viz., that the beak keeps the mucous membrane from falling over the hole and obstructing the ingress of the fragments. The old operation of lithotrity will now only be required for small calculi, which can be pulverised in a few minutes, and for which aspiration would be unnecessary. Lithotomy will only be demanded for very large, hard stones; big, soft calculi can be most safely disposed of by lithotrity and external urethrotomy at one sitting.

What are the conditions which bar lithotrity, enlarged as it now is, in its scope by Bigelow's operation? Boys will continue as heretofore to be submitted to lithotomy, for their parts are much too undeveloped to allow of the application of Bigelow's procedure, even if it were desirable; but women are admirably adapted for his operation, for in them the urethra is short, straight, and capacious. In men the only condition to preclude crushing is that contracted condition of the bladder which occasionally exists and interferes with the manipulation of the lithotrite. A strictured urethra can be restored to its normal calibre, and an enlarged prostate can usually be surmounted. No kind or amount of renal disease forbids Bigelow's operation if the patient be physically fit for it. In those cases where the diseased bladder is the cause, and not the result of the stone, I am afraid that his method will no more prove a success than did ordinary lithotrity. In the four instances of lithic-acid calculi in which I performed Bigelow's operation the results were admirable, but in the case of a phosphatic stone of local formation, entirely secondary to a diseased bladder, requiring the use of a catheter, it removed the calculus, but failed to cure the patient. In a recent clinical lecture at the Bellevue Hospital, Gouley has pointed out that surgeons will be mistaken if they suppose anaesthesia and aspiration have rendered lithotrity easier to perform, and that it will, on the contrary, now more than ever demand the utmost care and delicate skill. Very recently Keyes of New York has collected the results of 107 cases of Bigelow's operation performed by English and American surgeons with but six deaths. Nothing could be more satisfactory, and the success achieved far surpasses the results obtained by any other method.

Lithotomy will now only be required in adults for very large hard calculi. For stones up to three ounces in weight lateral lithotomy is an admirable operation, and although much larger calculi have been removed by it, the rectum was usually cut or torn. I consider that the introduction of Bigelow's operation will bring to the front those other forms

of lithotomy which have rarely been practised of recent years. I have a personal experience of everyone of them save the supra-pubic. The bilateral is specially adapted for those stones which are rather too large for the lateral method, for it gives as much room as two laterals. The recto-vesical is well devised for enormous calculi or debilitated subjects, for it can be performed with the minimum amount of cutting and loss of blood, and it affords the greatest amount of space. The extraction of a calculus by it closely resembles the removal of a child with the forceps, for in each instance the presenting body passes through the centre, where there is the most room. Two objections are urged against this operation. It is said the peritoneum may be wounded and that a urethro-rectal fistula may remain. The former may be avoided by making lateral incisions through the prostate instead of a vertical one, and a fistula is not necessarily incurable. According to Dulles' statistics the results of the suprapubic operation for stones above two ounces in weight were far more favourable than those of lateral lithotomy. The operation is specially indicated for large calculi in men who, on account of their enlarged prostates, are obliged to use the catheter, for a small aperture might be kept permanently open for the instrument. Median lithotomy will only be required for large hard calculi which have been "fragmented." In extracting a calculus in lithotomy the surgeon has the choice of removing it by cutting or laceration, for there is no such thing as dilatation of the prostate, as was long ago proved by Professor Ellis. Many years ago I carried out a series of investigations on this point and submitted the results to the Pathological Society, which proved that the normal calibre of the prostatic urethra was much larger than had been supposed, but that it could no more be exceeded than the calibre of any other portion of the canal. I further ascertained from my experiments and from an examination of all specimens of parts after lithotomy in the London museums, that a stone not more than 60 mm. in circumference could be extracted through a non-incised prostatic urethra without laceration. The extreme normal calibre of the prostatic urethra may be regarded as from 50 mm. to 60 mm., and in old men it is often greater. This is an important anatomical fact, for it enables us to take advantage of it and utilise it for breaking up large soft stones and extracting the fragments by external urethrotomy, and so avoiding the severer operation of lithotomy. The examinations made on twelve fatal cases of lithotomy occurring in the practice of one of the most distinguished British surgeons deceased, who professed to extract calculi by a limited incision and dilatation, showed that in every instance the prostate had been ruptured. To prove that the division of the prostate and its capsule is not followed by a fatal result, I need only refer to the twenty-two boys whom I have cut by the lateral method, everyone of whom recovered, notwithstanding the fact that the breadth of my knife exceeded the diameter of the lateral half of the prostate in each instance. The most successful lithotomists were probably Brett, Martineau, and Gutteridge, and the peculiarity in their method was that they used no force when extracting calculi, preferring to enlarge the incision if necessary rather than tear out the stone through an insufficient opening. The fewer the instruments used in lithotomy the better. For boys I employ, as a rule, only a staff and a knife, extracting the calculus with my finger. If, on account of the enlargement of the prostate, the depth of the perineum, or the shortness of his finger, the surgeon is unable to reach the bladder, he uses a gorget. Now, if the probe point on the gorget be transferred to one of the blades of the forceps, as seen at Fig. 11, E, the surgeon can slide the instrument along the groove of the staff into the bladder with unerring certainty. This slight modification of mine renders the gorget unnecessary, and so one less instrument is required. I have given up using the sharp-pointed knife for making the internal incision in men since Mr. Gutteridge convinced me of the risk attending its employment, for if it should slip from the staff, the posterior wall of the bladder will most likely be pierced, and the patient killed by peritonitis. Had the deaths which have occurred after operations through the above accident been published, the sharp-pointed knife would long ago have received its *congé*. In boys it is a choice of evils, for if the surgeon change his knife, he may not be able to introduce the probe-pointed one, and if he fail, he may push the yielding tissues before him, and rupture the urethra. I consequently still use a sharp-pointed knife for them, with a short broad blade, and, by holding it short, lessen the chance of doing mischief if it

should slip. I prefer Mr. Jonathan Hutchinson's rectangular catheter staff to any other. It has two great advantages. The surgeon can determine if the instrument is in the bladder or not, whether he strike the stone or not, for a short-beaked sound may touch a stone when a staff cannot. Then, again, it gives a straight road into the bladder instead of a crooked one, and so the chances of the knife slipping are reduced to *nil*. No tube or plug of any kind ought, I think, if possible, to be retained in the bladder after the operation, for however large a tube may be, it will not allow clots to escape, and if they cannot, they give rise to straining and cause bleeding or prevent its arrest. By leaving the wound open the surgeon sees what hæmorrhage may take place, for cases have occurred of fatal bleeding into the bladder when the wound was plugged. Then, again, the retention of clots which are rapidly decomposed by the urine in a few hours is a likely source of blood-poisoning. If hæmorrhage should occur, the best way to arrest it is to apply an ice-bag above the pubes, and insert pieces of ice in the wound and rectum.

In the treatment of stone in the bladder when it occurs as a local formation secondary to the diseased bladder, of which it was not the *cause*, but the *result*, the following pathological facts must be borne in mind:—Firstly, the condition of the bladder is such that, even if the calculus be completely removed by crushing and aspiration, some local irritation will remain, the alkalinity of the urine will persist, and a speedy recurrence of stone take place; secondly, the condition of the prostate in these cases not only does not improve, but gradually becomes more troublesome as age advances, and auto-catheterism is rendered increasingly difficult. The following indications have to be carried out:—1. Remove the stone. 2. Cure the cystitis. 3. Give the patient a short and ready route to his bladder for the catheter. A case such as the above is in this country too often relegated to lateral lithotomy, which is unnecessary and uncalled-for, for directly the surgeon has grasped the stone with his forceps it crumbles to pieces, and the operation, instead of being a speedy one, becomes a prolonged one, for he has to extract some twenty or thirty pieces, during all which time the man's engorged prostatic plexus of veins pours out blood like water. In devising an operation for such a case, we must take cognisance of the following facts. The stone is soft, and can on the slightest pressure be reduced to fragments small enough to pass along the normal urethra. An incision into the bladder is therefore unnecessary; but we want to cure the cystitis which caused the calculus, and this can only be done by allowing the urine to run out as fast as it enters the bladder, and so give it a physiological rest. We require further a short route for the catheter to go into the bladder. External urethrotomy fulfils all these conditions. All we have to do is to reduce the stone to fragments with the lithotrite, extract them through the perineal puncture, and wash out the bladder, leaving in a tube for drainage: the small puncture being kept permanently open for catheterism. It will at once be seen that whereas lateral lithotomy was a dangerous operation, and the wound could not be utilised for future catheterism, this combination of mine is attended by but little risk, comparatively speaking, and the aperture can be made useful for catheterism. What is it that makes lithotomy a perilous operation whilst external urethrotomy is not? It is because the former is an *intra-pelvic* operation, whilst the latter is an *extra-pelvic* one. Thus, therefore, by reducing the lateral lithotomy to a mere external urethrotomy, we shall diminish the rate of mortality correspondingly. I believe I was the first to introduce this combination, and in the unpromising cases in which I performed it, it was followed by the best results. But it may be asked, Is not this the perineal lithotomy of Dolbeau? It is not. There are two objections to this operation. In the process of dilating the urethra with instruments the urine always escapes, and the canal is very likely to be injured. The stone has consequently to be broken up in an empty bladder, which is a difficult and dangerous procedure if it be large, and during the long and tedious process the patient is bleeding, and no means can be taken for its arrest. Dolbeau cut first and then crushed the calculus through the perineal wound. I, on the contrary, crush first through the penis, and then cut. The operation of breaking up a large stone during lithotomy into several small ones is of ancient date, and is called "fragmentation" by the Americans, to distinguish it from lithotripsy, which it is not. I consider therefore that

the combination of a perfect lithotripsy at one sitting, followed immediately by external urethrotomy, is the proper treatment for large phosphatic calculi in men who are the subjects of chronic cystitis, and who are obliged to use the catheter; for we remove the stone at a minimum risk, we give the bladder the physiological rest it requires, and we convert penile catheterism, which in these cases is often a painful, bloody, and difficult process, into perineal instrumentation, which is free from all these annoyances. Last August I published the results of my first series of one hundred consecutive cases of operation for stone in the bladder; it is not, therefore, now necessary for me to trouble you with statistics.

In bringing these lectures to a close, I would express my regret that time has only permitted me to glance very cursorily at some of the more salient points of my subject; and I desire to thank you very sincerely, Mr. President and gentlemen, for the kind and cordial reception you have given me.

ON THE ANTI-MALARIAL ACTION OF THE CHINCHONA COMPOUNDS.

By T. J. MACLAGAN, M.D.

THAT quinine cures ague is one of the best established facts in practical therapeutics. How it does so we do not know. And it is impossible that we can know until we have some idea of the nature and mode of action of the ague poison. The existence of this poison is known to us only by its effects. These effects are the various forms of malarial fever.

Malarial fevers are most prevalent in marshy localities, in which there is much decomposing vegetable matter. Whatever puts a stop to this decomposition seems to arrest the development of the miasmatic poison. Cold weather, the complete drying up of the marsh, its drainage, even its submergence under water during a wet season, seems to have the effect of checking the spread of malarial fevers. These are exactly the circumstances which would check vegetable decomposition.

Marshes situate near the sea, and liable to inundation by it, are, *cæteris paribus*, more malarious than those which have no admixture of salt water. Salt water kills freshwater plants. Marshes liable to such inundation thus contain more decaying vegetable matter than those whose water is always fresh.

Malarial fevers are most common in autumn, when the vegetable matter formed during the summer begins to decay, and while the heat necessary to its rapid decomposition still prevails.

The association of malarial fever with vegetable decay is undoubted. What is the nature of the association?

Finding it all but invariable, the conclusion was not unnaturally drawn that the malarial poison was a product of vegetable decomposition; and various gaseous products of such decomposition have been suggested as possibly constituting the toxic agency. It has been found, however, that not one of these produces malarial disease.

Many marshes, too, contain much decomposing vegetable matter, and present all the conditions indicated as requisite to the development of malaria, without being a source of malarial disease. Where malaria prevails vegetable decomposition is generally abundant and active. But the converse does not hold good; for vegetable decomposition may be abundant and active in a locality which is not malarious.

No product of vegetable decomposition has been proved to be competent to cause intermittent and remittent fevers, and no causal connexion has been established between vegetable decay and the occurrence of these maladies. But there is another view of the matter, another possible explanation of this association.

Malarial fevers are most common in autumn, when vegetable decay is most active. But decay is a mere sequence of death, and death simply the cessation of vital activity. Autumn marks the time at which the annually-recurring active growth of plants comes to an end. The increased prevalence of malarial disease in autumn is thus associated with the cessation of the growth of living as much as with the decay of dead vegetable matter. It is possible that the association may be with the former rather than with the