the form of fragments, no doubt owing to the fact that greater surface was offered to their activity. Not only was the piperazine solution capable of dissolving the uric acid contained in the calculus, but it also dissolved nearly the whole of the other ingredients that were present, for out of the 50 mg. employed only 2 mg. were left undissolved.

TABLE IV.—*Experiment to show the Action of 1 per cent. Solution of Piperazine in Normal Urine on 50 Milligrammes of a Calculus, the Composition of which had been ascertained by Analysis. Temperature 39° C.*

Time.	Piperazine.	Borax.	Lithium Citrate.	Sodium Carbonate.	Potassium Citrate.
6 hrs.	The calculus had lost in weight 30 mg.	The calculus had lost in weight 30 mg.	The calculus had lost in weight 20 mg.	The calculus had lost in weight 15 mg.	The calculus had lost in weight 15 mg.
12 hrs.	Loss in weight 40 mg.	Loss in weight 30 mg.	Loss in weight 20 mg.	Loss in weight 15 mg.	Loss in weight 25 mg.
18 hrs.	Loss in weight 44 mg.	Loss in weight 35 mg.	Loss in weight 30 mg.	Loss in weight 20 mg.	Loss in weight 28 mg.
24 hrs.	Loss in weight 48 mg.	Loss in weight 35 mg.	Loss in weight 32 mg.	Loss in weight 25 mg.	Loss in weight 30 mg.

ACTION OF PIPERAZINE ON ARTIFICIAL URIC ACID.

As the result of numerous experiments on artificial uric acid, and also on uric acid which was collected from urine which had been treated with hydrochloric acid, it was found that piperazine was capable of dissolving almost its own weight in urine, after the phosphates had been removed; but when stronger solutions than 2.5 per cent. were employed an insoluble precipitate formed.

SUMMARY OF RESULTS.

1. Piperazine is not wholly oxidised in the body, and may be detected in the urine of those to whom it is exhibited.
2. Piperazine in solutions of 1 per cent. in normal urine, when kept in contact at a temperature of 39° C. (body temperature) for a given time, has the property of dissolving to a great extent a fragment of a uric acid calculus.
3. That the stronger the solution of piperazine in urine (up to 7.5 per cent.) the earlier did the solvent action begin and the more rapid was the completion.
4. That, notwithstanding this, with the stronger solutions of piperazine in urine the rate of solubility was not so markedly rapid over the weaker solutions as might be expected.
5. That the solvent action of piperazine in similar circumstances was greater than any other of the substances that were employed, namely, borax, lithium citrate, sodium carbonate, and potassium citrate.
6. That piperazine, in weak and strong solutions in urine, converted the undissolved portion of the calculus into a soft granular or pulpy condition.

7. That neither borax, lithium citrate, sodium carbonate, nor potassium citrate in similar circumstances rendered the fragment of calculus soft or pulpy.

In conclusion, my thanks are due to Professor John Theodore Cash, F.R.S., in whose pharmacological laboratory the experiments were for the most part performed, for his guidance and suggestion. I have to express my obligations to Professor Alexander Ogston, to whom I was indebted for supplies of calculi, which he most willingly placed at my disposal. I have also to acknowledge that the expenses connected with these investigations were defrayed by the Scientific Grants Committee of the British Medical Association.

EIGHT HUNDRED AND FIFTY-TWO OPERATIONS FOR STONE IN THE BLADDER.¹

By P. J. FREYER, M.A., M.D., M.Ch.,
Surgeon-Major H.M. Bengal Army.

My first lithotomy operation was performed on May 4th, 1877. Since that time I have operated on 852 cases of stone in the bladder by all methods—namely, 245 by perineal lithotomy, 6 by suprapubic lithotomy, 3 by rapid dilatation of the urethra in females, and 598 by litholapaxy, or “lithotripsy at one sitting,” as the operation is sometimes called. Though for statistical purposes it will be necessary for me to deal comprehensively with the whole of my operations for stone, it is to these latter 598 cases removed by Bigelow’s method that I propose directing particular attention in the present paper—demonstrating what a vast influence the modern operation has had in ameliorating the sufferings and diminishing the mortality attendant on stone in the bladder.

I performed my first litholapaxy operation on July 3rd, 1882. In 1886 I published my work on litholapaxy,² dealing with 128 cases of the operation performed by me down to the beginning of that year. I have from time to time published papers in the medical journals (*BRITISH MEDICAL JOURNAL*, *Lancet*, *Indian Medical Gazette*) giving full details of several series of this operation performed by me. The great majority of these operations were done in hospital practice, and careful notes of every case have been kept by my assistant surgeons and myself. In a large proportion I have had the pleasure of operating in the presence of one or more surgeons and showing them the results. There was no selection of cases, my rule being to operate on every patient suffering from stone coming under my care, no matter in what condition. No case was allowed to leave hospital, or observation in case of private practice, till a cure had been effected. My paper may, therefore, be accepted as an accurate and trustworthy record of work in this branch of surgery.

A word in the first place about the instruments now used by me in this operation. The lithotrites are all of one pattern, (Fig. 1) having fully fenestrated blades, with Bigelow’s handle and mechanism for locking and unlocking the blades. They range in size from 5½ to 18 (English) at the angle, the former being the smallest used for children and the latter the largest for adults. I have now abandoned the use of all but fully-fenestrated lithotrites in my practice. I consider the use of any other kind unnecessary, and almost unjustifiable, considering the danger that exists of *débris* getting impacted in the jaws of non-fenestrated instruments—an accident which cannot occur with fully fenestrated ones when properly used. The use of the lithotrite in the modern operation is to crush, never to fish out, the fragments—a rôle to which it was frequently consigned in the old operation of lithotripsy. I cannot conceive any circumstances in which it would be advisable to use a non-fenestrated lithotrite in the modern operation. After having used many forms of aspirator, I have now abandoned all others in favour of Bigelow’s simplified aspirator (Fig. 2), modified by Weiss of London, in accordance with suggestions made by myself and others. The cannulæ (Fig. 3) used by me are only slightly curved, with the eye on the concave surface close to the end. These are more easily introduced into the bladder, and more effective than straight

¹ Read at the International Medical Congress held in Rome, April, 1894.

² *The Modern Treatment of Stone in the Bladder by Litholapaxy*. London: J. and A. Churchill.

cannulæ. They range from No. 6 to 18 (English). Larger than this I never use, though sometimes a patient is met with in whom a No. 19 and 20 will pass with ease.

Fig. 1.

Fig. 2.

Fig. 3.

SEX AND AGE.

There were amongst these 598 cases of litholapaxy 434 adults—namely, 427 males and 7 females; and 164 children—namely, 158 males and 6 females. The adults varied in age from 16 to 96 years, the average being 48½ years; the children from 1½ to under 16 years, the average being just 7 years.

DURATION OF TREATMENT.

The average number of days spent in hospital after the operation, or under treatment in cases of private patients, was in the case of adults 6½ days, the period varying from 2 to 28 days; in the case of children 5½ days, varying from 2 to 31 days. I may mention, however, that in many instances the patients were kept in hospital one, two, or three days longer than absolutely necessary as a precautionary measure, or for purposes of observation.

WEIGHT OF CALCULI.

The *débris* of calculi removed varied in weight in adults from 2 grains to 6½ ounces, the average weight being 262 grains; in children from 1½ grain to 3 ounces and 2¼ drachms, the average being 93½ grains. The weights here given are those of the *débris* when carefully dried. The specimens have all been carefully preserved by me, and are now exhibited before you. The total weight of the calculous *débris* removed in these 598 litholapaxy operations amounts to 128,689 grains, or 294½ ounces. There were 188 calculi, weighing half an ounce and upwards; 88, 1 ounce or more; 30, 2 ounces and over; 8, 3 ounces and upwards, and 1 weighing 6½ ounces.

STATISTICS OF RECURRENCE.

These 598 operations occurred in 587 different individuals, the disease having recurred once in nine instances, and twice in one instance. In three other cases litholapaxy had previously been performed by other surgeons. In all these cases long intervals had elapsed between the first operation and the recurrence of the symptoms of stone; and, after careful inquiry, I am bound to say that neither in the cases of those previously operated on by myself nor in those operated on by others did the recurrence seem to be due to a fragment having been left behind at the first operation. They were all simple cases of recurrence of stone from constitutional causes. In eight other instances the patients had previously undergone lithotomy, three of them twice. Three of these lithotomy operations had been performed by myself. I attribute the rarity of recurrence of stone after litholapaxy in my practice to the extreme care exercised by me in seeing that the last fragments of calculus are removed. So far as my experience goes, recurrence of stone is as frequent after lithotomy as after litholapaxy.

OPERATION AT A SINGLE SITTING.

There is no point on which I have laid more stress in my published writings on this subject than the absolute necessity of completing the operation at a single sitting, no matter how large the stone may be. This is the essential feature of the operation. Amongst my 598 operations, in eight instances only was it necessary to have recourse to a second sitting, and in two cases only designedly. One was that of a boy aged 15, from whom I removed successfully a stone (or rather two stones), the *débris* of which weighed 3½ ounces, the details of which have been published³; the other, that of a man, aged 45, with a large calculus, 3 ounces in weight. After removing 2 ounces of *débris* I had to postpone finishing the operation to a second sitting, owing to the extreme exhaustion of the patient. In this case a fatal result ensued, from pyæmia. In the remaining six instances a fragment was undesignedly left behind at the first sitting, revealing its presence next day by the pain, stoppage of urine, and other symptoms, when it was removed at a second sitting.

DURATION OF OPERATION.

The length of time occupied by the operation ranged from a couple of minutes to two hours. It will vary, of course, with the size and consistence of the stone, the capacity of the urethra, the facility with which the instruments can be introduced, and the experience and dexterity of the operator. I am now in the habit of crushing as much of the stone as possible before withdrawing the lithotrite, so that in most cases of stone of ordinary size only one introduction of this instrument is necessary. The repeated introductions of instruments should, I think, be avoided as much as possible. Rapidity of execution is a quality which comes with practice; and there is no doubt that, all undue haste and roughness of manipulation being avoided, it is desirable to complete the operation as rapidly as possible, particularly when the patient is old and worn by the disease.

ANÆSTHETICS.

The patients were, as a rule, anæsthetised during the operation. During the last three or four years I have, however, been performing the operation without an anæsthetic in an increasing number of suitable cases. With a capacious urethra in an adult I should not hesitate to attack a stone of about an ounce in weight without the aid of an anæsthetic, or with local anæsthesia by cocaine, in a case in which the internal administration of an anæsthetic was undesirable or strongly objected to by the patient.

COMPLICATIONS.

Amongst these 598 litholapaxy operations there were many cases in which the calculous disorder was complicated by the co-existence of urethral stricture. My rule is to deal with the stricture by internal urethrotomy, or rapid dilatation by graduated steel sounds, and at once attack the stone by litholapaxy.

Enlargement of the prostate was present in a large number of cases. I have not found a moderate enlargement of this

³ BRITISH MEDICAL JOURNAL, May 9th, 1891.

organ any bar to the performance of this operation, but when great hypertrophy exists suprapubic cystotomy should be had recourse to. There is generally a good deal of bleeding during the performance of litholapaxy when the prostate is enlarged. It is necessary in such cases to exercise great care in removing the last fragments of *débris*, for they frequently get embedded in clots of blood in the bladder, which have to be broken up by frequent washings with the aspirator and then removed with the entangled *débris* of stone.

Cystitis accompanied the calculous disorder in a large proportion of cases, and in many instances the urine was foetid. For this complication no special treatment is, as a rule, necessary, the removal of the stone—the cause of the cystitis—almost invariably resulting in its disappearance.

Many of the patients also suffered from enlargement of the spleen, dysentery, piles, prolapsus ani, and other diseases. In short, no case of stone coming under my care has been refused the benefit of operation, no matter in what state of health, some having been apparently moribund when placed on the operating table.

Under these circumstances I need scarcely add that kidney disease in all its stages was frequently present, but, so far as the performance of litholapaxy goes, I never desist from the operation on this account; for, no matter what the state of the kidneys may be, I perform the operation, knowing that it gives the best prospect of recovery. Contrast in this respect Bigelow's operation with the old operation of lithotomy, which was contraindicated when kidney disease was present.

CASES IN WOMEN.

There were 13 females amongst this series of 598 litholapaxy operations, all turning out successful. One woman, from whom I removed a stone over an ounce in weight, was seven months pregnant and made an excellent recovery. The only special difficulty met with in this operation in the female is in retaining water in the bladder during its performance. Owing to the shortness and width of the urethra the water rushes out beside the instruments. This I now obviate by getting an assistant to place the fore and middle fingers of one hand in the vagina and press the posterior lip of the urethra against the lithotrite or cannula, a manœuvre which prevents the water from rushing out.

LARGE STONES.

I have already mentioned that there were amongst this series 30 calculi weighing 2 ounces and upwards. One was a hard uric acid stone, $6\frac{1}{4}$ ounces; and as this is, I believe, the largest stone on record removed by litholapaxy, and as the case has not yet been published, I will give the details briefly.

The patient was a male, aged 45, with symptoms of stone lasting twelve years. He was in wretched health, the urine being muco-purulent and foetid. The operation was performed on February 20th, 1892, Surgeon-Major Tuohy being present. When placing the patient on the operating table I imagined that suprapubic lithotomy would be necessary, but determined to try litholapaxy. Introducing my largest lithotrite, after some manipulation I caught a portion of the stone (which I found was irregular in shape), broke it off, and reduced it to fine fragments. This process I repeated again and again, chipping off portions or scraping the sides of the stone till I had removed about 3 ounces of *débris*. I then found that the main body of the stone was lying in a wide-mouthed pouch at the fundus of the bladder. After some difficulty I grasped the stone in this position, but could not move it from the sac into the main cavity of the bladder. After much effort I crushed the stone *in situ*, and then pulverised the fragments one by one, some in the pouch and some in the general cavity of the bladder. The central portion of the stone, $1\frac{1}{2}$ inch in diameter, was so extremely hard that several most powerful efforts with the lithotrite were necessary before it was crushed. The operation lasted two hours, during which $3\frac{1}{2}$ ounces of chloroform were used. A small pedunculated mucoid tumour, the size of a small cherry, was brought away by the lithotrite during the operation. The patient was much exhausted after the operation, but soon picked up strength. Surgeon-Major Seymour saw him with me on February 24th, when he was sitting up in bed; and on March 9th he was free from urinary symptoms, but weak. On June 18th Dr. Seymour, who took charge of my work during my holiday, wrote me: "That man from whom you removed that enormous stone came to show himself the other day. The last time I saw him he came in a dooly, looking like an old man of 70. Now he looks a fairly robust man of 40. I would not have believed such a change possible. He is able to walk as well as ever." One year after the operation (February 21st, 1893) this man appeared before me in hospital in perfect health. He informed me that his wife had presented him with a daughter one month previously, though he had lost all sexual power for several years before the operation.

The removal of large calculi of 2 ounces and upwards demands much patience, perseverance, skilful manipulation and manual labour. By the process of chipping and scrap-

ing above indicated, and fully described in a paper of mine,* large calculi can be reduced to such a size that they can be caught and crushed by a lithotrite which would not originally lock on them. In this way I have crushed successfully in a lad of 15 a stone weighing more than $3\frac{1}{2}$ ounces by a No. 9 lithotrite. The amount of manual labour required for dealing with these large calculi is excessive. My hands were often blistered and my arms frequently ached for days after performing litholapaxy in one of these cases.

ENCYSTED CALCULUS.

The manner in which the main portion of the large calculus above referred to, which lay in a pouch, was disposed of, naturally leads one to the consideration of encysted calculus of the bladder. Hitherto such cases have, by general consensus of opinion, been relegated to suprapubic lithotomy, and I am unaware of any published writings in which dealing with them by litholapaxy has been advocated. When the opening into the sac in which the stone lies is narrow, or when the stone almost fills the pouch, it will be necessary to have recourse to cystotomy, but, so far as my experience goes, such cases are rare, the stone as a rule lying loosely in a wide-mouthed pouch. For several years I have now been in the habit of dealing with encysted calculi mostly by litholapaxy, withdrawing the stone into the general cavity of the bladder when possible and crushing it there; otherwise crushing it in the sac. Though limits of time will not permit of my dealing exhaustively with this subject here, I will venture to give one typical example.

On January 30th, 1892, a male, aged 60, was admitted to hospital with symptoms of stone of three years' duration. These had commenced with severe kidney colic. The patient was so weak and in such pain that he could not leave his bed. He was passing blood and pus in the urine. Dysentery and piles were also present. On January 31st I performed litholapaxy. The stone was felt to be a large one, lying in a sac on the right side of the bladder, about the position of the ureteral orifice. It was found impossible at first to grasp the stone, owing to the walls of the sac hugging it rather tightly. By injecting water into the bladder by the aspirator this difficulty was overcome, the stone being caught by the lithotrite in the sac. I tried to withdraw it into the bladder, but this could not be effected owing to the neck of the pouch being too narrow; so the stone was crushed *in situ*. After this the fragments were crushed, some in the sac and some in the general cavity of the bladder. No. 15 lithotrite and No. 18 cannula were introduced several times before the whole of the *débris*, which weighed 705 grains, was removed. The stone was mainly phosphatic. After the calculus had been removed I made a survey of the sac by means of the lithotrite. It appeared to be egg-shaped, with smooth walls. The opening into the bladder was circular, with a sharp, smooth, well-defined edge, and $1\frac{1}{2}$ inch in diameter. The depth of the sac as felt by the lithotrite was $3\frac{1}{2}$ inches. The day after the operation the patient was sitting up in bed, free from pain and passing urine freely. He said he had not felt so well for two years. He made a rapid recovery, and was discharged on February 6th.

DIAGNOSIS.

In the *Indian Medical Gazette*, March, 1884, I first drew the attention of the profession to a new method of diagnosis for small calculi by means of the aspirator and cannula. It frequently happens that no matter how carefully we search with the sound, a small stone, weighing a few grains only, evades detection. When, therefore, a patient comes under my care with the usual symptoms of stone, and the sound fails to detect one, I pass a full-sized cannula, apply the aspirator, and go through the process of pumping in and exhausting water, moving the eye of the cannula about in the bladder in various directions, and inserting it into pouches, should such exist. Should a small stone be present, it will be carried with force against the eye of the cannula by the outward stream, and a ringing click announces its existence. Frequently the small calculus will pass through the cannula and appear in the glass receiver, thus obviating the necessity of passing a lithotrite. I have by this means detected a large number of small calculi in my practice. The practical advantages of this simple process have been recognised by several fellow labourers in this branch of surgery.

LITHOLAPAXY IN MALE CHILDREN.

As already mentioned, there were 158 male children, or lads below the age of 16, operated on by litholapaxy. It was not till 1886, four years after I had commenced to perform litholapaxy in adult males, that I performed the operation in children. Though an ardent advocate of the modern operation in the adult, I, like most other surgeons, at first opposed its extension to the case of male children, basing my oppo-

* BRITISH MEDICAL JOURNAL, October 12th, 1889.

sition on the undeveloped condition of the genital organs, the bladder being small, the urethra narrow, and the mucous membrane sensitive and liable to laceration. On the other hand, lithotomy in the child had always been a comparatively successful operation; and, so far as my own practice goes, I had no cause in this respect to abandon this operation in favour of litholapaxy, having had the good fortune to have now performed 197 lithotomies in male children with only 1 death. In fact, it was only after having had a run of 191 successful lithotomies in children that a fatal case occurred. In spite of this, however, I was so much impressed by the results announced by Keegan in two very able papers published in the *Indian Medical Gazette* in 1885, that I at once ordered the necessary instruments, and decided on giving the operation a trial. Since that time I have performed litholapaxy in male children 158 times, with 2 deaths. My first 119 cases were all successful, and I had then the misfortune of losing 2 cases consecutively. All our foregone theoretical objections to this operation in case of male children have vanished into thin air when pitted against the stern reality of accomplished facts. Notwithstanding the great success I have had with lithotomy, I have now practically abandoned the operation in favour of litholapaxy, owing to the two great advantages that the latter possesses—rapidity of cure and avoidance of a cutting operation. To Keegan is due the honour of having, in the face of strong opposition, shown that litholapaxy in male children is a feasible and safe operation.

MORTALITY.

Amongst these 598 litholapaxy cases there were 11 deaths; namely, 9 amongst 426 operations on adults, and 2 amongst 164 on children. These fatal cases, with the exception of the last two, have been fully reported in the medical journals from time to time; and the details of the remaining two will be given in due course, when I publish my next series of stone operations. The causes of death were: exhaustion 5 (with pneumonia superadded in 1); peritonitis, 2; pyæmia, 1; acute nephritis, 1; and acute cystitis, 2. All these were in bad health when coming under operation except one; and this patient had had retention of urine for thirty-six hours, with the calculus blocking the prostatic urethra. The kidneys were diseased in several of the cases, particularly in one, from whom I removed $3\frac{1}{2}$ ounces of oxalate of lime stone, and in the case which died from acute nephritis. In this latter I found at the necropsy two calculi in the right kidney, weighing 2 drachms. One patient was 90 years of age. One, a child of 13 years, who died of cystitis, had been roughly sounded a week before coming under my care, since which time he had been in great agony, so that probably the bladder had been injured during the sounding.

The 11 deaths in 598 litholapaxy operations, namely, 434 adults with 9 deaths, and 164 children with 2 deaths, give a mortality of 1.84 per cent. on the whole, or about 2 per cent. in adults and 1.22 per cent. in children. There were, on the other hand, 254 lithotomies in my practice with 11 deaths, namely, 54 adults with 10 deaths and 200 children with 1 death, giving a mortality of $4\frac{1}{2}$ per cent. on the whole, or $18\frac{1}{2}$ per cent. in the adult, with $\frac{1}{2}$ per cent. in children.

This is, however, not a fair method of comparing the results of the two operations, as since the introduction of litholapaxy into my practice only those patients that were unsuitable for this operation were subjected to lithotomy. Previous to my commencing to operate by litholapaxy I had done 94 lithotomies, of which 33 were in the adult with 6 deaths, or a mortality of 18 per cent., there being no deaths amongst children. Since then I have performed 758 operations in all with 16 deaths, or about 2 per cent., namely, 455 in the adult (434 litholapaxies with 9 deaths, and 21 lithotomies with 4 deaths) with 13 deaths, or less than 3 per cent.; and 303 in children (164 litholapaxies with 2 deaths, and 139 lithotomies with 1 death) with 3 deaths, or about 1 per cent. This is the proper method of comparing the results of the two operations; and, setting aside the results in children in whom lithotomy has always been a comparatively successful operation, it will be observed that the introduction of litholapaxy into my practice has had the effect of reducing the mortality in operations for stone in the adult from 18 to 3 per cent.

I may here point out that though I have been singularly fortunate in my lithotomy cases in children, the mortality attending this operation in the adult in my hands approximates pretty closely to that recorded in hospital practice both in England and India. Thus, Sir Henry Thompson has collected details of 1,827 lithotomies performed in British hospitals previous to the introduction of litholapaxy, showing 229 deaths, or $12\frac{1}{2}$ per cent. There were 1,028 children with 68 deaths, or $6\frac{1}{2}$ per cent., and 799 adults with 161 deaths, or 20 per cent. In an article in the *Lancet*, March, 1885, I gave the statistics of 2,592 lithotomy operations performed in Indian hospitals in 1882, showing a mortality of about 13 per cent. on the whole, practically the same as in British hospitals.

When I commenced to perform litholapaxy in 1882, I at first adopted this operation in selected cases in the adult only, relegating the difficult cases to lithotomy; then, as I gained experience, extending it to most of my adult cases. Then, in 1886, influenced by Keegan's results, I extended the operation to male children. I have now practically abandoned lithotomy in my practice in favour of litholapaxy, the force of which remark will be seen when I state that amongst the last 300 cases of stone performed by me in patients of all ages from 2 to 90 years, the calculi weighing from 2 grains to $6\frac{1}{2}$ ounces, there were only 6 lithotomies (1 suprapubic and 5 perineal), the modern operation having been found feasible in all the other 294 cases. In 1890 I had 106 cases of stone under my care, and they were one and all treated by litholapaxy with one death. With results such as these I have not felt inclined to follow the lead of Sir Henry Thompson in his attempt to revive the operation of suprapubic lithotomy in cases of large calculi when I could deal with them by litholapaxy, nor of his somewhat rash imitators who adopt the suprapubic operation in cases of small stone. I do not think that we can expect to improve on the results above indicated whilst we continue to extend the operation of litholapaxy to all patients coming under our care, no matter in what condition, even to apparently hopeless cases. They are, indeed, results unequalled, I venture to say, in any other large and important operation in surgery, and entirely due to the introduction of Bigelow's method of operating. That great surgeon is now no more, but his name is imperishably connected with the modern operation for stone and the word "litholapaxy" which he introduced to denote it.

THE POSITION OF A HUMAN BODY BURNT, BUT NOT COMPLETELY DESTROYED, BY FIRE.

By JONATHAN BECKER, M.B.,
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PHYSIOLOGICALLY, we know that a muscle contracts by heat, and that if the action of heat be continued, it passes into a state of heat stiffening or heat rigor, a condition beyond recall by the use of any known process. Anatomically, it is interesting to note that the larger a muscle in any one group, the nearer its relation to the surface.

The muscles of the human body are not conductors of heat; it follows, therefore, that heat would take a longer time to affect the deeper muscles than it would the more superficial ones, as heat must reach the deeper ones in the first place by convection and radiation through the already stiffened superficial muscles. It follows, therefore, that an intact human body which is subjected to heat in a sufficient degree, and which has not been affected with *rigor mortis*, will assume a position which is determined by the contraction of all the superficial muscles. This position, being the resultant of all the superficial muscular forces, might be called the position of superficial muscular equilibrium. If heat stiffening has taken place, this position is permanent until putrefaction is complete, unless destroyed by mechanical means.

The position of such a body clearly has no relation to the position it occupied before being affected by heat. The head must be kept in the middle line of the body, the jaws