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THE

ANATOMICAL, PATHOLOGICAL, AND SURGICAL

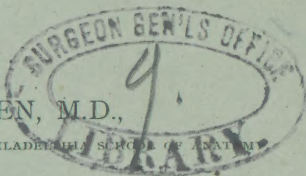
USES OF CHLORAL.

READ BEFORE THE PATHOLOGICAL SOCIETY OF
PHILADELPHIA, MARCH 12, 1874,

BY

W. W. KEEN, M.D.,

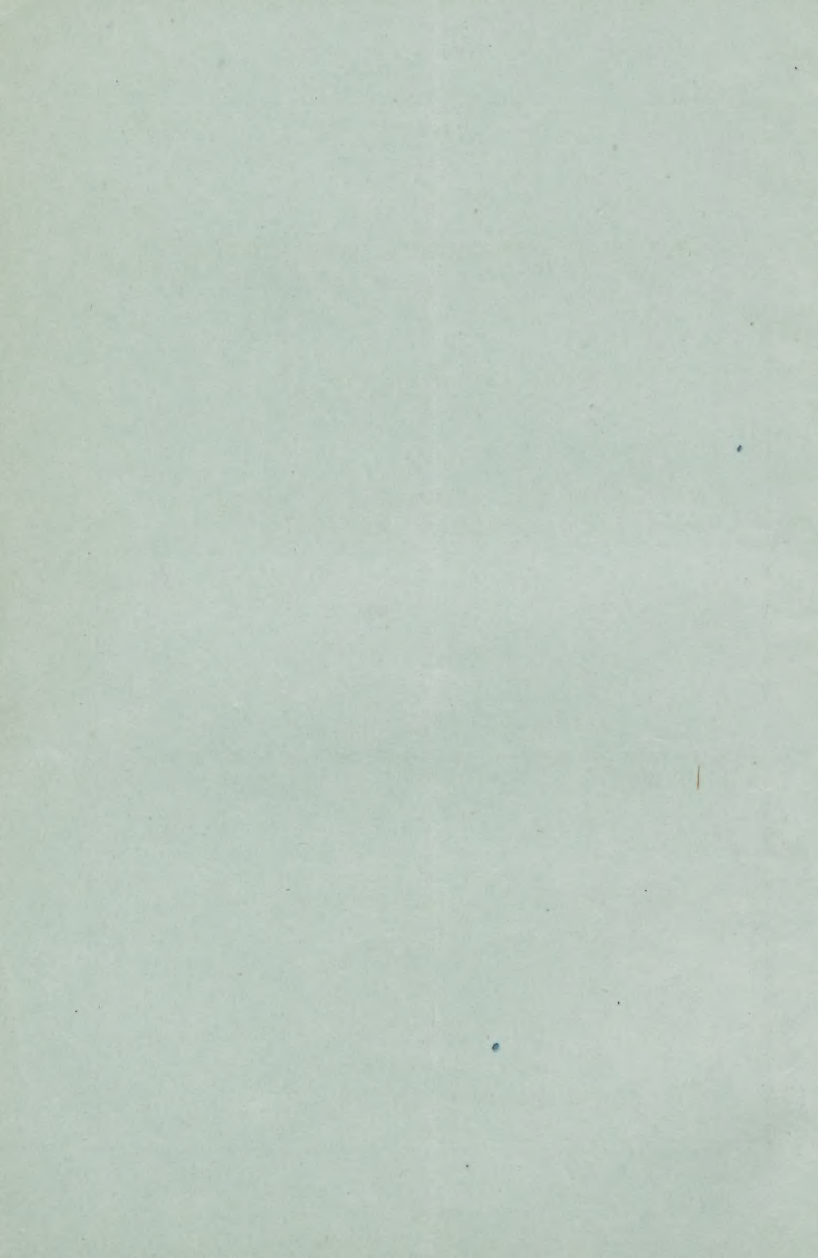
LECTURER ON ANATOMY IN THE PHILADELPHIA SCHOOL OF ANATOMY



(REPRINTED FROM THE PHILADELPHIA MEDICAL TIMES.)

PHILADELPHIA:
J. B. LIPPINCOTT & CO.

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With the Compliments of

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THE ANATOMICAL, PATHOLOGICAL, AND SURGICAL USES OF CHLORAL.

I. ANATOMICAL USE.

IN August last, I think, I saw a scrap in a journal simply stating that chloral was an excellent antiseptic. I made no note of it at the time, and almost forgot it till I had a case of caries of the tibia (reported below) in which I desired such a disinfectant, and it occurred to me to try it. The result being satisfactory, when I came on duty at St. Mary's Hospital in October I tried it on a number of cases (some of which are reported below), and then tried the following experiments with it in my office with a view to its possible use in the dissecting-room.

Experiment I.—October 22, 1873, I placed some mutton with pure water in a bottle, corked it loosely, and stood it on my office table, exposed, say, to an average temperature, day and night, of 65°, as a comparative experiment. In four days it smelt very badly, and in seven was disintegrated.

Experiment II.—Same date. Mutton in a solu-

tion of chloral, gr. ij to fʒj of water, and exposed to similar conditions. November 1 (ten days), slight mould. December 8 (forty-eight days), slight smell. December 25 (sixty-five days), entirely decomposed.

Experiments III. to VI.—Mutton placed in similar conditions October 22, 1873, but in chloral solutions of respectively 5, 10, 20, and 60 grs. to fʒj of water. At this date, March 12, 1874, 141 days, or nearly five months, they are all perfectly preserved, with no smell save that of mutton-fat and chloral, no mould, no disintegration. A microscopic specimen from that in the five-grain solution is exhibited to the Society, to show that the muscular structure is perfectly preserved, as are also all the others.

Experiment VII.—A condyloma, removed December 24, was washed for twenty-four hours in water, and placed, December 25, 1873, in a forty-grain solution. It is still (March 12, 1874) perfectly preserved, and with the other specimens is exhibited to the Society for inspection.

Experiment VIII.—Feeling encouraged by some success, I obtained a foetus, still-born at full term, and injected it December 10, 1873, as follows: one arm, by the brachial artery (precautions being taken of course to limit the injection to the arm), with a five-grain solution; the other arm with a ten-grain solution; one leg, by the femoral artery, with a twenty-grain solution; the other leg with a forty-grain solution; and, by the umbilical cord, the

trunk and head with an eighty-grain solution. I used in all two ounces of chloral, and of each solution I injected as much as I could, so that the skin was fully stretched, as if the part were extremely dropsical. I had here a completely comparative experiment, for all the parts of the fœtus were exposed to precisely similar conditions save the strength of the injection. I left it exposed on a table in a room of average temperature of 50° to 60° Fahr. March 10, just three months later, I examined it carefully. The body appeared perfectly preserved. The skin was shrivelled a little about the finger-nails, lips, eyelids, and scrotum, from evaporation; the toes were as plump as ever; the epidermis was slightly loosened. The head and neck, which were very much congested and discolored when received (a consequence, doubtless, of its being still-born), were of the same dark color, but no decomposition had ensued; and the common toilet-pins with which I had closed the incisions by which I reached the arteries were perfectly untarnished. On opening the parts injected with five-, ten-, and forty-grain solutions, and examining them, they appeared as firm as ever, all of natural color and consistence, and the microscope ($\frac{1}{5}$) showed no change in the muscular structure even with the five-grain solution. In order, however, to have a more careful examination, I gave Dr. J. G. Richardson a scrap of muscle from the ball of the thumb in the five-grain arm, another from the twenty-grain thigh; a slice of the tongue,

which, as the mouth was open, had partly dried, but was covered with a cheesy coating (hence, probably, the torula reported below), and a piece of the parotid gland. He kindly examined them with great care, with a $\frac{1}{25}$ in. immersion lens, eye-piece A, giving 1250 diameters, and reports as follows:

“A small piece of muscular tissue from the palm of the hand (five grains), teased out in a drop of chloral solution, showed the individual fibres with remarkable distinctness, the transverse striations being unusually well defined, and the whole structure quite free from granular or other degenerative change. (The specimen was shown by the class microscope.)

“A similar fragment from the thigh, injected with a twenty-grain solution, was likewise admirably preserved.

“A thin section from the tongue exhibited muscular fibres in the same state of complete preservation; and in these, by the aid of acetic acid, the oblong and rectangular nuclei under the sarcolemma were clearly brought into view. A minute shred snipped out from the upper surface of the tongue displayed the filiform papillæ very distinctly, and furnished numerous cells of tessellated epithelium, presenting all the characters of epithelium in a drop of fresh saliva. Multitudes of isolated torula spores and a few short chains of torula accompanied this section.

“A thin section from the parotid gland showed the lobules of the glandular tissue almost unaltered,

and, on the addition of acetic acid, the usual sharp definition of the nucleus in each gland-cell was obtained."

(An incision was made into one leg, and the above gross appearances were shown to the members.)

I have coated one arm with varnish and the other with rubber dissolved in benzole. I propose, after having exhibited it here to-night, to place one leg in a bag of saw-dust and the other in a bag of sand, and leave the remainder of the body exposed to evaporation during the next few months of hot weather. This will give me the means of determining whether the chloral will preserve the subjects in hot weather and of testing the best means of preventing evaporation. The results I will communicate to the Society in the fall of this year, whether they be good or bad, together with the results of any other experiments.

Experiment IX.—A negro subject was brought to my anatomical school February 23, 1874, in good condition as to preservation, but with the entire spinal cord removed, one leg off above the knee, and one femoral artery opened. It was therefore a very unfavorable subject to begin on, as so much of the solution must escape through, at least, the small arteries, which were cut. A half-pound of chloral, in the strength of 15 grs. to fʒj of water, was injected by the carotid the same day. The body was placed on the dissecting-table March 2, and has been almost entirely dissected since then. The cuticle was very firmly adherent. The muscles were of the most

life-like color, a little flabby perhaps, but not in the least easily torn. All the other parts, also, were of the natural color, texture, and condition, so that, for example, the aortic and other sympathetic plexuses were readily dissected. The odor of chloral was perceptible, but not at all offensive. March 7, the viscera were removed, and, instead of the usual fetid odor, which is so annoying, especially from its persistence on the hands, there was scarcely any smell. It was but slightly that of chloral, and was not disagreeable. This was twelve days after the injection. (Specimens shown.)

Experiment X.—A negro died in the city February 18, and lay exposed during the warm weather we had then till February 28, when he was brought to my rooms. The cuticle was off over all the chest, which was green and crepitant, and the legs were dropsical. A more unfavorable subject for preservation I have rarely had. Though a large man, I tried the chloral, on February 28, in the same strength and amount as in the last case, viz. : gr. xv to fʒj. March 12,—*i. e.*, twelve days after injection and twenty-two days after death,—the subject is perfectly preserved. The cuticle elsewhere is adherent, the chest is natural in color, the smell is gone, and the specimen of muscular tissue which I exhibit, though taken from the abdominal walls, the most unfavorable part of the body, is of admirable color and consistence.

The next subject I obtain I shall inject with one-fourth of a pound of chloral, and instead of the or-

dinary amount of water (a gallon to a gallon and a half), I shall dissolve it in not less than eighteen or twenty pints—that is, about five or six grains to ʒj; for my short experience seems to show that if the parts are fully and most completely distended they are preserved better, probably because the chloral penetrates more thoroughly into every minute capillary. In order to give a little more firmness to the muscular tissue, I shall also inject a pound or two of starch, dissolved in water and mixed with the chloral solution, and make a future report of the results.

It is important that I should not be understood to claim, as yet, that chloral will answer for the dissecting-room, to the exclusion of everything else. I have not had any experience beyond the mild winter we have so far had, and during a period of five months. What effect the hot weather of summer, with its moisture, will have, I cannot yet say, but hope to do so in the fall. Thus far I can claim for it entire superiority, in the winter-time, for all dissections, and especially for the finer and more delicate ones of the skilled anatomist. Its comparative merits may be summed up as follows:

1. *Cost.*—The price of chloral is about two dollars and fifteen cents per pound; and if one-half or one-fourth of a pound will do for each subject, the cost will be from one dollar to fifty cents for each subject. Chloride of zinc, or arsenic, costs about fifty cents for each subject.

2. *Condition of the tissues.*—Zinc hardens, discolors, and decolorizes the tissues to such an extent

that, for both dissection and operative surgery, they are rendered totally unfit to give a student the proper notion of their normal color and consistence. Besides this, many parts, such as the axilla, with its entanglements of blood-vessels, nerves, muscles, glands, etc., important to be well dissected, are in such a discolored, dirty condition as hopelessly to bewilder the most earnest student. Alcohol is better than zinc, but it also hardens and decolorizes. Arsenic, also, is better, but the tissues become very soft and offensive in a little while, besides the frequent annoyance of local poisoning about the fingers. Salt and nitre subjects have the same objections (except the poisoning), and also nearly always mould in a short time. Chloral keeps the color perfectly, and the parts are of their natural consistence for at least three months, and probably much longer. By this means far more delicate and useful dissections can be made, and the student has a correct idea of the condition of the parts just as they were in life.

3. *Subsequent injections* into the arteries, etc., can be made with far better effect, since none of the arteries are at all contracted as they are by the astringent action of zinc; and the injection will therefore penetrate much farther.

4. *Permanent preparations*.—I have not yet had time to try this question, and so I do not know how it may act as to heat, moisture, vermin, etc.; but so far as finer dissections and finer injections are concerned, it would seem to promise well.

5. *Odor.*—The chloral odor, in a single subject, is not strong enough to be disagreeable, but how it may be with a roomful of them I am not prepared to say. I intend, however, to try the effect of some of the essential oils, such as cloves, bergamot, rosemary, etc., or a mixture of them; for a fragrant cadaver may entice some otherwise indifferent students to a more thorough study of its texture and tissues.

6. *Instruments and clothing.*—The destructive action of zinc* in dulling the edge of the best knives, and thus worrying the dissector by the constant use of the hone, or, more frequently, making him careless and slipshod, is well known. Chloral does not affect the knives in the least; and even toilet-pins, after three months in the subject (Exp. VIII.), were not corroded in the least.

II. PATHOLOGICAL USES.

Besides the experiments detailed above, I asked Dr. Richardson to examine some pus, which I obtained from the Philadelphia Hospital through the kindness of Dr. Miller, on March 4, 1874. The following is his report, the examination being, as before, with the $\frac{1}{2}\%$:

“*Experiment XI.*—A specimen of pus from an acute abscess, preserved for six days in a five-grain solution of chloral, contained multitudes of well-formed pus-leucocytes, numerous dead (at least

* Zinc being our most common injecting material in Philadelphia, I use it mainly for comparison.

motionless) Bacteria from $\frac{1}{20000}$ th to $\frac{1}{2000}$ th of an inch in length, and considerable quantity of granular matter.

“*Experiment XII.*—A specimen of pus preserved six days in a twenty-grain solution presented precisely identical appearances; and since the Bacteria were about equally numerous, it seems probable that they had developed in the purulent fluid *before* it was mingled with the solution of chloral. On adding acetic acid or aniline to these specimens of pus, the ordinary reactions were manifested,—*i.e.*, the brightening of the nuclei or tinging of the nuclei and the cell-walls.”

My own examination coincided with his.

Experiments XIII. and XIV.—I examined pus from a chancre, and also pus from an ulcer, with precisely similar results.

These experiments, as well as those given before, but especially the microscopical results as determined by Dr. Richardson and myself, at once suggest the query whether chloral in solution may not replace alcohol in the preservation of permanent wet preparations in our anatomical and pathological museums. It will be observed that the solutions varied from five to eighty grains in strength; the specimens were mutton, a condylomatous tumor, human muscular, epithelial, and glandular tissues, pus from an abscess, an ulcer, and a chancre; the time varied from six days to one hundred and forty-one days; the conditions were unfavorable for their preservation: yet not only were they all preserved macroscopically,

but even the delicate cellular tissues were preserved microscopically; and, further still, the Bacteria already developed were killed even by a five-grain solution. Whether this preservative power will hold good for all sorts of wet preparations, for a longer time and in hotter weather, I do not yet know, but it will certainly do so for those named for five winter months, and probably longer.

If we can use it in place of alcohol we gain very greatly, first, in the lessened expense; for a solution of ten or twenty grains to the ounce is far less expensive than alcohol, and the bottles, instead of being hermetically sealed, need only be closed by glass stoppers, or even by ordinary corks. Secondly, this renders them entirely accessible for study at any time, whether in investigating any particular subject or specimen or for exhibition to a class; and any teacher who has used permanent preparations, hermetically sealed in expensive bottles, which cannot be passed from hand to hand, which are distorted by the refraction of the liquid and the round glass, and not to be got at to examine accurately what we wish to study, well knows how comparatively useless they now are, and how useful they will be if chloral should make them accessible. If evaporation take place, the solution is meantime becoming stronger, for only the water and not the chloral evaporates; and an annual or semi-annual inspection of the museum, with the addition of either water or the chloral solution, will remedy any such trouble. I do not think that chloral in solution changes chemi-

cally within at least a year. I have used in some of my experiments solutions in water nearly six months old, and have had patients take the syrup from an old bottleful obtained a year before, without any perceptible change in its action.

In pathological investigations of various fluids, such as pus, urine, blood, the fluids in dropsy, etc., a few grains put into the fluid may be sufficiently preservative, and enable us to keep them for a much longer time for more careful observation. I would suggest that about five or ten grains to an ounce of the fluid would be enough; and it would be better to add it in crystals, for if added in solution it might change the specific gravity of the fluid, and so affect the integrity of the more delicate morphological elements. I would also suggest whether a solution of proper density—varying with the objects to be preserved—might not be of great service for mounting microscopical preparations. Neither of the last two suggestions have I tried myself, except with the pus, which has kept perfectly for eight days; but both are, I think, well worth the trial.

III. SURGICAL USES.

When I commenced my investigations into the action of chloral, I had seen nothing published but the little scrap which filled out a column in a journal, although since then I have seen several notices of its surgical applications.* Yet, as my

* London Lancet, August 30, 1873, p. 311; Amer. Jour. Med. Sci., October, 1873, p. 531, and January, 1874, p. 261; Med. News and Lib., February, 1874, p. 27; Phila. Med. Times, February 19, 1874, p. 326, etc.

observations are independent in character, confirm the results obtained by others, and show the value in surgery of a remedy as yet new, I venture to append a few of the more striking cases in which I tried it; in some with good results, in others bad. It acts, first, as a complete deodorant within a very short time, by what chemical action I do not know; secondly, as a stimulant, so that what was a foul, sluggish ulcer will become, in from two to three days, a fine, red, healthy, granulating sore. But it must not be used too strong, or it may become a decided irritant, as any one who has ever taken a dose would naturally expect. I have generally found that gr. x to fʒj of water (or, in private practice, some fragrant water) is quite strong enough. In some cases even this, which is about a two per cent. solution, is too strong, and has to be diluted. The results of the cases below were most marked in those with foul, unhealthy, ill-smelling discharges, which were changed quickly to healthy-looking sores, with excellent and yet moderate, not abundant, pus. In fact, in every case the discharge was, I think, considerably diminished. I did not find, I think, that the sores healed any more rapidly than they ordinarily would. The application seemed rather to change an unhealthy sore which was stationary, or even enlarging to a healthy one, in the proper condition for the healing process, which soon began and went steadily forward. In no case was its hypnotic action shown.

Whether it will at all destroy the specific poisons,

such as that of a chancre, I do not know, for I had no opportunity to try it in the hospital. That it would do well in open buboes, as ulcers, I have no doubt; but the best test as to its possible destructive powers on the virus would be to try the auto-inoculability of a chancre which had been treated by chloral dressings.

I have found the mucous membranes also, as would naturally be supposed, more sensitive to its irritant properties than the skin, but not so much so in some cases as would be expected. In fact, I think it must be tested by experience in each individual case.

Cases I. and II.—One, a case of long-standing caries of the tibia, with very ill-smelling discharge; the other, of caries of short duration, but equally bad discharge. I used the chloral (gr. x to fʒi) both as an external application, by which alone nearly all smell was prevented and discharge diminished, and later, in the same strength, as an injection into the sinuses. The injection did not irritate, but yet did no appreciable good other than the external application had already done, though continued for nearly a month.

Case III.—A case of psoas abscess (in which for four years the woman had worn a truss by a physician's direction, for a supposed hernia!). On admission, the abscess was discharging, in the groin, a very offensive pus in large quantities. A ten-grain solution was applied externally, and the odor completely disappeared at once, greatly to her own comfort, as well as that of the other patients in the ward. The discharge also certainly lessened, but I scarcely think it could be from

the external application. It must have been from some other cause. As other injections had proved irritating, and she was rapidly sinking, I did not try the effect of an injection of chloral.

Cases IV. and V.—Two cases of large, filthy, and foul ulcers of the leg. I used a ten-grain solution as both a wash and a dressing; in one case mixed with a poultice, in the other simply by a compress, wet with the solution. The poulticed case did so well that all smell disappeared, the ward was freed from its previous contamination, and the ulcer did well. In the other case I had tried transplantation of skin, and four out of seven grafts had taken root. The continual application of the ten-grain solution on the compress was certainly too strong, for it not only destroyed the skin-grafts, but irritated the adjacent skin considerably. Generally, however, I have not found the constant dressing with the ten-grain solution too strong.

Case VI.—Rupial ulcers, of about the same size, on the leg and arm. As a comparative test, I applied a ten-grain dressing of chloral to one, and touched the other with nitrate of silver, dressing it with simple zinc ointment. They did about equally well.

Case VII.—This was, I think, the best test of all, so far as the deodorizing properties of chloral are concerned. I do not say *disinfecting properties*, for I suppose that this is a question for the chemist rather than the surgeon. A young woman was infected by her husband with syphilis, and then he attempted a mercurial treatment. He so far succeeded that when she entered the ward, as I was making my visit, I found half of the teeth out, the rest ready to drop out, the gums sloughing everywhere, and necrosis both of the upper and lower jaw so far progressed that the upper

jaw was loosening from all of its attachments. The smell was, I think, as bad as any I ever encountered, and the whole ward was filled with it in a very short time. I gave her a ten-grain solution of chloral as a mouth-wash, and on my visit the next day I could approach within six or eight inches before I was conscious of any odor. Yet the cause of the smell was constant, and the use of the wash intermittent. It was so grateful to her that she used it every fifteen or twenty minutes. The remaining healthy mucous membrane was not irritated. No hypnotic effect was visible from either absorption or the small amount probably swallowed.

Case VIII.—Gonorrhœa. In only one case of this kind have I tried chloral. I directed a one-grain solution, which so irritated the urethra that the patient would not allow its further use; but he was nervous about it, as I had inadvertently told him what I intended to use, and I scarcely trust his report. Parona,* however, reports an extensive use of it since 1870, in men and women, with the best results, in a strength of one per cent., *i.e.*, about 5 grs. to fʒi.

My friend Dr. Macpherson has tried it in several cases, and reports to me as follows:

Case IX.—Cauliflower excrescences of os uteri, with large hemorrhages and great fetor. During thirteen months he had tried numerous remedies. The only effective deodorant was potass. permang., and this, even in so weak a solution as gr. $\frac{1}{2}$ to fʒi, would irritate the parts so as to re-establish bleeding. He used chloral, gr. v to fʒi. The odor was at once destroyed,

* Med. News and Lib., February, 1874, p. 27, from Med. Times and Gazette, January 3, 1874, from Giorn. Ital. della Mal. Vener., October, 1873.

no bleeding resulted, the discharge lessened greatly, and changed its character to good healthy pus; pain was relieved, and she became able to walk about in ten days.

Cases X. and XI.—Both of long-standing ozæna in scrofulous subjects. A solution of $\frac{1}{2}$ gr. to f ζ i, by the nasal douche, proved irritating, and they were indisposed to allow further trial.

Case XII.—Syphilitic condylomata on the penis. The smell was almost intolerable from the mingled odors of the smegma and the condylomata. After washing with water, a ten-grain solution of chloral was applied, and the odor entirely removed. A slight balanitis occurred, which subsided on reducing the solution to 5 grs. The warts were removed, chromic acid was applied, chloral being used as a dressing, and the patient was well in four days, except one very small spot, which soon healed.

Case XIII.—Non-specific severe vaginitis in a child 4 years old, of strumous constitution. An injection and wash of 4 grs. to f ζ i was used, and no other treatment, and in two days the patient was nearly well.

Dr. Goodell also informs me he has used it considerably of late, and it does admirably as an antiseptic, deodorant, and stimulant.

