BEACH. (H. H. A.)

Styrone:

A Consideration of its Value as an Antiseptic.

COPAIBA IN SURGERY.

BY

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Presented by the author.

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STYRONE: A CONSIDERATION OF ITS VALUE AS AN ANTISEPTIC.

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The addition of a new agent to the long list of antiseptics that have been employed, and are now being used, in the various departments of medical and surgical practice is not advised without hesitation. Observations in hospital and private practice, extending through a period of eleven years, warrant me in endorsing all that I claimed for styrone when announcing the discovery of its antiseptic properties to the Boston Society for Medical Observation in 1879. The scarcity of the drug, owing to the expense of its production, has been prohibitory of its general use, until now it enters the market as a comparatively new product at a reasonable cost. The origin of styrone (from liquid storax and balsam of Peru) suggests the reason for the employment and the effectiveness of the balsams in antiquated and modern surgical dressings.

Styrone, when used as an antiseptic, possesses three important advantages:

It is { 1st, Efficient
2d, Non-poisonous
3d, Agreeable in odor.

Surgeons of experience will admit the desirability of an agent offering adequate protection to a wound, and by competent tests proved to be without toxic properties. Lest the clinical tests of poisonous action,

through absorption of the drug from dressing or the douching of cavities, should be insufficient, it has been given to dogs in doses of a fluid ounce with no unfavorable results. As a deodorizer of foul and offensive wounds or ulcers, particularly those associated with malignant disease or necrosed bone, it is as prompt, effectual and lasting as either of the poisonous or offensive smelling applications in common use. Its odor, not unlike that of cinnamon-water (U. S. P.), is worth the attention of surgeons who are using antiseptics near the head or face. In ulcerating cancerous growths it may be conveniently sprayed upon parts too sensitive to bear the douching necessary for clearing the surface of decomposing discharges. The following formula has been found useful in such cases, with the addition of morphine as required.

℞	Styrone	ʒi.	
	Glycerine	ʒi.	
	Distilled Water	ʒi.	M

To a raw surface, pure styrone is somewhat irritating; but in the form of an emulsion with olive oil, water or liquid vaseline, it may be applied freely to open wounds.

In the pleural and peritoneal cavities where the greatest opportunity is offered a *poisonous* antiseptic for absorption, styrone in solution[1] may be freely used without danger. One part to twelve, with water, is sufficiently strong to completely disinfect a foul and ulcerating surface.

In dentistry, I have the assurance of Dr. L. D. Shepard, formerly Professor of Operative Dentistry in the Harvard Dental School, and of Dr. C. A. Brackett, at present Professor of Dental Therapeutics, that they find it possessed of valuable antiseptic quali-

[1] 1-200, 1-100, or 1-50, with water, according to the requirements of the case.

ties and useful in their art. Dr. Brackett writes, "Styrone continues to be one of the agents upon which I place most reliance for correcting foul conditions in carious cavities and especially in the pulp canals of teeth . . . its odor is, for most patients and for myself, most agreeable."

I have never given styrone internally excepting to dogs. Its action upon the cholera bacillus is, however, so marked that a trial of it in cases of Asiatic cholera is indicated. It may yet corroborate the brilliant discovery of Koch, by killing the bacillus with which he explains cholera, and curing the patient. A solution 1–60, with a small proportion of glycerine added, tastes agreeably, and has a gently stimulating effect upon the mucous membrane of the mouth not unlike that of ginger syrup.

In the form of spray, using the following formula,

℞	Styrone	ʒi.	
	Glycerine	ʒi.	
	Distilled Water	ʒxxii.	M

I have known it to give great relief, with diminution of cough and expectoration, in a number of instances where the patients were subjects of phthisis, no other medicines being in use at the time. It may be substituted for carbolic acid in gargles requiring antiseptic action.

I have excised the female breast repeatedly, and after tying all vessels, washed out the resulting cavity with styrone and liquid vaseline (1–12), closed the wound with catgut sutures, enveloping the projecting ends of the drainage-tubes with a bunch of charpie as large as the fist, which had been saturated with the mixture and squeezed dry, then covering the wound with two layers of sheet-lint saturated with the mixture, overlapping the incision an inch on each side. A layer of borated cotton was afterward applied to

maintain an even compression. Upon removal of the dressing at the end of eight or ten days, a good union without suppuration has been found. No unfavorable effects from its use have been observed in any instance.

The following case, copied from the hospital records, furnishes some evidence of its value as an antiseptic and of the freedom with which it may be used in the pleural cavity.

The patient was a young man, a student under the care of Dr. Seelye, of Amherst, Mass. He had been in robust health up to April 25, 1888, when he developed the characteristic symptoms of pneumonia, with consolidation of the lower lobe of the left lung. An œdema of the right lung followed, and his condition became so critical that his life was despaired of for four days. His temperature was high, but controlled by 5 gr. to 7 gr. doses of antifebrin; pulse was rapid and feeble; respiration was rapid and shallow, with tracheal râles. Treatment (brandy, digitalis, carbonate of ammonia and atropia in $\frac{1}{100}$ gr. doses), lessened the œdema and relieved his breathing.

About May 1st, it was noticed that the heart-beat was well over on the right side of the sternum, and it has remained there ever since. This led to the belief that fluid had filled the left pleural cavity, though bronchial sounds were heard loudly as soon as he became a little stronger.

On May 4th, an aspirator-needle was inserted, and one-half pint of pus drawn off.

On May 6th, about sixty-six ounces of pus were removed. Breathing then became easier, and the heart changed its position toward the left side.

On May 7th, sixteen ounces of pus removed by the aspirator.

On the 15th, 18th and 20th, from six to eight

ounces were removed at each respiration; twelve ounces on the 22d.

Since the 15th, pus has not seemed to lie wholly in one cavity, but in pockets between the lung and chest-wall circumscribed by adhesions. Often the needle would strike nothing at one point but immediately after at a point one inch or more in any direction from the first puncture, ʒ i to ℥ vi would be found. Three or four points would be tried each day; and for the past ten days only two to three drachms have been removed from any one place, from some, nothing. For the past three weeks his temperature has ranged from 99.5° to 102.5°; pulse, from 120 to 140; respiration, from 25 to 40. Hoffman's anodyne relieves dyspnœa. Latterly, gtt. xii Majendie's solution morphia, twice daily, has afforded great relief. Brandy, ℥ ss, every three or four hours. Two quarts of milk, one or two egg-nogs daily; and for a tonic, tr. ferri chlor., acid phosp. dilut., and syr. ferric iod. For two or three days past pericardial friction sounds have sometimes been heard over right nipple.

May 28th, patient sent to the Massachusetts General Hospital. On entrance, general cyanosis; respiration very rapid and shallow; apex beat in fifth space, one inch outside of *right* nipple; slight systolic souffle at apex; flat throughout whole left chest; absent fremitus and feeble respiration; good resonance and respiration through whole right lung; a few coarse râles here and there; abdomen negative; urine highly acid, specific gravity 1027, no albumen, much sediment, urates. Liquid diet every two hours; carb. ammonia gr. v., and brandy ℥ ss, every two hours; tr. digitalis gtt. x, thrice daily; at 3 P. M., morphia subcutaneously, (½ grain), followed by relief of respiration and dyspnœa, and some sleep; at 6 P. M., another subcutaneous injection morphia.

May 29th, another subcutaneous injection morphia, ½ gr. at 4 A. M. Considerable cyanosis to-day and constant dyspnœa. Takes nourishment well. Transferred to surgical ward.

Dr. Beach saw him for the first time on the 29th and found his condition so serious (temperature 105°) that he explored the left chest immediately with the aspirator-needle in the ninth space, posterior axillary line, and withdrew one and a half pints of thick pus. When the cavity containing it had been exhausted, he punctured in the seventh space, and withdrew one and a half pints more. The cyanosis was much lessened, the patient breathed easier. The apex beat returned to a point inside of the right nipple, and there was good resonance over the left chest to the fifth rib.

On the following day his temperature was normal, color good, and respiration easy.

During the three following days the fluid began to accumulate again, and his temperature to rise once more. In anticipation of the previous experiences of the patient, Dr. Beach cut down upon the seventh rib, and made a resection which permitted free drainage, stitched a double tube in place, and washed out the cavity with a solution of styrone, 1 part to 200, afterward increasing the strength to 1–40.

On May 6th, the discharge was profuse but perfectly sweet; temperature normal; the lung has expanded; there is good respiration to the seventh rib in front; apex beat in stomach line; improving fast and gaining flesh. The discharge continued to diminish, and general improvement was constant.

July 9th, he was discharged well, the sinus entirely healed, and has gained twenty pounds since he entered the hospital.

Six months after, Dr. Seelye examined him, and pronounced him "in perfect health." He has gained in strength ever since he left the hospital.

In considering the strong germicidal properties of styrone, I have naturally been led to test its influence in hay-fever and rose-cold, knowing it to be a harmless and non-poisonous drug. Without wearying the reader by detailing many cases, I will simply add that it has been used sufficiently to prove that the marked relief and comfort following the use of spray containing styrone has been something more than a coincidence, whether or not the disease is due to the presence of micro-organisms. In not one case has it aggravated the symptoms. The following formula I have found useful as a spray for the nose and throat, used three or four times daily for five minutes, or more frequently, according to the severity of the case and the relief obtained each time:

℞	Styrone	gtt. x.	
	Glycerine	ʒ ii.	
	Water	ʒ iv.	M
℞	Styrone	gtt. v.	
	Liquid Vaseline	ʒ ii.	M

The latter to be used with a vaseline spray-producer.

The appended report of Dr. Edward K. Dunham, Bacteriologist of the Massachusetts Board of Health, is corroborative of the above and of the microscopical observations made by me, in 1879, of the power of styrone in restricting the growth of some micro-organisms. I am under many obligations to him for the skilful and painstaking efforts he has made to reach the facts, and for arranging them in such attractive shape. They are published with his kind permission.

EXPERIMENTS WITH STYRONE, SULPHONAPHTHOL, EUCALYPTUS EXTRACT AND GLYCOBORON.

The method employed in studying the germicide value of these four reputed antiseptics consisted in subjecting cultures of bacteria to their action for defi-

nite periods of time, and then testing the cultures for living bacteria of the species originally present.

The species of bacteria chosen for these experiments were: bacillus anthracis, bacillus choleræ Asiaticæ (Koch), streptococcus pyogenes, staphylococcus pyogenes aureus, and a mixture obtained from a cold-water extract of beef which had undergone spontaneous putrefaction after exposure to the air.

The steps taken to put the above method into practice were as follows: Erlenmeyer flasks or test-tubes of sterile bouillon made from beef-water with the addition of one per cent. of Merk's *peptone carne sicc.* and one-half per cent. of table salt were inoculated with the bacterium on which the germicide action of the antiseptic was to be tried, and the culture allowed to develop until the bouillon was distinctly cloudy. A known proportion of the antiseptic was then added and thoroughly mixed with the culture. The mixture then stood either at the temperature of the room, or in the incubator, and at intervals little samples were taken for examination with a sterile platinum loop. The amount taken for each test was about one-fiftieth of a cubic centimetre, which was transferred to a test-tube containing from five to eight cubic centimetres of sterile gelatine made of the same ingredients as the bouillon, with the addition of ten per cent. of Nelson's gelatine. The small quantity of antiseptic contained in the sample was therefore diluted with from 250 to 400 times its bulk of gelatine. The gelatine, after being thoroughly mixed with the sample was solidified on the inner surface of the test-tube so as to form a thin layer (Esmarch's "roll-tube"[2]). The roll-tubes were then set aside to develop, at the room temperature. Those in which no growth appeared were kept from one to five months, to exclude the chances of overlooking possible retarded or scanty growth.

[2] Zeitschr. f. Hygiene, Ed. I., 293.

These tests were made in duplicate; and, at the same time, a roll-tube of the micro-organism employed was made from a culture started at the same time, and like those treated with the antiseptic, but to which nothing had been added. This roll-tube served as a standard of comparison for the others, and made it possible to judge whether the antiseptic had retarded the growth of the bacteria.

A. Experiments with Styrone.

(1) On the Bacteria of Putrid Meat Water.

Minced beef was soaked twenty-four hours in twice its weight of cold water, strained, and the extract left exposed to the air for three days. Erlenmeyer flasks containing measured quantities of sterile bouillon were then inoculated with the putrid water, and allowed to develop for twenty-four hours. Definite proportions of styrone were then added, and the mixture preserved either at the room temperature, or at a constant temperature of 30 C. At intervals, roll-tubes were made with about one-fiftieth of a cubic centimetre of the mixture and five cubic centimetres of gelatine. Resulting growth in the roll-tubes, at the room temperature, was absent with three and one-third, two, one, and one-half of one per cent. acting through eight, twenty-four and fifty-two hours. One-third of one per cent. showed growth within the period of eight hours. At a temperature of 30° C., three and one-third, two, and four-fifths of one per cent. showed no growth in periods of eight, twenty-four and fifty-two hours. One-third of one per cent. showed growth while acting eight and twenty-four hours, and one-sixth of one per cent. showed growth in the three experiments of eight, twenty-four, and fifty-two hours.

These results indicate that one-third of one per cent. is not sufficient to kill the ordinary putrefactive

bacteria at the usual room temperatures. At a higher temperature the action of the styrone is a little stronger, but one-sixth of a per cent. does not destroy the bacteria even at a temperature of 30 C. (86 F).

(2) On Anthrax Spores.

Cleansed and sterilized silk threads were soaked in bouillon containing large numbers of disseminated anthrax spores obtained from potato cultures of anthrax grown at a constant temperature of 30° C. The threads were then quickly dried.

A number of these threads were placed in strong styrone. At intervals ranging from two minutes to twenty-six hours, two threads were taken out and placed in five centimetres of gelatine, and a roll-tube made. In every case an abundant growth of anthrax resulted, showing that styrone, even in full strength, is incapable of killing anthrax spores.

Another set of experiments similar to these was made with the saturated solution of styrone spoken of in the following paragraph. The results of these experiments were the same as those where styrone in full strength was used, showing that admixture of water with the styrone did not, in this case at least, increase its germicide action.

(3) On the Bacillus of Asiatic Cholera (Koch).

Eight test-tubes containing sterile bouillon were inoculated with the bacillus, and allowed to develop for twenty-four hours at a temperature of 35° C. To four of these tubes a quantity of a saturated solution of styrone, equal in bulk to the bouillon already present was added, and the tubes placed in a incubator at 35° C. From these tubes, and also from those not treated with styrone, samples were taken and roll-tubes prepared. In all the roll-tubes from the untreated cultures an abundant growth of the bacillus could be seen on the second day. From the tubes treated with styrone, samples were taken five minutes

after the addition of the styrone, in two of the resulting roll-tubes no growth appeared, in the other two, there were 180 and 360 colonies respectively. Samples taken twenty-four hours after the addition of the styrone contained no living bacteria.

The saturated solution of styrone which was used in these experiments, and the following ones, was prepared by heating a slight excess of the styrone with tap-water until the water reached a boiling point, allowing the mixture to become cold, and then filtering through a moistened filter. In this way a perfectly clear and homogeneous solution was obtained. This method was employed in order to avoid the use of an emulsion which might be of widely varying strength.

(4) On the Streptococcus Pyogenes.

Fresh cultures of the streptococcus pyogenes were obtained from a metastatic abscess in the axilla. With this material a number of bouillon cultures were made. and, after forty-eight hours incubation at 36.5° C., treated with definite proportions of the saturated aqueous solution of styrone. Roll-tubes were then made as in the previous experiments, to test the cultures for viable streptococci. The results are given in the following table:

Styrone Sol.	100 % †	3 % †	6 %	9 %	12 %	15 % †	21 %	30 %
After 8 min.	****	..	..	..	..	..	..	..
" 1½ hrs.	0	****	..	..	..	**	..	..
" 2 "	..	****	****	****	****	**	*	*
" 4½ "	..	****	..	..	..	**	..	..
" 6 "	..	****	****	****	****	*	*	*
" 8 "	0	..	..	..	..	..	..	..
" 18 "	0	..	..	..	..	..	..	..

† Experiment made in quadruplicate, the others made in duplicate.

An attempt has been made in the above to indicate the relative number of colonies present in the roll-tubes, as compared with the number in a control roll-tube made from a culture of the streptococcus prepared at the same time and manner as those to which the styrone solution was added, but to which no styrone had been added. The growth in those roll-tubes in which the number of colonies did not differ materially from that in the control is indicated with four asterisks, a considerably smaller number with three, and so on. The cultures were kept at a temperature of 36.5° C.

In order to determine whether the multiplication of the streptococcus would be inhibited by the addition of a smaller proportion of styrone than would be necessary to kill it, the following experiments were made. To test-tubes containing a known amount of agar-agar definite proportions of the styrone solution were added, and, after thorough mixture, the agar quickly solidified. These tubes were then inoculated with the streptococcus, and placed in the incubator at 36.5° C. At the same time a control culture was made to serve as a standard of comparison. Great pains were taken to have the amount of the bacterium used the same for all the tubes. The result of a comparison of the growth in the styrone-agar tubes, with that in the control-tube is given in the following table.

Styrone Sol.	0.8%	1.6%	2.4%	4%	5.6%	8%	12.5%	25%
After 24 hours,	****	****	****	****	****	****	0	0
" 7 days,	****	****	****	****	****	****	0	0

(5) On Staphylococcus Pyogenes Aureus.

This coccus was obtained in fresh culture from pus

derived from an acute abscess. The experiments with it were parallel with those made with the streptococcus, and require no special description. The results of bouillon cultures of the staphylococcus treated with styrone solution at 36.5° C., are tabulated as follows:

Styrone Solution added	100 %	60 %
After 1½ hours	****	..
" 2 "	..	****
" 10 "	..	****
" 24 "	0	..

Agar-agar, containing definite proportions of styrone, was inoculated with the staphylococcus. Kept at a constant temperature of 36.5°, and compared with a control culture of the same age, the styrone solution of eight-tenths, one and six-tenths, two and four-tenths, four, five and six-tenths, eight, twelve and five-tenths, and twenty-five per cent.. after twenty-four hours and seven days, showed in each case a growth in which the number of colonies did not differ materially from that in the control tube.

(6) On a Guinea Pig.

A guinea pig weighing 720 grammes, was fed, by means of a stomach-tube, with the saturated solution of styrone used in the foregoing experiments. The experiment was made three times, the dose being two cubic centimetres, five cubic centimetres, and ten cubic centimetres. In no case did any appreciable effect result.

B. Experiments with Sulphonaphthol.

(1) On Streptococcus Pyogenes.

Sulphonaphthol Solution added,	100 % †	3 %	15 %
After 8 minutes	0	..	..
" 1¼ hours	..	**	0
" 4¼ "	..	**	0
" 24 "	0	..	..

† Experiment made in quadruplicate, the others in duplicate.

These experiments were similar to those made with styrone. The sulphonaphthol was used in a solution prepared by adding about three cubic centimetres of it to fifty cubic centimetres of water, heating to incipient boiling, cooling and filtering. Temperature 36.5° C.

To determine the inhibitory action of the sulphonapthol. Temperature 37°.

Sulphonaphthol Sol.	0.8 %	1.6 %	2.4 %	4 %	5.6 %	8 %
Growth after 24 hours,	0	0	0	0	0	0
" " 7 days,	0	0	0	0	0	0

(2) On Staphylococcus Pyogenes Aureus. Temperature 36.5°.

Sulphonaphthol Solution added . .	100 %	21 %
After 1½ hours	0	*
" 24 "	0	0

To determine inhibitory action:

Sulphonaphthol Sol.	0.8 %	1.6 %	2.4 %	4 %	5,6 %	8 %
Growth after 24 hours,	****	***	*	*	0	0
" " 48 "	****	****	*	*	0 (?)	0
" " 72 "	****	****	**	*	*	0
" " 9 days.	****	****	****	****	*	0

(3) On Anthrax Spores.

Silk threads containing anthrax spores were immersed in sulphonaphthol, full strength, for twenty-four and forty-eight hours, and then roll-tubes made. In all cases an abundant growth of anthrax resulted after the threads had been transferred to gelatine.

C. Experiments with Pure Volatile Eucalyptus Extract.

(1) On Streptococcus Pyogenes.

A saturated solution was prepared in a manner similar to that followed in the experiments with styrone. Temperature 36.5°.

Eucalyptus Solution added	100 %
After 8 minutes	****
" 8 hours	****
" 18 "	****
" 24 "	****
" 7 days	***
" 8 "	***

(2) On Staphylococcus Pyogenes Aureus. Temperature 36.5°.

Eucalypti Solution added	100 %
After 1½ hours	****
" 24 "	****

(3) On Anthrax Spores. No effect.

D. Experiments with Glycoboron.

(1) On Streptococcus Pyogenes.

A ten per cent. solution was used. Temperature 36.5°.

Glycoboron Solution added	100 %
After 8 minutes	****
" 8 hours	****
" 18 "	****
" 24 "	****
" 7 days	****
" 8 "	****

(2) On Staphylococcus Pyogenes Aureus.

Glycoboron Solution added	100 %
After 1½ hours	****
" 24 "	****

(3) On Anthrax Spores.

No effect, even in full strength.

E. Experiments with Carbolic Acid.

These six experiments were made parallel with those to determine the inhibitory action of styrone and sulphonaphthol on the staphylococcus pyogenes aureus. A saturated solution of carbolic acid was prepared and used in the same manner as the solutions in the former experiments. Temperature 37° C.

Carbolic Acid Sol.	0.8 %	1.6 %	2.4 %	4 %	5.6 %	8 %
Growth after 24 hours,	****	****	****	****	***	*
" " 5 days,	****	****	****	****	****	***

COPAIBA IN SURGERY.

BY H. H. A. BEACH, M.D.,
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In the long-continued use of copaiba as an internal remedy, its value in surgical dressings may have been gradually lost sight of, until now it lies among the rubbish of forgotten things that excite only the interest of the antiquarian, its connection with a living and progressive art having in some unaccountable way become severed.

Some years ago, while reading the interesting description of "Medical, Surgical and Anatomical Cases," published by Lawrence Heister, in London, 1755, I was much impressed with the importance he attached to the balsam of copaiba in his dressings, and determined to test the drug in that capacity. It was accordingly applied to an indolent granulating surface, by first saturating charpie with the balsam, and after squeezing out the superfluous balsam, bandaging the charpie upon the ulcer. The unusually rapid growth of a handsome bed of rosy granulations, ready for the grafting process, was so clearly attributable to its use, that I continued to employ it, and finally adopted it as regular dressing to granulating surfaces in my hospital wards. It is simple, cheap, quickly prepared, and most satisfactory in its results. Its use has gradually spread to the wards of my colleagues at the hospital, and it is now an accepted dressing; being especially adapted to the flat, pale, granulating surfaces that commonly result from avulsions of the scalp, extensive burns and scalds, also for the cavities after operation for removal of necrosed and carious bone. It has

succeeded in raising healthy granulating surfaces for grafting after other stimulating applications had failed. At the hospital it is applied with cotton-waste instead of charpie. The waste can be easily picked apart and cut into short bits by convalescents. The porous nature of the dressing permits a ready absorption of pus and of its partial disinfection by the copaiba, which imparts a fragrant balsamic substitute for the sourish odor of pus partly decomposed. On the chances that its activity as a dressing depended upon the copaivic acid which it contains, I have also applied that substance with a negative result.