

takes place or not; perhaps it exists in birds' eyes; at least we find here the most interesting fact, that by ciliary muscle contraction the inner lamellæ of the cornea are displaced toward the anterior lamellæ.

2. Change of position of the retina. Formerly, even for the human eye, this mechanism was admitted, and of late years some oculists have asserted that the so-called accommodation in aphakic eyes was to be explained by a slight displacement of the retina backwards. But this aphakic accommodation is, no doubt, only an apparent one; by careful observation we can show that the aphakic eye lacks any accommodative change. Whether in animals an accommodation is possible by change of the axis is not yet quite certain; it may perhaps be possible in cephalopods' eyes; here we find the sclerotic extremely thin and changing its position on the slightest pressure.

3. A third possibility of accommodation is the displacement of the lens forward or backward without or with change of its convexity. This interesting mechanism is to be found in fishes' eyes (Beer). The eyes of fishes show, when at rest, myopic refraction of from 5 to 6 diopters; they have a negative accommodation, that is, for the distance, and this is performed by approaching the lens to the retina; the lens itself does not change its shape.

This movement of the lens is produced by a band-like muscle, "campanula Halleri," which stretches from the inferior part of the lens to the retina, the upper part of the lens being fixed to the sclerotic. By contraction of the muscle the eye can become approximately emmetropic.

A most interesting peculiarity is this: The movement of the lens is not directed straight backward, but backward and a little to one side, so that the image of an object is displaced sideways from the original position on the retina.

The fish's eye is thus seen to be wonderfully adapted to its task; as a rule the fish has to see near objects and is only exceptionally called on to see to far distances; it never becomes presbyopic, and by the lateral movement of the lens the fish is enabled to follow an enemy's movement without moving the eye.

In cephalopods' eyes a similar mechanism takes place, yet here we have no campanula, but a ciliary body very similar to that of mammals; its contraction draws the lens backward, so that here also we have normally a negative accommodation at a distance.

The mechanism of lens displacement, without change of convexity, is also to be found among reptiles; some of them seem to have a very slight range of accommodation, others, as for instance, the turtle, a larger one. Here a most remarkable positive accommodation takes place by advancement of the lens, which is in part produced by an increase of pressure in the vitreous, so that the lens is pushed forward through the pupil; it is very easy to observe this wonderful phenomenon in enucleated turtle eyes.

The interesting details on the comparative physiology of accommodation are inexhaustible. I wanted to show the different ways by which Nature has realized the problem of adapting the eye to different distances. As to human accommodation, I hope I have shown that many important questions, which at the first glance seem to be merely practical, are in intimate connection with physiologic science and can be elucidated by physiologic experiment. Any progress in our practical work should be preceded by scientific investigation.

EXPERIMENTAL PATHOLOGY AND SURGICAL TREATMENT OF ERYSIPELAS.*

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Since the discovery of the staphylococcus as a cause of suppuration and the streptococcus as the cause of erysipelas these organisms were found in many other conditions, and hence have long since lost their position as the cause of suppuration and of erysipelas only.

The streptococcus is found in septicemia and as a complication of diphtheria and other affections; while the staphylococcus is found in furuncles, carbuncles and all abscesses of a subacute nature.

When a wound is infected in these days of antiseptic precautions, pus abounds at first with staphylococci alone. In pre-antiseptic days, when pus was considered an almost desirable condition, when wounds were uncleaned, an erythema corresponding to erysipelas soon developed, accompanied by the clinical manifestations characteristic of this disease. It was evident that what seemed to be an ordinary infection could, when neglected, transform itself gradually into a more marked and virulent form, to be followed by general septicemia. At present these complications are not allowed to manifest themselves owing to prompt antiseptic cleansing.

The phenomenon, however, was apparent that if wounds were not cleansed the infection, which seemed moderate at first, would become more and more aggravated, apparently erythematous erysipelas or violent phlegmonous erysipelas, resulting in gangrenous cellulitis or hospital gangrene. Especially was this the case if the infection took place in the superficial lymphatics where phagocytes are not so plentiful as in the deeper or cellular lymphatics, and where the opsonins could not so readily help in the process of destruction.

Clinical experience has proven this point. If, however, the infection be locked up in the subcutaneous tissues, then an abscess, which may be strictly circumscribed at first, becomes more and more virulent in appearance. These clinical phenomena led me to experiment with the staphylococcus and streptococcus under various conditions to see whether or not it was possible to alter the virulence of these apparently dissimilar organisms so as, in a measure, to explain the clinical phenomena.

The following experiments were carried out by me in the bacteriologic laboratory of the Medico-Chirurgical College. The streptococcus was isolated from a virulent case of septicemia, which proved fatal in eight days' illness. It gave the typical growth on gelatin and agar.

Tubes containing 10 c.c. of bouillon were inoculated with virulent streptococcus, one tube being kept neutral. To a series of eight were added a 1 per cent. solution of bicarbonate of soda in minims of 2, 4, 6, 8, 16, 32, 64 and 100 respectively; likewise to the same number of minims was added a solution of hydrochloric acid, 1 to 1,000. This whole series of acid, neutral and alkaline media were then placed in an incubator at 44 degrees C. The result of this experiment showed a plentiful growth of streptococci in the neutral tube. The streptococci also grew in the series of acid tubes seemingly well, but losing the chain-like arrangement and partaking more and more of the staphylococci or grape-like arrangement, until they seemed typically staphylococci in the tube containing 100 minims.

When a gelatin culture was made from the tube containing

* Read in the Section on Surgery and Anatomy of the American Medical Association, at the Fifty-eighth Annual Session, held at Atlantic City, June, 1907.

100 minims of the acidulated solution, the growth produced appeared typically as an ordinary *Staphylococcus albus*, the appearance of the original streptococcus having been altered in the acidulating process.

On the other hand, throughout the whole series of alkaline tubes, the organisms grew, retaining their typical streptococcic appearance. The alkaline group retained the toxic conditions, while the acid group seemed gradually to lose it. It became evident to me, therefore, that in the presence of a streptococcic infection an acid antiseptic medium would more readily diminish the virulence of the streptococcus, and would tend to restrain the development, and gradually destroy it, than a neutral or alkaline antiseptic solution.

In 1887¹ I published an article which demonstrated, for the first time, that the coagulating power of the bichlorid of mercury solution, when coming in contact with the blood, would disappear by acidifying this solution. In this way the original antiseptic power of bichlorid of mercury would not only be retained in presence of albuminous substances, such as blood, but also be greatly enhanced. This was done by the addition of 5 parts of hydrochloric acid to a solution of bichlorid of mercury, 1 to 1,000. I also at that time, for practical purposes, embodied the same idea in the shape of an acid sublimate tablet by which solutions could readily be prepared; that is, a combination of tartaric acid with bichlorid of mercury, which is now used extensively.

The experiments thus produced seem to fulfill all the expectations claimed for them in making the bichlorid of mercury solutions more reliable than ever before.

I have treated erysipelas by local applications of acid, bichlorid of mercury, ice-cold solutions. I did not suspect at that time the additional fact that acid medium, as demonstrated by the experiment just related above, would have the added property of so altering the soil as to mitigate at once the virulence of the streptococcus.

The virulence of an attack of erysipelas depends not only on the virulence of the infecting streptococcus, but also on the propitious quality of the patient's soil—the more alkaline the medium the more rapid and more virulent the development of erysipelas.

The opsonic index in cases of erysipelas is not always the same, and depends largely on the relative alkalinity of the patient's serum. A clinical fact of great interest has been the lack of immunity which erysipelas affords after an attack; on the contrary, an attack of erysipelas leaves the patient more susceptible to future attacks, showing that the opsonins of erysipelas are either very scanty or else disappear from the system for some unknown reason.

Perhaps the most important light thrown by Pasteur on infection was the fact that a micro-organism would be increased and decreased in virulence under different surroundings, giving pathologic manifestations of very different intensity.

The truth of this discovery is especially manifest in the fact that, while suppurative foci do occur now and then in operative cases, they are seldom or never found in the hospital clinic as was frequently the case in pre-antiseptic days.

When the suppurative process was started, it was rather favored in its development than checked on the supposition that pus consisted of the foul humor of the body finding its exit through the wound. The retention of pus locally in the foul surroundings allowed the organisms to rise in virulence and gradually to assume a degree that would result in symptoms of erysipelas. When a patient was contaminated from a wound in

which the organisms had reached such a violent stage, erysipelas would start from the outset. This occurrence is rare now, because of the care with which infected wounds are sterilized from the first.

If, however, the infection has already taken place, the phagocytic action of the blood must be increased by the administration of heart tonics, such as strychnin, digitalis and tincture of the chlorid of iron. Local, acid, ice-cold solution, according to my formula mentioned above, affords the best antiseptic action for this purpose; it should, however, be made to gain direct access to the infected structures. Since the infection exists in the lymphatic vessels, it is proper to make scarifications of the skin according to Esmarch—especially for two or three inches beyond the infected area—so as to lay open the lymphatic vessels. The venous capillary hemorrhage that ensues allows the vast numbers of infected streptococci to escape, while the ice-cold solution of bichlorid of mercury applied to the lymphatic vessels comes in direct contact with the streptococci in their course of absorption.

Should the nose or some delicate part of the face be infected, the scarifications can be replaced by copious acupuncture. A compress is kept to the parts constantly wet with the solution. Cold, as here applied, is made the medium which contributes to the destruction of the streptococcus. Should the case become complicated by a deeper infection involving the cellular tissue, an incision should be made over the affected area for thorough drainage and for the further sterilizing of the wound. I believe that all the indications are met directly in this manner.

The use of an acid, ice-cold bichlorid of mercury solution, as well as the scarification of the infected area, constitute the main points of advantage over the methods generally used.

In making the scarifications, the skin is stretched, and the lymphatic vessels and capillaries are distended; the weight of the blade only should be the pressure at the cutting edge. Sufficient force is thereby exerted to obtain the desired result; that is, an opening in the lymphatics. The skin being distended, owing to the attack of erysipelas, the scarifications do not amount to any more than a pin scratch.

My experience in a large number of cases both in hospital and private work has resulted in unfailing success by checking, from the first, the starting infection; for I believe that through the constitutional tonic treatment with the tincture of the chlorid of iron and the local antiseptic measures all the indications of this violent form of infection will be conquered.

From the above I conclude that:

1. Erysipelas varies in its form of attack according to the violence of the streptococcus at the time of the invasion.
2. The receptivity of the patient is also an important factor.
3. Acid media of themselves diminish the violence of the streptococcus.
4. Simple alkaline medium tends to increase the virulence.
5. Our antiseptics become more potent if the solution is acidulated.
6. Direct contact of antiseptic solution with the streptococci in the lymphatics can be obtained by gentle scarifications of the reddened area, and that the course of the organisms can be stopped if the scarifications are

1. Deutsch. med. Wochschr., No. 40, 1887.

made for an inch or two beyond the diseased surface, allowing the solution to arrest and destroy the organisms on their inward path.

DISCUSSION.

DR. A. J. OCHSNER, Chicago, thought Dr. Laplace's suggestions worthy of trial. If it is possible to change the virulence of the streptococcus regularly in this manner, the paper, he stated, marks a very important step in the progress of therapeutics and in our ability to manage this disease scientifically. The change from streptococcus to staphylococcus seems most remarkable. So far as the practical part of the paper is concerned, he would look on it with very much less enthusiasm than on the scientific observations which it contains. There is no doubt but that, in cases of erysipelas seen early, it is a simple matter to dispose of the infection. Dr. Ochsner called attention to the fact that about fifteen years ago the *Berliner klinische Wochenschrift* contained an article based on a very large number of observations made in one of the German prisons where erysipelas was endemic. The medical director of this prison discovered empirically that if these prisoners, at the very beginning of the attack of erysipelas, were at once treated by means of careful washings with strong alcohol, repeated at intervals of an hour, directed toward the point of infection instead of away from it, in order not to carry the infection further, he could regularly abort the disease. The number of cases observed in this prison was so large, and the description of the cases seemed so honest and reasonable that from that time Dr. Ochsner has used this treatment and he has found it reliable. Since that time recurrent cases of facial erysipelas that have come under his observation, and the observation of those who have worked with him, have invariably resulted in cutting short the attack when this mode of treatment was employed. Of course, he said, it is possible that the use of alcohol in this manner has an effect similar to that of the acid described in the paper. These observations, he thought, show either that these aborted streptococci will return to be virulent streptococci or that they remain indefinitely in the staphylococcic form. If there is any uniformity in this, it is certainly a most important observation. Of course it is known from clinical observation that there is a tremendous difference between erysipelas and erysipelas. There are cases of erysipelas that never amount to anything so far as their severity is concerned, although they may extend over the entire body. Other cases run a very severe course, and, he thought that the facts stated in this paper might be an explanation of the clinical observations with which we are all familiar.

DR. ERNEST LAPLACE, Philadelphia, said that the streptococcus, when cultivated in an acid medium at 104 F., seems gradually to diminish in virulence. Pasteur laid special stress on the varying virulence of germs under different circumstances. A notable example of this consists in what takes place in inflammation of the appendix, where the micro-organisms, being located within the cavity, gradually increase in virulence to the extent of causing gangrene, reminding one of the bygone days of surgery where lack of antiseptic precautions favored the development of hospital gangrene.

The Best Professor of Clinical Medicine in the World.—A breezy little article giving advice to a medical student in the *Gaz. Méd. Belge*, page 352, concludes with the remark that the best professor is the patient himself. "Besides what you can learn from him, all the rest is of trifling importance. He is the one you must listen to, for he will not deceive you nor brag of his own ideas and discoveries, and while you are listening devour him with your eyes. Try to get on the best terms with him. Go to him early in the morning. Be the first at the hospital; you can leave when you choose after every one else is there. In taking your vacation, plan to be in the hospital when the rest have gone on their vacations. In selecting teachers seek those who talk to the patients rather than about themselves at the bedside."

THE SUDDEN APPEARANCE OF APNEA IN
THE COURSE OF TABES DORSALIS
AND ARTERIAL SCLEROSIS.*

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The first patient, a young married woman 26 years old, had a syphilitic infection seven years ago. The past six months the patient has suffered from lancinating pains in the thighs and legs. She has also been annoyed with the feeling as though there was some substance interposed between the soles of her feet and her shoes. There have also occurred several attacks of nausea and vomiting, which, from her description, could very well have been gastric crises. Besides these attacks of nausea and vomiting there were no signs of vagus involvement.

Recently the thigh and leg pains grew so intense that morphin was required to allay the pain. The patient showed no disturbance of coordination. The pupils reacted sluggishly to light. The patellar and ankle reflexes were absent. The tactile sense and perception of temperature and of tuning-fork vibrations were unimpaired. There was, however, well pronounced hypoalgesia in the feet, legs and thighs, and the plantar surfaces of both feet exhibited a marked delay in transmission of the pain sense. The absence of patellar reflexes, the presence of hypoalgesia and delay in transmission of the sense of pain without trophic symptoms or any other signs, of multiple neuritis or syringomyelia, justified the diagnosis of tabes dorsalis. During the morning of the same day on which I examined her the patient was given $\frac{1}{4}$ grain of morphin hypodermically. About forty minutes after the injection of morphin the patient suddenly, and without the slightest sign of distress, ceased breathing and lapsed into a semicomatose state. The attending nurse used artificial respiration for about twenty minutes, when suddenly automatic respiration and consciousness were simultaneously resumed.

The patient had been given $\frac{1}{4}$ grain morphin hypodermically as I entered the house, and a few minutes after I had finished my examination there recurred the same symptoms seen in the morning. The patient became unconscious and ceased breathing. There was a slight cyanotic tinge to the skin of the whole body, the lips were pale and cyanotic. The pulse, which had been 80 up to the advent of apnea, now had a rate of 120. The radial artery widened its lumen. The diameter of the radial artery seemed to have increased threefold, but the maximum pressure was greatly diminished. At the same moment a pulsation in the dorsal veins of the hands was plainly visible. The pulsation was centripetal and strictly synchronous with the arterial pulse. The veins of the hands were dilated, but there were no signs of stasis from the right heart, either in enlargement of the heart's area of dullness to the right or dilatation of the jugular veins. In other words, the patient had vasomotor relaxation in the veins as well as in the arteries. The instant automatic respiration was resumed (after a lapse of about twenty minutes) all signs of vasomotor relaxation disappeared; the artery retracted to its original caliber. The veins retracted at the same instant to their usual size, the venous pulse disappeared and the pulse rate dropped from 120 to 80.

* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-eighth Annual Session, held at Atlantic City, June, 1907.