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MEDICAL AND SURGICAL REPORTS

OF THE

BOSTON CITY HOSPITAL



Sixteenth Series

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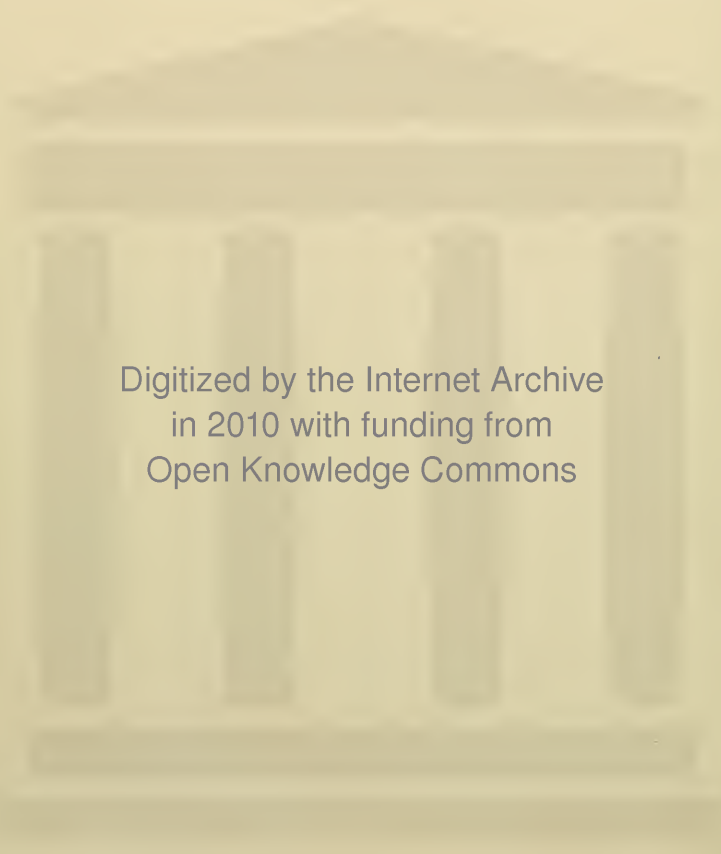
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MEDICAL AND SURGICAL REPORTS

OF THE

BOSTON CITY HOSPITAL

Sixteenth Series

EDITED BY

GEORGE H. MONKS, M. D., GEORGE G. SEARS, M. D.,
AND F. B. MALLORY, M. D.



BOSTON
PUBLISHED BY THE TRUSTEES
1913

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PREFACE.

The present volume of Medical and Surgical Reports is the first that has been published since 1905. It contains a collection of papers by members of the Staff, some of these papers now appearing for the first time, and some of them being reprints of articles published elsewhere.

The editors wish to acknowledge the kindness of the Trustees in making possible the publication of these reports. The expense of the illustrations has been defrayed by contributions from the Trustees, the Boston City Hospital Alumni Association and the authors of the different articles.

The editors have been greatly aided by Dr. Walter C. Howe, and they desire especially to express their indebtedness to him and their appreciation of his services.

It is hoped that another volume of reports will be published as soon as the material available seems to warrant it.

GEORGE H. MONKS, M. D.

GEORGE G. SEARS, M. D.

F. B. MALLORY, M. D.

A LIST OF THE TRUSTEES, THE MEDICAL
AND SURGICAL STAFF, AND THE
HOSPITAL OFFICERS.

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I.

THE THEORY OF MEDICINE AS CONTRASTED WITH THE ART.

BY DAVID W. CHEEVER, M. D.

This brief paper contains no new information, and those who are reading only to gather facts are advised to omit it.

It is hard enough to keep up with the polyglot medical literature of the day. And yet the writer dreams that some few doctors might be benefited by reading what follows. It is a plea for the recognition of the individual as distinct from a system; for the patient, rather than the case.

No one can deny, for example, that the *technique* of a hospital surgeon, who toils through six to twelve operations a day, is superior; it is like the minute and unvarying processes that make a pin or a nail. But the result of the former is not a pin; but a human being, complex, animate, sensitive. The wound may be exact and heal well; the patient may get well, but he will not be happy under a mechanical treatment alone. He lacks something; he longs for something; he suffers for want of sympathy.

If to the horrors of apprehension are added the mental pains of conscious anæsthesia, he notes and feels each step of the operation and each doubt which presents itself. He learns too much, when he should know nothing. So, too, any unnecessary exposure of apparatus before an operation discourages the patient.

Did you ever sit in the dentist's chair and wonder and dread and watch what tool he will use next on a sensitive tooth?

Suppose yourself laid on your back, and looking at a glittering heap of instruments tabled near you. Is it reassuring? Add to this the careless half-allusions of medical assistants and the wonder-bearing tattle of nurses.

All patients are not treated so; none should be.

Unconscious anæsthesia should be procured in bed and not on the operating table.

Apprehension is unreasoning, terror is childish, but so are many sick people; these emotions inflict a needless strain on the nerves; they craze some people, and they delay and even prevent recovery in others.

A long-watched, doubtful and trying case of mine finally and most reluctantly assented to operation. During the long minutes of waiting her turn I sat by her and tried to reassure her. She inhaled ether in fear, and yet anæsthesia was easy and complete. The operation was skilfully and quickly done — there was no complication. Antisepsis was not at fault,— she was strong enough to bear such an operation, and yet immediate arrest of peristalsis followed her rousing from ether; not vomiting, not immediate collapse, but death in thirty hours, with a distended abdomen, absence of all bor-borygmi, gradual failure. She died of shock.

What was extreme and fatal in her case is often needlessly, though not fatally, inflicted on sensitive patients. They are harmed by it; they could and should be spared even the slightest shock from preparations, delay, exposure.

An elderly and feeble woman was operated on by me for cancer of the breast. She was very nervous, timid and unreasonable, but perfectly sane. I hurried the operation, and refused the axillary dissection, on the ground that it would be too much for her and that a scirrhus of the breast, at her age, did not travel fast. She recovered from the surgery and passed into chronic mania.

With every symptom of appendicitis, except temperature, a strong woman was urged to operation; she refused; we delayed; symptoms deepened; she resisted all and any operation, but it was thought a duty to insist. Reluctantly she yielded, but declared she should die — there was nothing about the operation that should have prevented recovery. She died of arrest of peristalsis in thirty-six hours.

Under the perfectly proper apprehension of her surgeon who had not had time to study her case, a woman was forbidden to return home, taken to a hospital, kept over night, operated on the next morning for what was diagnosed as tubal pregnancy, which was found, but in a subacute and not urgent state. She recovered, but this is the point: I found her just before operation; having vomited all night from shock (not having been sick when she visited the surgeon the afternoon before), she was exhausted and in bad shape. I advised nutrient enema

with brandy, and perhaps brandy subcutaneously. Ether stimulated her all right. She did well, but was very long in recovering digestion and strength. This might have been a dangerous case, was unnecessary, and shows the need of individual and patient attention in surgery done *en masse*.

I used to wonder at and not justify the optimism of a noted practitioner,— to the patient chiefly, less to the friends. As I reflect I am inclined to think he was wise and did best. The doctor must not lie directly, but he is right in concealing or stretching the truth. Hope is often the sheet anchor for the patient. With human beings we should be humane. "*Ars est celare artem.*"

Laboratory methods give precise and unmistakable knowledge; the patient is incapable of recognizing this, but he will appreciate and be the better for cheerful sympathy and a personal interest.

If to surgery, how much more to common illnesses do these views apply? The sick body means a sick mind. What does it need? What does it crave? What benefits it?

Hearty interest — cheerful contact — hopeful words. Especially in a chronic case, he will succeed best who reads character as well as symptoms, and ministers to the soul as well as the body.

Lucretius, noblest of Latin poets, combining fire and air and water to make a living being, says there is something more, "*nescio quid*," the "*anima*," or spirit; and this he even distinguishes from the "*animus*," or ordinary intelligence.

Bind up and heal the broken and trailing tendrils of this "*anima*" with assurance and cheer.

II.

THE USE OF OPIUM IN GANGRENE.

BY GEORGE W. GAY, M. D.

The object of this paper is to call attention to the beneficial effects of opium in certain conditions and lesions of the lower extremities occasionally met with in elderly people. While serving as interne in one of our hospitals in 1865, in the days of "Swan Alley Ulcers," hospital gangrene, etc., the writer was taught the value of this drug in those conditions resulting from degeneration of the blood vessels of the lower extremities, due to arteriosclerosis, atheroma, thrombosis, etc. Of course the importance of these changes was not appreciated in those days as it is at the present time. Now it is a familiar saying, even among the laity, that a person "is as old as his arteries." Arteriosclerosis, "hardening of the arteries," as common parlance has it, is a very common condition and means a wearing out. Many of the sudden deaths from "acute indigestion," as reported in the daily press, are due to this degenerative affection. For example, a clinical picture frequently met with in elderly people by every practitioner consists in dyspnoea, short breath on running up stairs, chasing a street car, or undergoing any unusual mental excitement. In the absence of other competent explanation of the symptom, it indicates a degeneration of the coronary arteries, or of those in other parts of the body, that means destruction. There is no cure for this condition, although a great deal can be done to prolong life and make it well worth the having.

When vascular degeneration affects the lower extremities in the form of endarteritis, atheroma, thrombosis, etc., we have other manifestations that may terminate disastrously. The arterial coats are thickened and, in consequence, lose their elasticity. The lumen of the vessels is diminished, the circulation is retarded, capillary action is impeded, stasis follows, and the tissues break down in indolent ulceration, sloughing and gangrene. Similar conditions are not infrequently met

with in diabetics, and while these patients should receive the peculiar dietetic treatment applicable to this affection, yet the method advocated in this article may well find a useful place in the management of these cases in accordance with suggestions that will appear later.

Pain in the feet and especially in the toes of elderly people is suspicious of a more serious affection than "rheumatism." It may be the initial symptom of an indolent ulceration which may terminate in gangrene. Should the patient be a victim of arteriosclerosis, as most of them are, the dangers resulting from impaired nutrition are all the more imminent.

Upon inspection the circulation will be found sluggish, as indicated by the dark, purplish color and slow return of blood following pressure, etc. The tibial vessels will be indistinct, or not to be detected by palpation; sensation may be altered, as well as the temperature. Under these circumstances even trivial lesions, as abrasions, blisters, black spots, etc., demand careful attention. They may mean mischief. The toilet of the nails calls for much care. Corns and bunions should not be neglected, but on the contrary should receive respectful consideration. The circulation and the nutrition of the parts are seriously impaired, and unless corrected to a certain degree, destructive processes may ensue to the permanent harm of the patient.

Whatever may be the cause of the conditions under consideration, whether it be arteriosclerosis, atheroma, diabetes, thrombosis, embolism, etc., the indications for treatment are to stimulate the circulation and to increase the nutrition by supplying the tissues with more pure arterial blood.

For the attainment of these objects the most efficient drug known to the writer is opium. It relieves pain and quiets restlessness. It is a tonic to the heart and blood vessels. It supports the nervous system. Used properly, it produces a calm, even sense of comfort and contentment. It stimulates the circulation and thereby increases nutrition of the tissues in the extremities.

For the class of cases under consideration opium is preferable to any of its derivatives, as morphia, codeia, etc. The deodorized or the simple tincture is more convenient of administration than are the solid preparations, as the dose can be more readily adapted to the varying conditions. The initial doses should be small, that the physiological and not the toxic effects of the

drug may be obtained. This is an important factor in the method and merits careful attention. In ordinary cases it is well to begin with two or three drops of the tincture, deodorized or simple, night and morning. This amount may be increased by one or two drops every four to six days until some improvement is evident either in relief to the pain or the appearance of the affected parts. The moment that appears, the dose is to be maintained, or perhaps lessened a little. The writer has never had occasion to exceed twenty drops in divided doses in the twenty-four hours. One of his cases has taken ten drops daily for two years or more with benefit and no harm. It seems to act as a tonic similar to strychnia, except that the improvement was much more apparent under the opiate treatment than it was under the former agent.

In many instances the drug should not be left in the control of the patient, nor need he know what he is taking. The physician or some reliable person should have charge of the medicine, "the drops," to insure the proper dose and a proper restriction of the amount taken. These precautions are essential to obviate the danger of establishing the opium habit. One of my patients in the long-ago pauperized himself and some of his friends through lack of a proper supervision. He took hundreds of bottles of "McMunn's" elixir of opium, which was at one time used extensively until supplanted by the deodorized tincture. His sloughing ulcers of the leg healed and remained well during the remainder of his life, but he got out of bounds in the use of the drug. This is the only instance the writer has seen of this sort under this mode of treatment.

The long continued use of opium, the "long dose," as that prince of medical lecturers, Dr. Edward H. Clarke, used to term it, calls for judgment and discretion in order to obtain the full benefit of the method. Careless, offhand prescribing has no place in the use of this powerful and seductive drug. It is better to avoid giving it on a prescription as much as possible. The physician should control not only the dosage, but also the entire quantity consumed, as a guaranty that only the desirable effects shall be obtained.

So far as the amount is concerned, the same rule should be followed here as is indicated in the opium stage in malignant and incurable diseases. Should the dose be too rapidly increased under latter conditions, or carried to too great an

extent, the time is liable to come when the drug ceases to give relief and the patient is indeed in a pitiable state. Her sheet anchor is gone. Her nervous system may be demoralized by the drug and the disease, and the ingenuity of the medical attendants is taxed to the utmost to give the relief so desirable in these distressing cases. Partial relief to suffering, which can usually be secured with moderate doses of the opiate, is preferable to entire relief for a time at the expense of large and increasing doses that cannot be long continued. In the class of cases under consideration in this paper, large doses of opium are not a tonic and would eventually do more harm than good. The writer cannot insist too strongly upon this point. It is the mild, tonic effects that are desired and not the stronger, variable, stimulating effects that are liable to be followed by a reaction that defeats the objects of the method. Properly managed under the supervision of a discreet physician, the drug can be used indefinitely with benefit. The stomach and bowels are not disturbed to any extent. Vitality is maintained. The nervous system is steadied and supported and life is better worth having not only for the patient but for all within the sphere of his influence.

A clergyman, 70 years of age, had gangrene of all the toes of one foot, except the fifth, which was the result of an embolism of the femoral artery following an operation for appendicitis. He had arteriosclerosis with atheromatous arteries. The question of an amputation was left to the decision of the writer. By reason of the degenerative condition of his blood vessels and the exhaustion of the patient, it was thought that his chances of life would be better under a conservative than under a radical mode of treatment. Furthermore, his circumstances were such that time and expense were of secondary importance. He was put upon two drops of deodorized tincture of opium night and morning. This dose was increased gradually until it had reached ten drops, *i. e.*, twenty drops in the twenty-four hours. Under this treatment the toes have dropped off, or have been snipped off if necessary, the wounds have healed and the patient is in good condition. He spends his winters in the South, takes an interest in life and is free from suffering. He has taken the drug three and a half years, taking ten drops daily. His family physician, Dr. H. J. Little, writes, "His recovery has been remarkable and is a marked tribute to conservative treatment and opium."

A police captain, 75 years old, a victim of arteriosclerosis, was gradually disabled from pain, swelling and redness of the feet and debility. He improved for a time under tonics and rest. Later, however, deep ulcers appeared on a toe of each foot and soon involved the other toes. One was amputated, but the wound refused to heal. The left foot became densely swollen, painful, red and shiny, threatening to slough. The old gentleman was prostrated by his condition and the question of radical treatment called for a decision. He was placed upon the opium treatment, as in the previous case, and soon an improvement was in evidence. One toe dropped off, or was snipped off with scissors. The ulcerations and wounds slowly healed and in a few months he had sound feet. He was free from pain and has remained very comfortable for over a year. In the words of the family physician, Dr. E. S. Boland, "In estimating the actual value of the opium, the fact that he also had rest in bed, good food, nursing and $\frac{1}{30}$ grain strychnia three times a day must be kept in mind, but he had all these before you gave him the opium and did not improve."

The personal element enters very largely in the management of these long and often tedious cases of senile degeneration. The patient is on the down-hill side of life. His tissues have a lowered vitality. His recuperative powers are impaired. He does not rally from comparatively trivial disturbances as he formerly did. One or more of his functions may be showing signs of failure. Fortunately, however, the patient does not usually realize, as does the medical attendant, that the fight is eventually to be a losing one, and that a moderate degree of comfort and as great a prolongation of life as may be are all that can reasonably be expected from any sort of treatment. Patience, tact and perseverance are indispensable to a successful management of these cases. Much, very much, can be done for the welfare of these patients aside from the use of medicine. But in the experience of the writer no drug excels the juice of the "divine poppy," opium.

III.

PERTUSSIS: THE HISTOLOGICAL LESION IN THE
RESPIRATORY TRACT.*

BY F. B. MALLORY, M. D., AND A. A. HORNOR, M. D.

INTRODUCTION.

Microscopic study of the trachea and lungs from three patients who died of whooping cough at the South Department of the Boston City Hospital shows a lesion which involves the ciliated epithelium lining the trachea and bronchi. The lesion is apparently peculiar to this disease and offers, perhaps, a mechanical basis as the cause of the characteristic symptoms. It is due to the presence of great numbers of minute bacilli between the cilia of the cells.

MATERIAL AVAILABLE.

The number of cases available for investigation has been very small, owing to the infrequency of death from uncomplicated whooping cough early in the disease. The tissues studied consisted of portions of the trachea and lungs obtained at two recent post-mortem examinations and of small pieces of lung from an autopsy done fifteen years ago. No nasal mucous membrane was preserved in any instance. More careful study of the distribution of the histological lesion throughout the respiratory tract is unquestionably desirable, but there is no knowing when tissue for such a study will be obtained. Therefore, it seems desirable to put on record the present incomplete observations.

LESION.

The first of the two recent cases is the more acute. Symptoms had existed for fifteen days or more. Microscopic examination shows large numbers of minute bacteria between the cilia of

* Reprinted from "The Journal of Medical Research," Vol. XXVII, No. 2 (New Series, Vol. XXII., No. 2), pp. 115-123, November, 1912.

many of the cells lining the trachea. The cilia of single cells or of small or large groups of them may be thus affected. The micro-organisms usually extend to the base of the cilia, but may reach only part way. They frequently cause a lateral spreading or mushrooming of the cilia covering a single cell. In many places the cilia are reduced to short stubs or are entirely wanting. Even these stubs of cilia usually have numerous bacteria packed between them. The long axis of each organism tends to coincide with the direction of the cilia.

The second of the two recent cases was of about forty-two days' duration. The cilia lining many of the cells of the trachea have to a large extent disappeared. In places only stubs of them remain. Bacteria are much less numerous than in the first case, but occupy the same position between the cilia even when only stubs of them persist. In one duct running from the trachea to a mucous gland many of the epithelial cells are ciliated. Between the cilia of some of these cells organisms similar in appearance to those in the trachea are present in small numbers.

Careful examination of sections of the lungs from these two cases failed to show any bacteria between the cilia of the cells lining the bronchi and bronchioles. In the lungs, however, of the case autopsied fifteen years ago, in which the symptoms had lasted for about sixteen days, the cells lining these structures in the sections from certain areas show masses of minute bacteria between the cilia. The organisms are, as a rule, fairly uniformly distributed on the surface of all the cells lining the bronchi and bronchioles affected, but other bronchi, sometimes in the same sections, show none at all. Evidently the lesion is not evenly and uniformly distributed throughout the lungs.

Masses of bacteria similar in size and appearance to those between the cilia were found in places in the secretion in the trachea and bronchi. In the trachea they were associated with cocci of larger size, but in the bronchi they seemed to exist in pure culture. Occasionally they were present in numbers in the cytoplasm of polymorphonuclear leucocytes.

MICRO-ORGANISM.

The bacteria found between the cilia of the cells lining the trachea and bronchi are very minute and stain but lightly by ordinary methods. It is probably on this account that they

seem to have been overlooked in the past. The following procedure was found the best for bringing them out distinctly in Zenker-fixed tissues:

Stain paraffin sections by the usual eosin-methylene blue method, but be sure to have the stain with methylene blue intense. Dehydrate quickly without differentiation in absolute alcohol. Clear in xylol and mount in xylol colophonium or balsam. Then differentiate in direct sunlight. This step may require one to many hours according to the intensity of the original stain. Decolorization should be stopped at the stage when the differentiation is sharp and the bacteria are still deeply stained.

The micro-organism occurring chiefly between the cilia of the epithelium, but also to some extent in the secretion, is a minute ovoid bacillus. Its center stains less deeply than its ends. It is Gram negative.

The organism suggests strongly the bacillus discovered in 1900 by Bordet and Gengou¹ in the sputum from cases of whooping cough and obtained by them in pure culture in 1906.

This bacillus of Bordet and Gengou is fairly generally accepted by bacteriologists at the present day as the cause of whooping cough, for the following reasons: It is found only in cases of whooping cough and is always present in the earlier stages of the disease. The patient's blood produces an antibody which is specific for this organism as can be demonstrated by the complement-fixation test (the so-called Bordet-Gengou reaction).

Klimenko² has confirmed the work of Bordet and Gengou in regard to the cultural peculiarities of bacillus pertussis and its biological reaction with the blood of whooping cough patients. In addition he has produced with this organism an infection of the respiratory tract in monkeys and puppies with symptoms more or less closely resembling those of whooping cough, although without the peculiar whoop, and has obtained the organism again from the trachea and lungs. He was also able to demonstrate the complement-fixation test with the blood of these animals.

REACTION.

The injury caused by the bacilli located between the cilia of the cells lining the trachea and bronchi is slight. The toxin secreted by them must be mild. No necrosis of the cells is

produced. At most there occurs a gradual destruction of the cilia and this is doubtful. It is an artefact very easily produced by rough handling post-mortem. Future study must decide this point. In the bronchi of the lung where the cells were perfectly protected no such denuding of the ciliated epithelium had occurred; but this might be due to the lesion in the lung being early.

The reaction on the part of the tissues to the bacilli is moderate. The production of mucus does not seem to be increased. There is, however, a slight to moderate inflammatory exudation evidenced by the migration of polymorphonuclear leucocytes in varying numbers between the epithelial cells lining the trachea and bronchi to reach the lumina of these structures. Occasionally endothelial leucocytes are also present and are sometimes phagocytic for the other leucocytes. The sub-mucosa shows a moderate infiltration with lymphocytes, including plasma cells.

The action of the bacilli in the respiratory tract would seem to be largely mechanical. By their presence in such large numbers, dozens to a hundred or more between the cilia of a single cell, they must interfere seriously with the normal ciliary action and thus with the removal of secretion and of inhaled particles, in consequence of which the lungs must be more exposed to infection by inhalation than under ordinary circumstances.

At the same time, the production of a mild toxin and its absorption are shown in several ways:

1. By the exudation of leucocytes into the lumen of the trachea and bronchi from the blood vessels lying outside of them.

2. By certain changes which take place in the lymph nodules of the spleen, lymph nodes, and gastro-intestinal tract. These changes are mild in character but similar to those occurring in diphtheria, scarlet fever, and certain other infectious diseases, namely, proliferation of endothelial cells in the centers of the lymph nodules and phagocytosis of the adjoining lymphocytes. Fibrin is sometimes formed in the same location. The explanation of this lesion probably is that the endothelial cells proliferate and produce an antitoxin to counteract a toxin brought there by the circulation and in the process use the surrounding lymphocytes as nutritive material.

3. By the production of the well-recognized lymphocytosis of whooping cough, probably also as a result of the reaction to a toxin derived from the bacilli.

4. By the production of an antibody which is present in the blood and acts specifically toward the Bordet-Gengou bacillus.

BRONCHO-PNEUMONIA.

The broncho-pneumonia which sometimes develops in fatal cases of whooping cough is perhaps a complication due to other organisms. In the first case, containing many foci of atelectasis, where endothelial and polymorphonuclear leucocytes were present in small numbers in the alveoli, no organisms of any kind could be demonstrated. In the second case, with evident broncho-pneumonia the exudation was more active, polymorphonuclear leucocytes were numerous, and in some of them a few flattened cocci in pairs were present. No organisms similar to those infesting the ciliated epithelium could be found. In the third case, with numerous bacilli present between the cilia of the epithelium lining the bronchioles, no exudation was present in the alveoli.

Results.—The observations recorded here show that a definite relation exists between the casual agent in whooping cough and the ciliated epithelium lining the trachea and bronchi. The local effect produced by the organism is chiefly mechanical. It now remains to be demonstrated by experimental work whether or not the bacillus discovered by Bordet and Gengou will produce this same mechanical effect or lesion. If it does not, then the true casual agent must be obtained in pure culture and tested in the same way.

Experimental work along these lines is now under way. It has proceeded far enough to enable us to state that sputum from an acute case of pertussis injected into the trachea of a puppy causes the same lesion to appear as is found in man, namely, masses of minute bacilli packed between the cilia of the lining epithelium.

SUMMARY AND CONCLUSIONS.

Whooping cough is due to a minute bacillus which occurs in large numbers between the cilia of the epithelial cells lining the trachea and bronchi and possibly also the nose. The location of the organism is apparently characteristic for the

disease. Its action seems to be largely mechanical. It interferes by its presence with the normal movements of the cilia and possibly leads to their destruction.

The mechanical interference with the action of the cilia, and possibly their destruction, prevent the normal removal of secretion. The bacilli and the secretion produce a continuous irritation which results in coughing and usually also in the characteristic spasm known as whooping.

The bacillus found in the lesions is probably identical with the organism discovered and described by Bordet and Gengou, but this identity remains to be demonstrated by the experimental production of the characteristic lesion in monkeys and puppies.

SYNOPSIS OF CLINICAL HISTORIES.

Case 1 (12.24).—Female, 1 year 2 months old. Admitted March 6, 1912; died March 9, 1912.

Family history unimportant.

Previous History.—Was a full term, normally delivered baby. At age of 12 months had "pneumonia." From then until recently has not been well; has had a loose cough without expectoration. During these 2 months has been exposed to several cases of pertussis.

Present Illness.—February 22, child began to whoop whenever she coughed; many paroxysms daily and six or seven at night, during which patient would "get black and couldn't catch breath." The paroxysms frequently ended with vomiting. Child has lost weight and has had "moderate fever during past 2 weeks." Lately her breathing has been rapid and she has been chilly and has had "sweats."

March 6. Temperature 101° F. Pulse and breathing rapid. Coughs with decided whoop; became cyanotic and vomited during examination. Lungs disclose many moist crackling râles throughout.

Patient became steadily worse after admission. March 8, temperature 105° F., pulse 160, respiration 85; pulse weak, respiration shallow.

Post-mortem examination thirteen hours after death showed numerous fibrous adhesions in both pleural cavities, mucopurulent bronchiolitis, and areas of atelectasis.

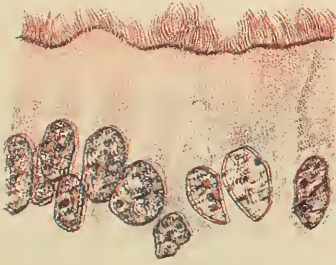
Case 2 (12.25).—Female, 2 years 9 months old. Admitted March 18, 1912; died March 19, 1912.

Family history negative.

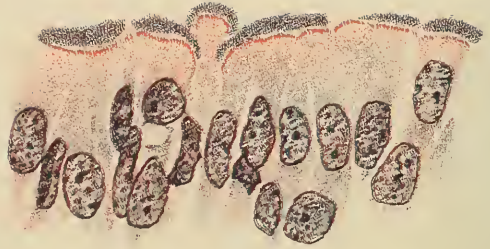
Past History.—At age of 5 months had diphtheria, otitis media, and abscess of neck. Two months before admission had measles and was ill for 2 weeks. Has been definitely exposed to pertussis several times during past 2 months.

Present Illness.—During convalescence from measles patient began to cough and "whoop." Complained of sore mouth. One week ago began to have high fever with rapid breathing, loss of appetite, and fever at night. Has been gradually growing worse.

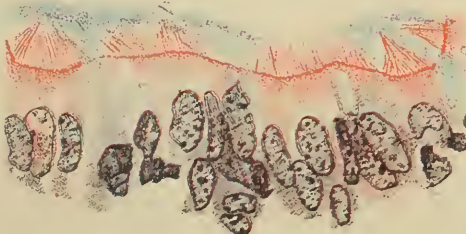
Physical Examination.—Patient is cyanotic and has frequent paroxysms of coughing followed by vomiting.



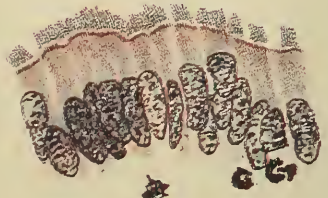
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Left ear presents a profuse discharge of mucoid material. Mouth and throat negative. Cervical lymph nodes slightly enlarged. In both lungs many coarse moist-râles and broncho-vesicular breathing. In left lung an area of dulness in front from second to fifth rib and extending to left border of heart. Other organs negative.

March 19. Since admission temperature has risen from 99° to 104° F.; pulse weaker and more rapid; respirations have increased from thirty-five to fifty per minute. Died same day.

Post-mortem examination two and one-half hours after death. The lungs showed numerous small foci of solidification not exceeding one centimeter in diameter, varying from red to gray in color. The trachea showed slight exudation on its surface. Other organs negative.

Case 3 (97.300).— Male, 2 years 9 months old. Admitted August 23, 1897; died August 30, 1897.

Family and previous history negative.

Present Illness.— August 14, began to cough, feel feverish and complain of soreness in chest. August 21, began to whoop and vomited four or five times a night but not in day time.

Physical Examination.— Well developed and nourished. No aural or nasal discharge. Lungs present numerous râles scattered throughout. Heart and other viscera negative.

August 30. Since entry has coughed and vomited frequently; stools watery. Suddenly developed clonic convulsions; later under treatment became conscious and rational. Still later temperature became elevated, pulse weak and rapid, respirations shallow; child died three hours after convulsions.

Post-mortem examination practically negative. The vessels of the brain were congested and the pia was somewhat edematous. Lungs showed no foci of atelectasis or of broncho-pneumonia.

REFERENCES.

1. Bordet et Gengou. *Annal. de l'Institut. Pasteur*, 1906, xx and xxi.
2. Klimentko. *Centralbl. f. Bakt., Abt. I., Originale*, 1908, xlviii 64-76.

DESCRIPTION OF PLATES.

(The drawings are by Miss Etta R. Piotti, the photomicrographs by F. B. M. The magnifications of the photomicrographs are exact, of the drawings approximate.)

PLATE I, FIG. 1.— Ciliated epithelium lining normal trachea of child. $\times 1,000$.

FIG. 2.— Ciliated epithelium lining trachea of child dying in acute stage of whooping cough. Large numbers of minute bacilli present between the cilia. $\times 1,000$.

FIG. 3.— Ciliated epithelium lining bronchus of child; mucus forming in cells and collecting on surface. $\times 1,000$.

FIG. 4.— Ciliated epithelium lining bronchus of child dying in acute stage of whooping cough. Masses of minute bacilli present between the cilia. $\times 1,000$.

FIG. 5.— Minute bacilli present in masses between cilia of two cells lining trachea. $\times 1,500$.

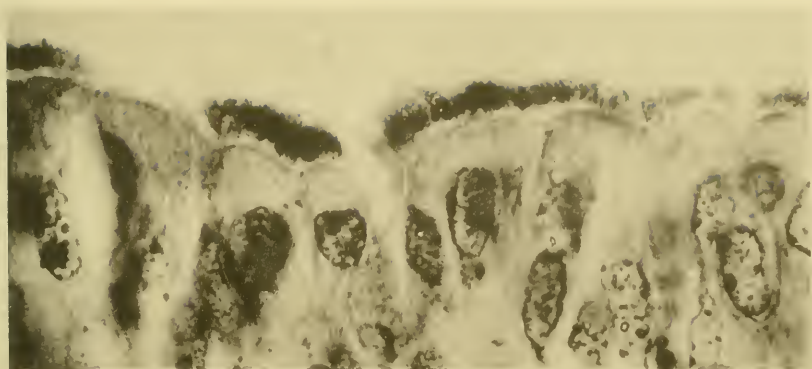
FIG. 6.— Desquamating epithelial cell in trachea with numerous bacilli between cilia. x 1,500.

FIG. 7.— Ciliated epithelium from trachea of child dying at a late stage of whooping cough. Bacilli still present in small numbers between cilia. x 1,500.

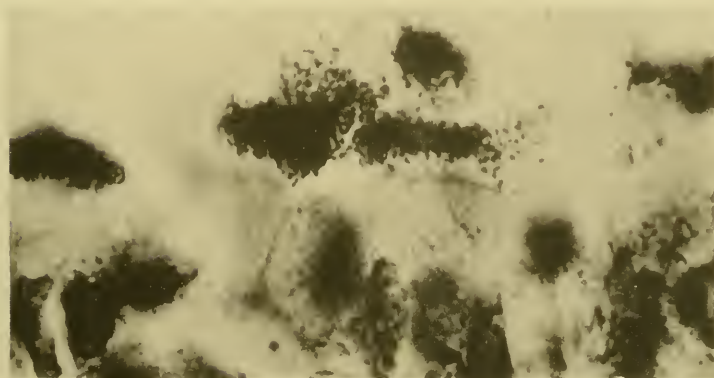
PLATE II., FIG. 1.— Ciliated epithelium lining trachea of child dying in acute stage of whooping cough. Masses of minute bacilli present between cilia. x 1,000.

FIG. 2.— Ciliated epithelium lining trachea from same case. x 1,500.

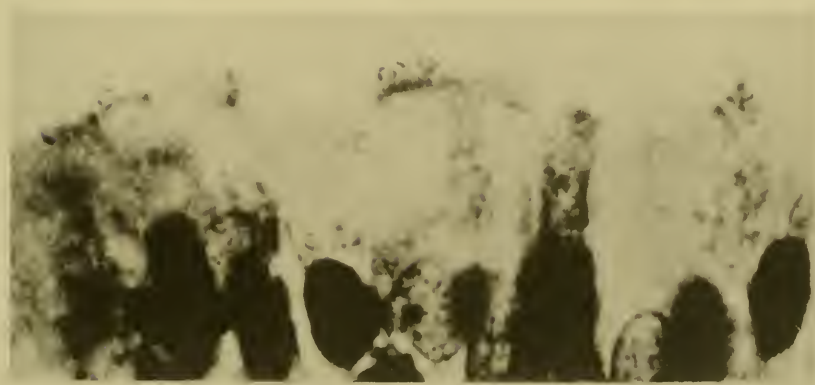
FIG. 3.— Ciliated epithelium lining trachea from child dying at a late stage of whooping cough. Bacilli still present in small numbers between the cilia. x 1,500.



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IV.

THE RELATION OF THE BORDET-GENGOU
BACILLUS TO THE LESION OF PERTUSSIS.

BY F. B. MALLORY, M. D., A. A. HORNOR, M. D., AND F. F. HENDERSON,
M. D.

INTRODUCTION.

We have already shown * that the primary essential lesion of whooping cough consists in the presence of masses of minute bacilli between the cilia of the epithelial cells lining the trachea and bronchi. Their action is chiefly mechanical: they interfere with the normal movements of the cilia by sticking them together; in this way the micro-organisms furnish a continual irritation which results in the symptoms peculiar to the disease.

EXPERIMENTAL PRODUCTION OF LESION.

The discovery of the primary and apparently characteristic lesion of whooping cough naturally suggested an attempt to determine whether or not the organism growing between the cilia corresponded to the bacillus described by Bordet and Gengou as the cause of whooping cough. Klimenko's demonstration that it was possible to infect puppies with that bacillus afforded a simple means of testing the matter.

Our first experiment was to find out if we could produce in animals the same peculiar lesion that we had found in man. For this purpose a puppy was inoculated intratracheally at intervals of one week for five weeks with sputum collected from patients in the acute stage of whooping cough. The animal was killed at the end of six weeks and the tissues fixed in Zenker's fluid. Paraffin sections stained in the way already described showed numerous minute bacilli between the cilia of many of the epithelial cells lining the trachea. They corresponded morphologically in every way with those occurring in the human tissues.

* Mallory and Hornor, "Journal Medical Research," 1912, XXVII., 115-123.

PURE CULTURES.

The next step was to obtain if possible a pure culture from a case of whooping cough and repeat the experiment with it.

Sputum was examined from thirty patients in the acute stage of the disease. The characteristic bacillus was found in all in large numbers and often in an almost pure state both free and inclosed in polymorphonuclear leucocytes and rarely between the cilia of desquamated epithelial cells. After repeated failures, pure cultures were finally obtained directly from the sputum from two different patients. A third pure culture was obtained indirectly from a puppy infected by means of sputum injected into the trachea. No attempt was made to obtain a large variety of cultures for study and comparison as work of this character had already been done by Bordet and Gengou and repeated by Klimenko.

It was found impossible to start cultures except on the potato-blood-agar medium devised by Bordet and Gengou. For the first twenty-four hours the growth is slight even on this material. After that length of time, however, the bacilli grow readily and abundantly, and later may be transferred to various other media such as blood serum, and especially veal agar and veal bouillon. The single colonies on solid media may reach a diameter of 2 mm. to 4 mm. in forty-eight hours. They are rather thick and almost colorless and transparent at first; later they are slightly grayish and more or less opaque. The colonies possess a tenacious mucoid character which becomes more distinct in older cultures, so that a whole colony may be lifted up at once on a platinum needle. It is probably owing to this peculiarity that the organisms adhere to the cilia of the cells and stick or mat them together.

For comparison and control we used a culture of the original Bordet-Gengou strain for which we are indebted to the courtesy of the Parke-Davis Company.

MORPHOLOGY OF BACILLUS PERTUSSIS.

In coverslip preparations made from sputum the microorganisms appear as minute bacilli with rounded ends. They are of about the size of influenza bacilli or a little larger and more regularly ovoid. They are Gram negative and stain lightly with the usual basic anilin dyes. In smears from cultures on potato-blood-agar and on blood serum the bacilli are so short

as to resemble for the most part micrococci. On some of the other media such as veal agar they tend to grow longer and occasionally present large forms. If the organism is replanted on the potato-blood-agar medium the large forms disappear.

EXPERIMENTAL WORK WITH PURE CULTURES.

Several puppies were directly inoculated in the trachea with pure cultures. In two of the puppies the success of the inoculation was readily demonstrable in sections. The bacillus was reobtained in pure culture from one of the dogs but not from the other. In two puppies the results were negative and also in two others inoculated with the Parke-Davis culture. These four dogs in which the results were negative all came from one litter and were strong, healthy animals. The organisms were obtained in cultures, however, from the trachea or lung in each instance. Judging from other experiments the bacilli were probably present between the cilia in very small numbers, but none happened to be present in the sections cut and stained.

Three adult monkeys (*rhesus macacus*) inoculated intratracheally showed no symptoms and were, therefore, not killed. Histological examination might have shown the characteristic lesion. Klimenko obtained fairly well marked symptoms with several monkeys but other experimenters have failed of success.

He states that he failed to get symptoms when he inoculated young rabbits and guinea pigs. Infection readily takes place, however, as is shown by the presence of the characteristic lesion (see Fig. 2, Plate IV.) in the first rabbit we inoculated. The experiment was repeated with four others in order to see if any symptoms could be detected. They were inoculated on the first, third, fourth and fifth days by dropping a small amount of bouillon culture into the nares. Three of the animals became more or less emaciated and all had fairly free secretion from the nares, but they developed no other symptoms. They were killed at the end of six, six, fifteen and twenty-five days, respectively. The infecting organism was reobtained in pure culture from the first three, but the original cultures from the fourth rabbit were too greatly contaminated to render this feasible.

In the animals successfully inoculated the bacillus pertussis was found regularly in the trachea, less often in the larger and smaller bronchi and in four instances (all rabbits) in the nares.

In all of these situations it occurred between the cilia of the lining epithelial cells. In addition it was occasionally found free in the secretion in the trachea or bronchi.

INFECTION BY CONTAGION.

Several puppies kept in the same cage with the first one inoculated with sputum acquired infection by direct contact or by contagion and showed the typical lesion in the trachea and lungs. This result confirms the observation of Klimenko, that normal puppies are readily infected if kept in more or less intimate contact with inoculated animals.

SYMPTOMS OF INOCULATED ANIMALS.

The chief symptoms presented by puppies are sneezing and coughing, which appear in from two to six days. There is usually also more or less secretion from the nose and eyes. In a few days the coughing becomes more severe and is spasmodic in character. According to Klimenko, who made a special study of the clinical phenomena following inoculation, the puppies almost always die in from two to six weeks.

The only symptom shown by the rabbits was emaciation. No coughing or sneezing was ever observed.

INOCULATION OF ANIMALS.

Various methods of inoculating animals in the respiratory tract with the pertussis bacillus were tried; through a tracheotomy wound; by the introduction of a swab, which had been dipped into a veal bouillon culture, directly into the nares and trachea; by injecting a culture into the trachea through a small catheter. In the end the following method was found to be much the simplest procedure. Hold the animal on its back with its mouth shut and with its nose pointing upwards. From a glass syringe or tube let a veal bouillon culture flow a drop at a time into the nares. More or less of the material is sure to be inhaled. Inoculation by this method can be repeated daily if desired. All inoculations by this method were successful. On this account a culture of the strain obtained originally from Bordet was tried again on a young rabbit. A growth in veal bouillon was dropped into the nares on four successive days and the animal was killed on the eighth day. The bacillus was reobtained in pure cultures from the trachea and bronchi

and was found microscopically in moderate numbers in sections of the nares, trachea and bronchi (Plate IV., Figs. 3 and 4).

LESION IN INFECTED ANIMALS.

The lesion in the infected animals corresponds in every way with that in man but the number of organisms is rarely so great. The bacilli are not as a rule uniformly distributed over the lining epithelium. They are few or numerous in certain areas and wholly lacking in others. Occasionally only single cells or small groups of them have any organisms among the cilia.

The animal lesions show clearly that the cilia are not destroyed, and that the cells are not in any noticeable way injured. On the other hand, a certain number of polymorphonuclear leucocytes can usually be found migrating between the epithelial cells to reach the free surface. Occasionally they are fairly numerous. Only a moderate accumulation of lymphocytes in the wall of the trachea was observed; the blood was not examined for lymphocytosis.

SUMMARY AND CONCLUSIONS.

The failure up to the present time to observe the bacillus of whooping cough in its peculiar and characteristic location in the respiratory tract is probably due to its small size and to its staining but faintly by ordinary methods.

The reason the Bordet-Gengou bacillus has not been unqualifiedly accepted as the cause of whooping cough is largely due to its presence having been demonstrated only in connection with the disease, not in connection with any evident lesion. It might have been a secondary invader like the streptococcus in scarlet fever. We have demonstrated the primary essential lesion of the disease and the characteristic relation of the causal agent to it. In addition we have been able, with sputum and with pure cultures of a micro-organism corresponding in every way with the Bordet-Gengou bacillus, to produce the same characteristic lesion in young animals and in four instances (one puppy and three young rabbits) to obtain the organism again in pure culture. Moreover, we have produced the same lesion in the nares, trachea and bronchi of a young rabbit after infecting it through the nares with a subculture of the bacillus obtained originally from Bordet and were able to grow the

micro-organism again in pure culture. We have, therefore, supplied the steps which have heretofore been lacking, according to Koch's law, for the complete demonstration that the Bordet-Gengou bacillus is the cause of whooping cough.

This result should encourage further investigation in search of a vaccine or antitoxin which may be of use in the treatment of the disease. The diminution in numbers and final disappearance of the micro-organisms under ordinary conditions in the course of comparatively few weeks strongly suggests that conditions for growth become unfavorable, probably owing to the development of some antibody.

DESCRIPTION OF PLATES.

Plate III.

FIG. 1.—Section of trachea from puppy inoculated through a tracheotomy opening with sputum from acute cases of whooping cough. Few to many minute bacilli are present between the cilia. A polymorphonuclear leucocyte on the surface contains several of them. $\times 1,500$.

FIG. 2.—A section of the trachea from a young rabbit inoculated with sputum in the same way. The bacilli are fairly numerous between the cilia. $\times 1,500$.

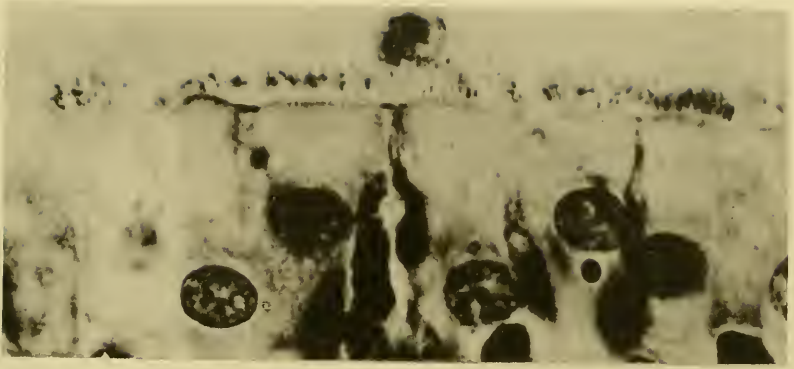
FIG. 3.—A section of the trachea from a puppy inoculated intratracheally with a pure culture of a bacillus corresponding in every way with that described by Bordet and Gengou as the cause of whooping cough. $\times 1,500$.

Plate IV.

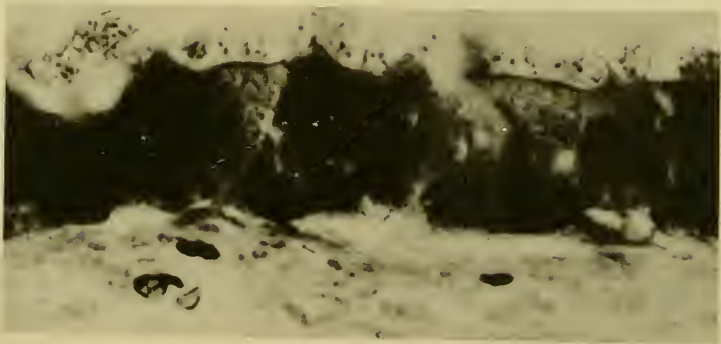
FIG. 1.—Section of the trachea from a puppy inoculated intratracheally with a pure culture of another strain of micro-organism identical morphologically and culturally with the first. The bacilli are numerous between the cilia and also in the secretion on the surface. $\times 1,500$.

FIG. 2.—Section of nasal mucous membrane from a young rabbit inoculated with a pure culture through the nares on four separate days and killed at the end of one week. The bacilli are numerous between the cilia. $\times 1,500$.

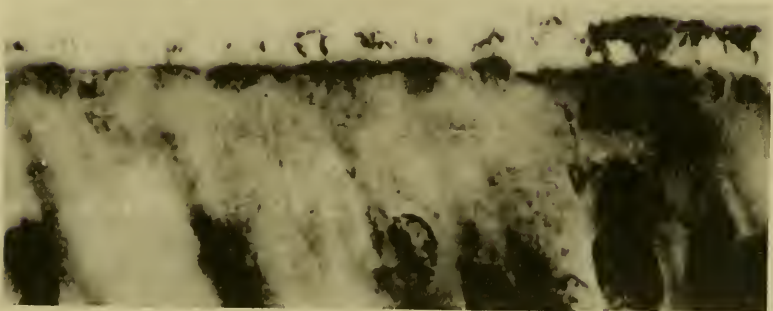
FIGS. 3 and 4.—Sections of the trachea from a young rabbit inoculated through the nares with a subculture of bacillus pertussis obtained originally from Bordet. The micro-organisms are very numerous at the points where they have been able to penetrate between the cilia, and multiply. $\times 1,500$.



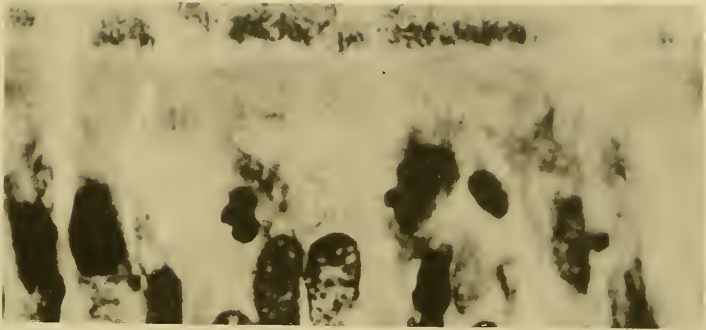
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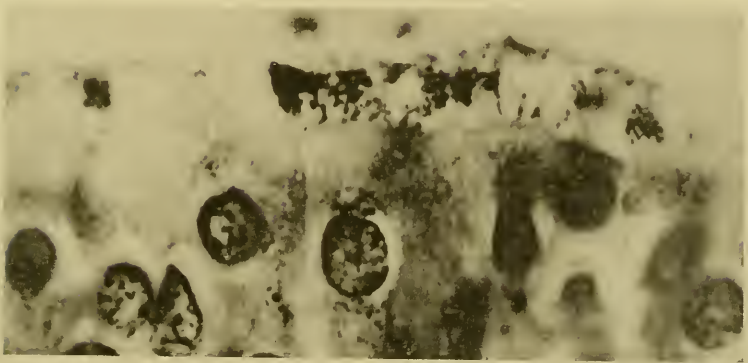
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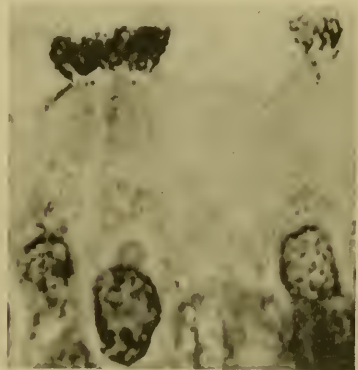
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V.

PROTECTION OF MILK.

BY E. M. BUCKINGHAM, M. D.

The object of this paper is to call attention to what I believe is a real danger: That in seeking to make milk a safe food we may rely too much upon its treatment by heat, and too little upon its careful production; that we may thereby retard improvement in production, and that by improper pasteurization we may introduce a false security and for young children an especial danger. There are large financial interests concerned in showing, if they can, that pasteurization is always reliable and that care in production is not so reliable. I shall mention certain epidemics that would have been prevented had there not been a failure in pasteurization which had been relied upon, to the exclusion of watchfulness in production.

I would by no means deny what all know, that common disease germs are destroyed by a known amount of heat, nor even that milk so heated is apparently borne by infants for a long time. I say apparently well borne, because I hope to show that much of the heated milk in use is not heated as it is supposed to be to a definite temperature, but because of the difficulty of the process it is heated to an unknown temperature. This uncertainty deprives of value the clinical results seen in well babies, so far as they tend to prove that pasteurization does not hurt them. It also exposes them to whatever danger there may be in superheated milk and it deprives us of the certainty of freedom from danger should disease germs be present and the desired temperature not be reached. This is no reason why milk should not be treated by heat in emergencies, but is perhaps a reason why at present we should not rely upon it exclusively.

My attention was first called to uncertainty in the exact temperature by observing that milk modified by lime water and an excess of sugar of milk and pasteurized sometimes did and sometimes did not turn brown. Inquiry brought

the statement that under these circumstances a chemical change takes place at certain temperatures, but not at lower ones, and that this change accounts for the discoloration. Further inquiry of an expert developed the statement that an exact temperature is very hard to obtain. It is easy to see why. If milk is heated slowly, it remains some time at a fermenting temperature. If this continues too long, the milk is spoiled. It therefore is desirable to reach the desired temperature quickly, and this makes overheating easy.

Some years ago I wanted a ready means by which milk could be pasteurized by untrained nurses, acting with a simple apparatus which automatically would stop increasing the heat when the desired degree was reached. Thinking I had reason to believe that much of the so-called sterilized milk was really not heated to the boiling point, to find what might be the facts, a series of experiments was carried on by my interne, Dr. Baldwin, at the Children's Hospital. This was done in the ward kitchen. The milk bottle, containing a modification then actually in use, was fitted with a thermometer held by the cotton packing so that the bulb was in the middle of the milk, and the stem passed through a cork, fitted into a hole that had been drilled through the lid of the heater, so that it could be read. The bottle was surrounded by water to the height of the milk, and did not rest on the bottom of the heater. Underneath was an alcohol lamp. I have unfortunately lost my notes, but the results were disappointing. While the thermometer seldom reached the boiling point, there were great variations. Opening the window or the door, or both, made a difference, although the heater was not in the direct current. With both closed it was impossible to move quickly about the room without sensibly affecting the thermometer. This work seemed of no value except as showing difficulty.

The Baltimore epidemic of septic tonsillitis reported by Hamburger in the "Journal of the American Medical Association," April 13, 1912, was traced to a certain dairy. It was shown that just before the outbreak the pasteurizing plant was closed for repairs, the management relying upon cold weather to keep the milk from spoiling. This neglected to guard against disease germs and the result followed. The Chicago epidemic reported by Capps and Miller in the same journal, June 15, 1912, was also traced to a certain dairy. Milk from the infected dairy was supplied to a hospital among

others. The supply of the children's ward with seventy cases was received raw, and was pasteurized by the hospital. There was no case of infection. The supply of the rest of the hospital was pasteurized by the dairy plant, and there were numerous cases among internes and nurses as well as in the community, showing conclusively, if it needed to be shown, that some treatment by heat is efficient, but showing also that treatment by heat is of no value unless properly done. During the Boston epidemic of 1912 (I am not now speaking of the more severe epidemic of 1911), I reported all the cases of tonsillitis seen by me up to the date of the circular of the Board of Health, together with their milk supply. The supply was quite various and no inference could be drawn. Neither was I able at that stage to distinguish clinically between the cases. Later, when they were over, I could say that two of the cases were sicker and longer drawn out than the others; that enlarged cervical glands in one of these cases broke down and needed operation; also that in this last household there was a slight case beginning on the same day. These two households both got their milk from a supply previously under suspicion and which was now pasteurized. If these cases really originated in milk, it was a case of failure in pasteurization. In the "Journal of Medical Research" for April, 1912, Schorer and Rosenau report careful experiments upon pasteurization in commercial plants. They point out many sources of failure amounting at times to many degrees of temperature. They were able, however, to reduce the error to a few degrees by employing an automatic regulator, reheating the milk that passed over in the first few minutes, and repeating this reheating as often as any interruption occurred in the process, also by taking especial precautions to insure that the heated milk should be well mixed by allowing a margin of safety by heating a little above the required degree and by maintaining the heat for a sufficient time. They conclude that their studies emphasize the necessity for official control over all pasteurizing plants. I would suggest that even a good operator will be subject at times to nagging, in order to hurry the product to market when milk trains happen to be late. Therefore it would be better, if possible, to protect milk from disease germs in the first place rather than to infect and then disinfect.

It appears to me that enough has been shown to perhaps explain the difference of opinion among clinical observers

as to the clinical effect of pasteurization. They have not all been dealing with the same thing.

The Boston epidemic of septic tonsillitis in 1911 was traced to the milk of a certain dairy. Great pains had undoubtedly been taken at this dairy to give a good supply, and no particular blame can be attached to it for not foreseeing what had not before happened. It is, however, true that the incident was used by many critics to show that this event proved the need for pasteurization by showing that care in producing and handling milk had failed. This criticism appears to me unsound, because there was an epidemic of tonsillitis at the time in the region whence the milk came, while so far as I know no attempt has been made to show that there was an efficient medical and veterinarian inspection of the farms. Here seems an obvious failure in an otherwise good system, and one that can be remedied.

Davis, in the "Journal of the American Medical Association" for June 15, 1912, states that at the time of the Chicago epidemic above referred to, some of the milkers were severely ill and continued to milk regularly. Hamburger, in a discussion reported in the same journal of June 22, 1912, states that at Baltimore patients with sore throats kept at work on the farms. An English epidemic at Colchester was stopped by removing from the herd a single cow that had mastitis. Both the Baltimore and Chicago epidemics could then presumably have been prevented by an efficient inspection of men and beasts. Of course such inspection should be official. It does not then seem chimerical to hope that the era of general pasteurization should come to an end in the not distant future. Pasteurization certainly removes an incentive from the farmer to do his best, and I can but think that the prevailing tone of discussion on this subject is unfortunate. Doubtless pasteurization will always have a place as an additional precaution in emergencies.

It would not be fair to suddenly demand of farmers that all should at once come up to the level of certified farms, but much dirt could be cleaned up at little expense and proper inspection could be supplied by the state. Medical inspection should possibly include members of milkers' families, and non-reporting of slight cases of illness could well be penalized. In the case of typhoid, the cause of which is well known, a single case

traced to a milker shows that he is filthy in his habits and is unfit to work on food. Whether he has typhoid or not, we do not want a man to go from the water-closet to the milk pail without washing his hands. The money cost of a modern milk plant is great and for this reason consideration should be shown to men already in the business. Bulletin No. 46 of the United States Bureau of Animal Industry for 1903 shows, however, on page 120, that by intelligent, unremitting industry it is possible even with antiquated stables to get a low bacterial count, as low on one occasion as 1,500. Therefore a farmer who cannot afford to renew his plant may yet hope to produce a clean milk.

The especial danger, if it exists, to which infants are exposed by pasteurization is scurvy. This has been attributed to changes in fat, in proteids, to destruction of ferments and to other causes. It may depend on something not yet discovered, and its existence has been denied. Laboratory work has been done in this direction, but the question is essentially a clinical one. Since 140° for a sufficient time destroys pathogenic germs, and since there ought to be a margin of safety lest the heat is less than is supposed, and since the degree of heat may also be greater than is supposed, the real question is, Do babies acquire scurvy from a continued diet of milk, heated to, say, 145° or a little over?

In solving this problem there are difficulties. It is certain that scurvy is caused not only by heated milk but also by various forms of incorrect diet. Duty to our patients requires us to modify such diets as well as to omit heat, but by so modifying we throw these cases out of consideration. The known effect of orange and lemon juice is such that in most cases it is a duty to prescribe them, but this again complicates the case. Rigid scientific proof is to produce scurvy by giving a good food properly heated, and then to see it disappear on removing the heat, but with no other change whatever. This for obvious reasons has not often been done. A few cases have been reported in which the conditions have been met, excepting that we do not know the exact temperature, only that the milk is said to have been pasteurized. There is not much likelihood of mistaken diagnosis because the diagnosis is easy if one recognizes its possibility, but the small number of reports, although to be expected as explained above, may reasonably

be objected to. I believe that the most we can say at present is that at some temperature, not yet determined, scurvy follows if the condition is maintained too long. Even this is disputed.

I conclude that the production of a good safe milk is not so hopeless as some would have us believe, but that it should be guarded by an efficient official inspection; second, that pasteurization is efficient, but that it too has its dangers and should also be guarded by an efficient official inspection, and third, that there is some evidence that pasteurization is injurious to young children and that for the present a safe raw milk is to be preferred for them.

VI.

THE CONSERVATIVE TREATMENT OF TOXÆMIA
OF PREGNANCY WITH CONVULSIONS.

BY CHARLES M. GREEN, M. D.

For some time it has seemed to the writer that in this impatient surgical age there is a too prevalent tendency, in the presence of the gravest obstetrical emergency generally known as, but inadvisably named, eclampsia, to proceed too hastily to forced delivery, whether the convulsions first occur before or during labor. Since it is now generally accepted that the ovum or fœtus is the source of the toxines, the effects of which so often culminate in convulsions before, during, or after delivery, and since the death of the fœtus in utero often is followed by an abatement of the convulsive seizures, it would seem logical to proceed to empty the uterus as the first step in the treatment. But whether the toxines are of fœtal origin or whether they are the product of imperfect maternal metabolism and non-elimination of waste products, the fact remains that the toxæmic woman is ill prepared to resist the shock and trauma of any surgical procedure. Except in the presence of grave surgical emergency, such as fulminating appendicitis or serious bodily injury, no surgeon would operate on a patient with alcoholic toxæmia, nor does the internist look to see the chronic alcoholic survive the supervening toxines of grave general infection, such as pneumonia. Save in exceptional cases, therefore, it would seem more logical to postpone active surgical treatment for a reasonable time, until by active eliminative measures the toxæmic gravida is better prepared to withstand the added strain of delivery; and the writer believes that when the shock and trauma of the *accouchement forcé* are hastily imposed upon a nervous system already reacting to toxæmic irritation, the *coup de grâce* is not infrequently given to women who under more conservative treatment might recover. Moreover, under successfully applied eliminative therapeutics, the cervix and lower uterine segment often soften

and expand to a degree that the woman speedily delivers herself under the usually exaggerated uterine contractions of the convulsive attack, or sufficiently to permit delivery without undue shock or injury. After the cervix is softened and somewhat dilated, it is not difficult to procure by digital dilatation a sufficient expansion for the delivery of the small, non-viable fœtus, making use of embryotomy, if necessary; and when the fœtus is developed to a viable age and is alive, the use of a suitable hydrostatic rubber bag very generally results in a dilatation sufficient to permit safe delivery by forceps or podalic version.

Whatever the obstetric treatment may be, the fœtal mortality is high, even 50 per cent. In forty cases, recently quoted by Hirst, in which abdominal Cæsarean section was performed for maternal toxæmic convulsions, there were eighteen fœtal deaths; and yet this method of delivery would seem to afford the best fœtal prognosis. The fact is, of course, that the fœtus very generally participates in the maternal toxæmia, and even if viable, as it often is not, and delivered alive, it frequently succumbs for that reason, and even exhibits typical toxæmic convulsions. Moreover, as is well known, the premature baby does not well endure the strain of operative delivery, and even after instrumental cervical dilatation or vaginal Cæsarean section delivery must be effected by operative procedure. Under these circumstances it would seem that in deciding on the line of treatment to be pursued in a given case, that which affords the best prognosis for the mother should be chosen, since that which is best for the mother is generally best for the child. An exception might be made in the case of the late primigravida, nearly at term with living baby, but with undistensible cervix and vaginal tract; in such a case, in which great parental desire may justify the possibly increased maternal risk, abdominal Cæsarean section undoubtedly affords a better prognosis for the baby than strenuous delivery by the genital tract, but the safely delivered Cæsarean baby may subsequently succumb to its toxæmic condition.

If in reasonable time the patient fails to respond to eliminative treatment and to other medical measures for the control of convulsions and the reduction of blood pressure, if there is deep coma, cyanosis, and pulmonary œdema, resort in desperation is naturally had to emptying the uterus by forced cervical dilatation or by vaginal Cæsarean section; in such cases, how-

ever, whatever the treatment, there is usually a lethal termination. But it has seemed to the writer that in many cases eliminative treatment fails because it is not sufficiently vigorous and persevering, and perhaps because it requires a much more exacting and protracted personal attention of the physician than does the rapid evacuation of the uterus.

The method of eliminative treatment employed by the writer is essentially as follows: First of all is given a high compound enema consisting of

Oil of turpentine, 1 dram; extract of aloes, 20 grains; the white of one egg; sulphate of magnesium, glycerine, water, of each 2 ounces.

Next, the patient is given, when feasible, and it is generally feasible in hospitals, a hot water immersion bath.* Immersion needs not generally to be continued for more than a few minutes before perspiration appears on the forehead. If the patient is visibly dirty, or if sweating does not soon occur, the use of a flesh brush will promote the activity of the skin. If the pulse is weak, a stimulant is indicated before the bath. The woman is then rolled in a blanket, placed in a warmed bed, laid on a rubber blanket covered with a sheet, and another rubber blanket is spread over the extra blankets which cover her. It is well to remember that this treatment not infrequently serves to induce labor; but in the presence of convulsions the invasion of labor is to be welcomed. If the immersion bath is not available, the hot, wet pack is made use of; dry heat is much favored by some clinicians. An ice bag is applied to the head. If the patient is comatose the stomach is washed out and there is left therein a moderate amount of water, perhaps 8 ounces, containing 2 ounces of Epsom salts or a like amount of castor oil, with 2 drops of Croton oil; if conscious, the patient can swallow the cathartics. In the presence of marked œdema it is not well to give much water at first; otherwise the conscious patient should be caused to drink freely, and bitartrate or acetate of potassium may be given to neutralize acidosis. Fluid in the form of salt solution should be given to the unconscious patient, one or two pints under the breasts, in the face of free diaphoresis and purgation; by this in-take and out-go of liquids the blood may be effectively washed of its toxins. Nitroglycerine in $\gamma\delta\sigma$ grain doses is sometimes valuable to relieve blood tension and

* See a paper on this therapeutic measure in the "Boston Medical and Surgical Journal," Vol. CXLIII., p. 624, for December 20, 1900.

promote diaphoresis, but generally the blood tension is sufficiently reduced by the active function of skin and bowels. *Veratrum viride* is much approved by some authorities, but that drug and pilocarpine have both been discarded by the writer. To control convulsions and nervous restlessness, morphine is used; in the event of a living, viable foetus, and in order not to inhibit uterine contractions, it is used in moderate doses, generally not more than $\frac{1}{4}$ grain, with subsequent $\frac{1}{6}$ grain doses at two-hour intervals or $\frac{1}{4}$ -grain doses according to indications and results.

Meanwhile watch is kept for the invasion of labor, which quite generally supervenes. If labor is not excited by the eliminative treatment, and the toxæmia and convulsions abate, pregnancy is allowed to continue, especially when the foetus is alive and not yet viable; if the foetus is dead, the woman is generally allowed to await spontaneous delivery. In chronic nephritis, however, labor is quite generally induced not later than the end of the eighth month. When under eliminative treatment labor begins, as soon as the cervix is softened, effaced, and a little dilated, hydrostatic bags are used and the labor terminates unaided, or more generally is completed with forceps or version and extraction. After delivery, eliminative treatment is continued until convulsions cease and œdema disappears. Sometimes there is free postpartum bleeding, and in the presence of a persisting high blood pressure this is regarded as a beneficent phenomenon. Reference has already been made to what must be regarded as rational treatment of severe toxæmic convulsions when the usually successful eliminative and sedative measures fail.

It is generally recognized that neither ether nor chloroform is a good anæsthetic for use in the obstetric surgery of the toxæmic parturient in convulsions, on account of the pulmonary and renal irritation of the former, and of the hepatic irritation of the latter; some authorities on this account recommend nitrous oxide gas. With this anæsthetic agent in the conditions under consideration, the writer has had insufficient experience to judge of its merits; but for the last four years he has used anæsthol, consisting of ether 46 parts, chloroform 37 parts, and ethyl chloride 17 parts, and has been well satisfied with its effects.

The section of the Boston City Hospital for diseases of women is intended primarily and chiefly for gynæcological

surgery; but a considerable number of cases of pathological obstetrics are necessarily received during the year, and in the three and one-half months immediately preceding the time of this writing ten successive cases of pregnancy toxæmia with convulsions have come under the writer's observation and treatment. The treatment has been conducted in accordance with the views above expressed, and a brief synopsis of these cases may be of interest.

Case 1.—M. S., 20, primigravida at six and one-half months, entered early on September 12, 1912. (Vol. 182, p. 361.) She had had headache all night and two convulsions before the ambulance arrived. On admission she was conscious, but excitable and irrational; face and legs œdematous; no fever or vomiting; always constipated; pulse 112; blood pressure 150; foetal heart 144. Urine: 1.030, acid; albumin, largest possible trace; sediment, free blood and pus, granular and hyaline casts with blood attached. No signs of labor. Eliminative treatment immediately begun, and during the day patient received a compound enema, 60 ounces cream of tartar water, 9 drams of Rochelle salts, and $\frac{1}{2}$ grain of morphia in $\frac{1}{6}$ grain doses; she was perspiring freely at 2 p. m., had four dejections, passed a large amount of urine (not collected and measured), and had four convulsions.

September 13. In-take, 130 ounces cream of tartar water, 30 ounces milk, 27 drams Rochelle salts, 2 ounces Epsom salts, 15 grains jalap, 15 grains triple bromides, three $\frac{1}{6}$ -grain doses of morphia; out-go, 17 $\frac{1}{2}$ ounces collected urine, 8 dejections, free sweating. Patient more rational and quiet, sleeps at intervals, no more convulsions.

September 14. In-take, 86 ounces cream of tartar water, 40 ounces milk, 24 drams Rochelle salts, 15 grains triple bromides; out-go, 25 $\frac{1}{2}$ ounces urine, 18 dejections, profuse sweating. Patient slept at intervals.

September 15. In-take, 50 ounces water, 12 ounces cream of tartar water, 47 ounces milk; out-go, 24 ounces urine, 10 dejections, continued sweating.

September 16. Patient rational since yesterday, sweats profusely, bowels kept open with one dram Rochelle salts every hour, urine 23 ounces, dejections 10, kept quiet with $\frac{1}{6}$ -grain doses of morphia every four hours alternating with triple bromides; albumin, $\frac{1}{4}$ per cent.

September 20. Pulse and temperature normal, blood pressure 160; is taking fluids freely, milk diet, œdema gone; no morphia for two days, bromides omitted; total urine last four days, 213 ounces; foetal heart, 140.

September 25. General condition improving, kidneys and bowels working well, blood pressure 150.

On October 2, three weeks after admission, patient was in excellent condition, and in spite of rather heroic sweating and purging, labor had not supervened. As the foetus was still alive, it was hoped that pregnancy might continue until the baby was safely viable; but four days later the foetal heart was not heard, and on October 8 a macerated foetus was spontaneously born; the placenta contained a large white infarct. On

October 24, when the mother was discharged well, the urine had sp. gr. 1.022, and contained a trace of albumin but no renal elements.

Case 2.—G. C., speaking no English, entered late, October 18, 1912 (Vol. 184, p. 209). The only history obtainable was that patient had been well up to 2 p. m., when she had a headache; at 4 p. m., she had a convulsion, and four more prior to admission, when she was unconscious. Apparently nearly at full term, but not in labor; baby living; maternal pulse and temperature 138 and 102.8, respectively. She was put on the usual eliminative treatment; and as the cervix was soft and would admit one finger, a Voorhees bag was inserted. The next forenoon the cervix was found fully dilated, and a living baby weighing seven pounds was delivered with low forceps. Patient recovered consciousness on the third day; she then drank well and her general condition was satisfactory. She was able to nurse the baby, which weighed seven and one-half pounds on the twenty-sixth day, when mother and baby were discharged well, the mother's urine showing no albumin and no renal elements.

Case 3.—M. N., 29, single, secundigravida, entered November 9, 1912 (Vol. 185, p. 197). For a week she had noticed œdema of feet and legs, and had felt unable to work; in bed one day and had vomited all food; no pain or headache; pulse 86, temperature 98.6; had several mild convulsions before, and one shortly after, admission. Patient seven months pregnant, cervix closed; foetal heart not heard nor movements felt. Urine: 1.028, acid, albumin $\frac{1}{2}$ per cent, many granular casts with cells attached, few fatty casts, some free blood and pus. Eliminative treatment. Patient had no further convulsions after admission until the night of November 14, when she had six, and it seemed best to induce labor. The cervix was soft and dilatable, and a Voorhees bag was introduced under anæsthol in the early forenoon of November 15; a six to seven months macerated foetus was normally born at 7.30 p. m., the placenta showing many white infarctions. For several days after delivery patient was irrational and restless, requiring large doses of bromides; but she completely recovered from her toxæmia and was discharged well on the twenty-sixth day.

Case 4.—M. B. M., 36, septigravida, entered in the evening of November 10, 1912 (Vol 185, p. 213). She had noticed œdema of the legs for the past two days, and had had headache and disturbed vision since the morning; at 6 p. m. she had labor pains, at 6.45 p. m. her first convulsion, at 7.45 p. m. a second, and a third in ambulance. On admission the cervix was soft and admitted one finger, the foetal heart was not heard, blood pressure 200; she was put on eliminative treatment, and there were no further convulsions. Next morning the os admitted two fingers, the cervix was easily dilated under anæsthol, and a six to seven months macerated foetus was delivered by internal podalic version. On the sixteenth day the woman was discharged well except for her chronic nephritis.

Case 5.—H. W., negro, 22, married ten months, primigravida, entered early on November 26, 1912 (Vol. 186, p. 17), having had three convulsions. She was unconscious, restless, and breathing stertorously; moderate œdema of face and ankles; apparently eight months pregnant, cervix soft, admitting one finger, not effaced; membranes not ruptured; head presenting, high; foetal heart not heard. Urine: $\frac{1}{2}$ per cent albumin.

Blood pressure 145. Patient was placed on the usual eliminative treatment, to which she reacted well, but continued to have convulsions. At 9 a. m. she was definitely in labor, and by 11 a. m. the os was almost fully dilated; the membranes were then ruptured, dilatation completed, and an eight month's living baby delivered with high forceps. The woman continued to have convulsions for forty-eight hours after delivery, however, having thirty-three in all; she then became conscious and rational, and made an uninterrupted convalescence. Despite drastic saline purgation, she had an abundant supply of breast-milk after the third day, and was able to continue entire lactation for the baby, which steadily gained weight. Mother and baby were discharged well on the eighteenth day.

Case 6.— M. C., 18, married ten months, primigravida, entered December 4, 1912 (Vol. 186, p. 133), having been delivered at home at 3 p. m. that day of living twins at eight months, and having had twelve post-partum convulsions before entrance. At entrance she was semi-conscious, but irrational, flowing moderately, uterus hard. Temperature 102.2, blood pressure 148; the urine showed a very slight trace of albumin. Patient was placed on the usual eliminative treatment, to which she responded well, but had eight more convulsions during the next forty-eight hours. She then gradually recovered consciousness, temperature fell to normal, and patient made an uninterrupted convalescence. There was slight lactation, but insufficient for nursing. The babies were fed on modified cow's milk, and were discharged with the mother on the twenty-third day, the latter well, the former weighing three and one-half and five and one-half pounds, respectively.

Case 7.— M. H., 20, married one year, primigravida, entered at 11.30 p. m., December 29, 1912 (Vol. 187, p. 73). For past three weeks has had some swelling of hands and feet. At 7 p. m. to-day went to bed with severe headache, had a convulsion and became unconscious; two more convulsions before admission. At entrance patient was semi-conscious, but irrational; apparently eight months pregnant; cervix soft, admitting two fingers; membranes intact; head presentation; foetal heart, 152; urine, $\frac{1}{2}$ per cent albumin; blood pressure, 140. Patient was put on eliminative treatment, but as convulsions continued the largest size of Voorhees bag was introduced at 2 a. m., December 30. Patient took in active labor, expelled the bag at 8.30 a. m., and delivered herself in an hour of a stillborn foetus; placenta much infarcted. Patient returned to bed and eliminative treatment continued; she had altogether three convulsions before entrance, twelve between entrance and delivery, and seven after delivery, the last at 4.10 p. m., December 30. She then regained consciousness and made a rapid and uneventful convalescence.

Case 8.— M. H., 33, married eight years, primigravida, entered January 1, 1913 (Vol. 187, p. 101). Headache and epigastric pain for several days before admission; first convulsion at 1 a. m., January 1. At entrance patient was conscious, but not rational, very restless with much jactitation; apparently seven and one-half months pregnant; cervix soft, admitting two fingers; membranes not ruptured; head presentation; foetal heart, 140; urine, $\frac{1}{4}$ per cent albumin; blood pressure, 148. The usual eliminative treatment was instituted, and the largest size of Voorhees bag was introduced. Patient's condition remained about the same throughout

the day, but without further convulsions. At 8 p. m. the bag was extruded from the cervix, which was soft and completely dilatable; head not engaged, foetal heart 160. Under anæsthol the high forceps was applied, and the baby extracted apparently dead, but after forty minutes of mouth to mouth insufflation the baby was resuscitated and lived, although small and choked with mucus. The mother made an uninterrupted convalescence, regaining rationality on the second day after delivery, and both mother and baby were discharged well.

Case 9.— F. K., 23, primigravida, entered in the afternoon of January 2, 1913 (Vol. 187, p. 141), having had ten convulsions at home and one during transportation. Patient apparently seven and one-half months pregnant, comatose; pulse, 130, thready; cervix soft, admitting three fingers; membranes intact; head presentation; foetal heart not heard. Urine shows large trace of albumin; blood pressure, 190 to 205. Placed on routine eliminative treatment, and the largest-sized Voorhees bag inserted. Six further convulsions, patient being semi-conscious and very violent in the intervals. At 2 a. m., January 3, the bag was found to have been extruded and patient was delivered of a dead foetus by high forceps. After delivery the blood pressure fell to 80, but subsequently rose to 90, and remained at that level throughout convalescence, which was satisfactory. The patient had no further convulsions, but on the third day, after regaining consciousness, she was for a time maniacal, but recovered in twenty-four hours from her psychosis, and was discharged well.

Case 10.— I. P., 19, primigravida, married one year, entered at 8 p. m., January 20, 1913 (Vol. 187, p. 345), having had four convulsions. Headache for several previous days, but no eye symptoms. Patient was found to be semi-conscious, very restless, and breathing stertorously. She was apparently at term; the cervix was hard and not effaced, admitting one finger; membranes intact; head presenting; foetal heart not heard. Urine showed hyaline casts and $\frac{1}{2}$ per cent albumin; blood pressure, 180. Patient was immediately put on eliminative treatment; she drank water freely and perspired well; but the bowels did not move in spite of continued administration of salts. Within the next hour the patient had two more convulsions. The largest Voorhees bag was then inserted, at 9.30 p. m., and labor pains soon began. At 1.30 a. m., January 21, the bag was still *in situ*, the cervix thinned, but still rigid, the os admitting only two fingers. Patient had had two more convulsions, but further delay was decided upon. By 5.30 a. m., patient had had three more convulsions; a total of eleven. By this time the bag had been extruded, the os easily admitted four fingers, the cervix was soft and its dilatation was readily completed. The foetal head, previously high and floating, had become well engaged; under anæsthol, therefore, the delivery of the dead foetus was quickly completed by an easy intermediate forceps operation. The placenta showed extensive areas of white degeneration. The patient was allowed to bleed moderately from the uterus, and no ergot was given. The blood pressure fell after delivery to 150, and the next day to 140. Patient recovered consciousness within a few hours. Eliminative treatment was continued; but the bowels did not move for twenty-four hours after entrance, and then not until after the patient had received two high compound enemata, and by mouth two drops of Croton oil and a total of twenty-two ounces

of Epsom salts. After the bowels had moved the patient drank water almost continuously for thirty-six hours. She had no more convulsions after delivery, and her convalescence was uncomplicated save for an attack of tonsillitis.

In these ten successive cases, then, one of which was a case of twin pregnancy, five babies were discharged well, and six were stillborn (including three macerated fœtuses); all the mothers recovered.

VII.

CEREBRAL COMPLICATIONS IN PNEUMONIA.

BY CHARLES F. WITHINGTON, M. D.

There are to be excluded from the present discussion: First, cases of so-called cerebral pneumonia, in which the pulmonary lesion, possibly slow in developing physical signs, is accompanied by intense cerebral excitement and delirium the cause of which is later cleared up by the diagnosis of pneumonia. Such cases are sufficiently familiar to everyone. Second, cases in which pneumonia develops as a terminal infection in persons suffering from cerebral lesions producing paralysis.

The scope of the paper will be cases of a distinctly cerebral character developing during or immediately following pneumonia and related to the specific infection of the latter disease. These may be divided into two classes: First, those with organic lesion; second, those without. In the former category by far the most common condition is meningitis. Other lesions are:

Embolism, thrombosis, hæmorrhage and softening, œdema, encephalitis (*a*) with abscess, (*b*) acute hæmorrhagic.

Certain of the latter cases shade off into the second group, where there are paralyses without demonstrable lesion. The latter are to be considered toxic in origin and may affect, (*a*) the brain, (*b*) the peripheral nerves.

MENINGITIS.

Meningitis, while uncommon in pneumonia, is found more frequently than any other organic lesion. Pye-Smith, in Allbutt's system, says that meningitis is a complication in 1 to 1,000 cases of pneumonia of patients above ten years and in from 1 per cent to 2 per cent in cases below ten years of age. It may come in the first week of very grave cases or about the tenth day in less rapidly fatal pneumonias. He says it is usually purulent and universally fatal. The latter statement is appar-

ently incorrect. (See Holt's case, below.) If it is upon the vertex it is often undiagnosed during life, the delirium being considered toxæmic. If basal, it is more readily diagnosed.

Gossage suggests that the exudate may be serous and not purulent and may disappear spontaneously like corresponding pleurisy. He gives a case where head retraction, twitching, and optic neuritis were present, which recovered.

Laiguel, Lavastine and Roger Voisin* find in a series of autopsies of patients dying with broncho-pneumonia lesions on the one hand representing simple œdema; on the other, an inflammation. They could not tell whether one was the precursor of the other. The lesions ranged from a simple congestion to a purulent meningitis. They appeared alike in patients who had and who had not manifested meningeal symptoms during their broncho-pneumonia.

Holt† records a case of pneumonia in a child of two, sick ten days with consolidation of left lower lobe. On the eleventh day, convulsion of all extremities, retracted head and rigidity. Lumbar puncture produced one and one-half ounces of clear fluid, high tension, no cells, no deposit, but culture after twenty-four hours showed abundant growth of pneumococci. The next two days, stupor and rigidity; no eye symptoms except photophobia; no Kernig. A second lumbar puncture two days later showed pneumococci in culture. The child recovered.

Netter‡ speaks of meningitis as sometimes due to pneumococci, with or without pneumonia, and says that the proportion of meningitis found in autopsies in cases of pneumonia varies from 43 per cent to 1.39 per cent; clinically, from 8 per cent to .08 per cent.

Levi§ speaks of serous meningitis due to pneumococci which are characterized by a simple serous exudate between meninges, with strong vascular congestion. These lesions of infectious origin may be due sometimes to microbic toxins but often are the result of microbes themselves, which may be pneumococci, typhoid, or grippe bacilli, streptococci and probably, also, bacillus coli. They show generally an attenuated infection which phagocytosis can conquer. While purulent

* Archives de Médecine Experimentale, Vol. XVI., p. 207.

† Archives of Pediatrics, Vol. XXIII., p. 276.

‡ Archives gen. de Médecine, Vol. XIX., p. 257.

§ Archives de Médecine Experimentale, 1897, p. 49.

exudates show the victory of the microbes over the phagocytes degenerated into pus globules, some curable cases like pneumonic meningitis are due to lesions of this nature. Sterility of the cerebrospinal fluid must not be asserted on failure with ordinary cultures. In these a pneumococcus of feeble vitality may not survive, while an inoculation in a mouse may prove positive. Even in cases where such inoculations were apparently negative, that they have some validity may be shown by their conferring an immunity against virulent injections.

Fraenkel* criticises Aufrecht and regards the hemiplegia which the latter describes in pneumonia as a purely symptomatic disturbance of the nervous system, rejecting the hypothesis of meningitis because of the lack of characteristic symptoms of the latter and also from the fact that some of them are cured.

THROMBOSIS.

Whipham † cites a characteristic case of this condition. A child of one year, eleven days previously suddenly ill with convulsions, cough; no history of otorrhœa, patchy consolidation of the left lower lobe. Four days later, right side suddenly spastic, head retracted; spasm passed off in two hours; head stayed retracted; vomiting; repeated convulsions, starting on the left side and spreading over the whole body. Head retraction increasing. Death four days after the cerebral symptoms. Autopsy showed a septic thrombosis in the superior longitudinal sinus and the connecting veins were thrombosed. The right lateral sinus, recent thrombosis, the straight sinus, white, slightly adherent clot. Small abscesses in the left occipital lobe, large abscesses in the right, with thick pus communicating with the right lateral sinus. Both middle ears contained pus. Lungs: Acute purulent bronchitis, left lower lobe, solid bronchopneumonia.

Suckling ‡ reports a case of right hemiplegia from cerebral thrombosis complicating pneumonia, remarking that this is the first case of hemiplegia met with in one thousand cases of pneumonia in the Birmingham Workhouse Infirmary. A girl of eighteen, admitted on the tenth day of illness with pneumonia of the left base. On the fourteenth day, ear-ache without discharge; fifteenth day, temperature rising; in the evening

* *Zeitschrift für Hygiene*, 1898, p. 315.

† *British Medical Journal*, April 30, 1910.

‡ "*Birmingham Medical Review*," Vol. XXX., p. 94.

patient comatose. After one day of incomplete unconsciousness, coma became complete, followed by paralysis of right arm and right leg. Patient died on the seventeenth day. Post-mortem: Thrombosis of the basilar artery, left half of circle of Willis, also of deep and superficial arteries of the left hemisphere. No emboli.

Thrombosis of the sinuses, it may be said in passing, is not rare in other infections; for example, typhoid* and even in pernicious anæmia. (*Ibid*, Vol. XIII., p. 25, Osler.)

CEREBRAL ABSCESS.

Landrieux † reports a case of pneumonic hemiplegia with a cerebral abscess, with pneumococci. A man of forty, with good health and habits, four days before admission, had been thrown into the water and rescued after ten minutes. Had chills for next two days. Following day, cough, pneumonia of left upper lobe. On fourth day of illness, slight stiffness in the neck; no Kernig sign. Lumbar puncture gave fluid of normal color flowing under slight pressure. No abnormal contents. Same evening, left hemiplegia, total, flaccid. Slight conjugate deviation of the eyes and head. No coma, no aphasia. Extreme abundance of polynuclear leucocytes. Death on the sixth day of the disease. Autopsy showed usual lesions of pneumonia; nothing found in the meninges. No increased volume of either hemisphere. Abscess cavity right hemisphere, partly in the lenticular nucleus, partly in the anterior segment of the posterior arm of the internal capsule. Pure culture of pneumococci in the fluid; inoculation of mice, positive. The writer speaks of the impossibility of distinguishing between this case and the pneumonic hemiplegias which we are to consider later under the head of paralyzes without lesion. The foregoing condition is sometimes referred to as encephalitis with pus, but we come next to a much more frequent condition.

ACUTE HÆMORRHAGIC ENCEPHALITIS.

Strümpell, ‡ in 1890, gives the first clear description of acute primary encephalitis. He points out a close relation between some cases of encephalitis in children and poliomyelitis, two

* "Johns Hopkins Bulletin," Vol. VII. (Blumer, Thayer and Haines).

† Revue general de Clinique et de Thérapeutique, 1903, Vol. XVII., p. 129.

‡ Deutsches Archiv. f. Klin. Medizin, Vol. XLVII., p. 53.

conditions resembling each other in their infectious origin, differing chiefly in the character of the resulting paralysis. Quite distinct from these cases in children is the acute encephalitis of adults, of which Strümpell gives two cases with careful post-mortem studies, one in a healthy man of twenty-seven, another in an old man. In both, the clinical picture was sudden unconsciousness, paralysis, in one with crossed patellar reflex, in the other with rhythmical movements of the unparalyzed side, with exceedingly high fever, 107.9°. The essential and significant pathological finding in both cases was a true, acute interstitial inflammation proceeding from the vessels into the white matter of the brain, with hyperæmia and a development of leucocytes about the enlarged vessels and abundant punctiform hæmorrhages. Both patients showed a pneumonia and one of them a splenic tumor. Strümpell says that acute hæmorrhagic encephalitis may also be the sequel of other diseases, especially influenza. Very severe cerebral symptoms (headache, loss of consciousness, hemiplegia) come on suddenly and lead to speedy death with high fever. Autopsy shows several hæmorrhagic, encephalitic foci, usually confined to one hemisphere. Brain yellow and softened, very œdematous and studded with numberless little capillary hæmorrhages. He adds, "It is of practical importance that, according to more recent observations (the author, Oppenheim and others), a *curable* form of encephalitis also occurs in adults. Acute onset with fever and grave general cerebral symptoms (headache, stupor, delirium, occasionally deep sopor); also marked focal cerebral symptoms (hemiplegic disturbances, aphasia, hemianopsia, symptoms of cortical irritation) and after some time (a few days or several weeks) an entire disappearance of all symptoms with the exception, perhaps, of certain residual ones which, however, do not progress. An ophthalmoscopic examination is of great diagnostic importance in all these cases. It frequently, though not invariably, shows a marked optic neuritis with more or less marked venous congestion."

Mollard and Dufourt,* upon acute encephalitis in pneumonia, quote from Chartière, with an example, who says that many cases of pneumonic hemiplegia are to be classed as encephalitis.

Also from Chappet (thesis), who finds only one case with autopsy where there is actual encephalitis. This was in a

* Lyon Médical, Vol. CXVI., p. 821.

woman of seventy-three who, in the course of pneumonia, was taken with paralysis of the face and left arm. Autopsy showed congestion of meninges, right hemisphere, of rosy color. In several other cases the brain is the seat of hæmorrhages which seem to depend on another cause (softening and thrombosis). On the other hand, he cites numerous cases of hemiplegia followed by recovery in which a large part must have been played by encephalitis. Mollard cites the case of a man of forty-four, alcoholic, seen the fourth day after a chill; pneumonia of the right base, anteriorly. Seventh day of sickness, violent delirium, rigidity, retraction of neck and head. Lumbar puncture, clear, limpid fluid like spring water, rare cellular elements, three polynuclear, one lymphocyte, no pneumococci. Death on the eighth day. Autopsy showed pneumonia. Dura not adherent. Congestion of the vessels of the meninges, vessels dilated, one small meningeal hæmorrhage. Along sulci a sort of jelly, scanty, no pus. The brain showed a delicate rose color, not disappearing with washing, diffused over both hemispheres. Section of white matter showed no hæmorrhage but bloody points. Inoculation of subarachnoid fluid showed culture negative.

Mollard gives two causes for the encephalitis of pneumonia: first, toxines; second, pneumococci carried through the blood. Perhaps both act. Pfuhl has found in the brain bacillus of Pfeiffer, Kurschman the bacillus of Eberth and Leichtenstein a meningococcus.

As to the occurrence of pneumococcus, two groups are described: (1) of pure pneumococci infection, (2) with associated infection. In the first group of five cases, pneumococcus was abundant in the blood. In two of these the brain was sterile notwithstanding the gravity of the infection, but, in the other three, cultures from the brain substance gave many pneumococcic colonies. In the second group of five cases the diplococcus lancecolatus was associated with streptococcus and staphylococcus. In all the brain was poor in bacteria and showed only one of the kinds found circulating in the blood.

Leichtenstein * described cases of acute hæmorrhagic encephalitis occurring, first, in epidemics of cerebrospinal meningitis; second, in ulcerative endocarditis; and third, in influenza. The etiology in all cases is infectious.

* Deutsche Medicinische Wochenschrift, 1892, p. 39.

Comby * finds that the etiology corresponds with what has already been described. The symptoms are, sudden onset, convulsions general or localized, often epileptiform, coma, contractions. Sometimes convulsions are wanting, being replaced by flaccid hemiplegia which might suggest cerebral softening. He says that many cases recover. Meningitis is excluded in these cases by negative spinal fluid. In the latter polynuclears are found to predominate in bacterial meningitides; lymphocytes in granular meningitides. In encephalitis there are no leucocytes.

Turning now to the second group, previously indicated, of paralyzes without lesion, we may premise by saying that possibly in this group are some of the cases last referred to, of recovered encephalitis. Most of the inorganic cases, however, are toxic in origin. The poison may spend itself (a) upon the brain, producing hemiplegias somewhat analogous to those seen in uræmia, without lesion, and (b) upon the peripheral nerves, being analogous to the neuritides following diphtheria.

Lesieur † and others restricted the term pneumonic hemiplegia to cases in which there is no gross alteration of the brain, it being admitted, of course, that the gross alterations of hæmorrhage, softening, etc., already considered, are liable to occur in pneumonia.

Of this type of cases considerable has of late years been written by a few French and German authors.‡ Space will not admit of a detailed discussion of the views of these writers nor of a description of their illustrative cases. These "true pneumonic hemiplegias" occur mostly in young people and are generally recovered from. Hence the relative scarcity of autopsies. Some of these writers hold that the cases may have been due to a larval pneumococcic meningitis, and Comby refers some of them to a secondary encephalitis.

But the majority hold to the view of a toxic influence either directly upon the brain cells or through vaso-motor nerves. The flushed cheek in pneumonia suggests to several of them a

* Le Bulletin Médical, 1906, No. 5.

† Société Médicale des Hôpitaux de Paris, Vol. XXVIII., p. 570.

‡¹ Lesieur (and others). Société Médicale des Hôpitaux de Paris. Vol. XXVIII., p. 570.

² Chantemesse. Ibid. 1893, Vol. X., p. 875.

³ Doernberger Münchener Med. Wochenschrift, 1904. Vol. LI., p. 833.

⁴ Daireaux. Archives générales de Médecine, 1906, Vol. II., p. 2241.

⁵ Moizard. Journal de Médecine, Vol. LXVII., p. 689.

⁶ Bouloche and Lépine, Thèses de Paris.

⁷ Lesieur et Froment. Révue de Médecine, Oct., 1911 (special number in honor of the festival of Lépine).

similar vaso-motor disturbance inside the cranium, as does also the fact that vaso-motor paralysis sometimes first affects the limbs which are later to show a true paralysis. Boullouche is inclined to think some of them hysterical.

These paralyzes are often of short duration and usually of benign character, which indicates that they are not associated with any permanent material alteration in the nerve centers. It is usually at the end of the second or third day in the onset of pneumonia, rarely later, that the aphasia begins. It may be preceded for some hours by headache, bewilderment, vertigo, or paræsthesia in the right side of the face or right arm. Sometimes the symptoms become frankly hemiplegic. Aphasia may begin without any impairment of consciousness or may follow a true apoplectic attack. The type is usually ataxic as in lesions of the third left frontal convolution. The patient may pronounce only a few monosyllables more or less appropriate to what he wishes to say. At first the intellect is blunted and he cannot understand what is said but after a few hours indicates by a gesture that he wishes to talk.

One writer believes that such paralyzes are usually on the right side, which accounts for their frequent association with aphasia. The aphasia is usually short, disappearing after three or four days. Illustrative cases are cited, in one of which aphasia appeared early on the third day of pneumonia with slight syncope, followed by prickling of the right arm; at noon further syncope and aphasia which lasted only one day, with recovery. In a case cited from Balzer, a patient with aphasia died of pneumonia five days later. The brain was found perfectly normal and microscopic examination of the third convolution showed nothing.

Doernberger reports a case so characteristic that it deserves quoting. It is that of aphasia in a boy of three and a half, who had a wandering pneumonia involving both lungs. On the sixteenth day there was loss of consciousness and speech; pupils dilated, fixed, equal; eyes wide open as if looking at a distance; occasional scream, otherwise stupid; no response to call. Stiffness of neck the following day; clonic spasms of the left extremities; face drawn to left. In two or three days the convulsions and meningeal symptoms disappeared. On the tenth day after the onset of the cerebral symptoms, patient free of fever, notices playthings, laughs and puts out his hand, makes fruitless efforts to speak, distorting his face in the

attempt. On the following day he speaks the first words, "Yes" and "No." His speech from that time gradually returned and he resumed complete health.

ILLUSTRATIVE CASES FROM CITY HOSPITAL RECORDS.

I have examined the records of pneumonias, so far as they are catalogued in the Boston City Hospital files, for a number of years, and find among about 7,600 patients that there appear to have been the following types of cerebral disturbances: 21 cases of meningitis, 4 of embolism, 2 of thrombosis, 1 of softening, 3 of abscess, 2 of œdema, 2 of hemiplegia, 1 of transient aphasia. I find no diagnosis to have been made of encephalitis, though it is probable that that condition may have been responsible for several of the cases otherwise classified. In addition there was one case of facial paralysis occurring apparently as a consequence of pneumonia. A few typical instances of each of the foregoing groups may be cited.

MENINGITIS.

Of the 21 cases 5 were confirmed by autopsy and 2 others by lumbar puncture.

J. M., 63, service of Dr. Bowditch, April 20, 1898. Severe headache in the morning, fainted in the afternoon, unconscious for a short time. Following day, cough, temperature 102, consolidation of the right lower lobe, posterior. Process increased through the right lung. On the 28th, violent muscular twitching, eyes turned up and to the left, jaws stiff, rigid; death on the eighth day of the disease. Autopsy showed pneumonia with pneumococci in the smears, throughout the whole right lung. The dura was adherent to the skull. Pia thickened. Considerable amount of thick yellow fluid extending along the vessels from the left occipital to the front part of the parietal lobes. Same on the right hemisphere to a less extent. Also on the superior part of the cerebellum. Brain section normal, middle ears normal, cord normal. Smears from the exudate showed pneumococci in considerable numbers.

The other cases of meningitis showed similar symptoms; one other illustration will suffice:

R. A., 35, service of Dr. Mason, entered April 15, six days after a chill, with pneumonia. Crisis on the twelfth day of pneumonia; two days later temperature began to rise again. Three days later much worse, sudden violent delirium; seemed to be in pain. Neck rigid, head not retracted. After two and a half hours, patient quieted. Following day, Cheyne-Stokes respiration, dilatation of pupils; knee jerks present but slight. Death. Autopsy showed organizing lobar pneumonia. Brain: Dura not adherent. Pia opaque. Between it and the brain, green

yellow material, thick, viscid, veins much congested. Cerebellum covered with exudate. Ventricles contained slightly opaque fluid in excess in quantity. Middle ears normal.

EMBOLUS.

N. D., Italian, 30, single, service of Dr. Morse. Sick June 1, chill, consolidation of middle lobe. Crisis on the tenth day. Temperature normal three days, but began to complain of pain in legs, especially the right, which is cold from right knee downward. On the anterior and outer aspects of the leg, a diffuse purple area. Left leg cold from just below the knee. No pulse in the posterior tibial or dorsalis pedis in either leg, nor in the right popliteal artery. Strong pulse in both femorals. No phlebitis. Slow gain in both legs followed until June 17, when the patient fell out of bed at 3 a. m. Unconscious, Cheyne-Stokes respiration, general muscular rigidity, jaws closely set, arms straight and rotated inwards with frequent twitching. When the legs were raised patient breathed more noisily as if in more pain. Well defined ankle clonus. Pneumonia wholly resolved. Patient died fourteen hours after the cerebral attack, which, in view of the preceding peripheral emboli, was evidently itself of embolic origin.

THROMBOSIS.

L. D., about 50, male, service of Dr. Folsom. This patient had an attack of pneumonia November 5, which was still unresolved on December 20 when a brief attack of erysipelas supervened, and he left the hospital at his own request February 2. Was readmitted with pneumonia of left side. On March 9 there was delirium; on March 13 he died. The autopsy showed unresolved consolidation, without tuberculosis, both lungs. In the brain the veins of the pia and arachnoid over the posterior half of the left cerebrum were deeply injected and between them abundant profuse hæmorrhages into the tissues of the pia. Same injection with hæmorrhage was present over the median aspect of the posterior halves of the cerebrum and to a less extent over the posterior third of the right half of the brain. On the left side, a firm grayish yellow thrombus was present in the vein of the fissure Rolando. In some of the other veins posterior to this in the median fissure and to a less extent over the posterior portion of the right half of the cerebrum, similar thrombi.

SOFTENING.

K. W., female, 24, married, service of Dr. Sears. June 1, slight pain for a few days. Yesterday unconscious, white count 27,000. Five days later neck rigid, dull, stupid, incontinent. Consolidation of lower right back, stupid, and twitching of the hands. June 15, died. Autopsy showed consolidation. Brain: Nothing exteriorly; slight increased cerebrospinal fluid; many areas of softening in the anterior part of the cerebrum confined to the white matter. These areas frequently connected with one another and contained gray yellowish puriform material. Smears show collection of large mononuclear cells, no polynuclears.

ABSCESS.

M. Y., female, 39, married, service of Dr. Mason. August 24 to September 5, pneumonia followed by empyema, which was opened in

December and continued to discharge. February 18, vomiting, lost consciousness, collapse, followed three days later by violent delirium and death. Autopsy showed empyema of the right side, on the left side consolidation with cavity. Brain: Turbid fluid with many leucocytes among the meshes of the pia, at the base, and in the left ventricle. Abscess cavity in the posterior horn of the right ventricle; rough walls; green, foul-smelling material. Abscess cavity continuous with ascending horn which to its end is filled with similar material. Around the abscess and along the course of the ascending horn brain substance for distance of one cm. presents numerous punctate hæmorrhages.

ŒDEMA.

M. B., aged 11 months, service of Dr. Williams. Two months ago convulsions and bronchitis. Convulsions recurred on day of admission, February 13, and the patient died suddenly eight days later. Autopsy showed lungs in last stages of gray hepatization of the left lower lobe. Œdema of the brain. Beneath the pia a well marked collection of fluid, the pia being raised above the brain $\frac{3}{8}$ of an inch. No tubercle bacilli found anywhere.

In the collection of cases no diagnosis of encephalitis was made, clinically or anatomically, but it is probable that some of the cases of hemiplegia may have been of that nature, as can be conjectured from cases quoted in the earlier part of this paper, and the following is possibly one of that character.

J. P., Italian, 27, male, service of Dr. Shattuck. December 19, symptoms for four days, pneumonia left lower lobe. White count 26,000. Three days later marked delirium, convulsive attacks. Once jumps up and runs about the ward. Defervescence on the ninth day of the illness. Following day return of fever. Temperature 101 to 101½. Next two days temperature rising. Constant delirium requiring restraint. Fever continues on the fifteenth day, temperature to 104, white count 20,900. January 1, great deal of resistance; difficult to examine reflexes; slight retraction of the neck; spasticity of arms and legs; Kernig apparently present; no Babinski. Lumbar puncture gave one ounce of clear fluid without pneumococci. Patient died without change in his condition and there was no autopsy.

The evidence in this case, from the negative content of the spinal fluid, rather favors encephalitis as against meningitis, though the symptoms might suggest the latter. Other cases of hemiplegia also suggest encephalitis, viz.:

E. C., female, service of Dr. Sears. Entrance March 1, without history. Pneumonia of the right back, herpes of lips, no brain symptoms. Following day temperature dropped and was normal for nine days. Then complained of severe right-sided headache somewhat relieved by ice cap. Lungs nearly clear. Following day, headache worse, weakness of left arm. Following day, complete paralysis of left arm, partial of left leg. Stupor, gradually deepening to coma. Occasional convulsion of left side of body with exception of left arm. Rising temperature. Died March 13. No autopsy.

Under the second group of brain symptoms without lesion is a brief case of aphasia:

E. E., married, 32, female. April 8, temperature 104, consolidation of right lower back, white count 22,500. Articulates rather poorly. April 19, marked aphasia, tongue protruded slightly to the right. Movements of both sides of the face equal. Pupils equal and react. Ocular motions normal. Field of vision normal to rough test. Knee jerks normal. No paralysis. Some words are unintelligible and others are better pronounced on repetition than at first. She can write and read aloud better than she can talk. Next four days power of speech much improved and she was discharged later, well.

A case of facial paralysis of transient character during the convalescence of pneumonia was apparently of the toxic type and may have been of central origin or due to peripheral neuritis.

The most remarkable case which has come under the observation of the writer, of grave cerebral symptoms occurring consecutively to pneumonia and apparently presaging a fatal result, is the following, which was seen in consultation at the Boston State Insane Hospital:

The patient, W. M., was an attendant in that institution and a strong and healthy young man of admirable habits. On February 5, 1912, the patient complained to his friends of headache and general pains. On February 7 he went off duty, and went to bed, complaining of headache and general pains in the shoulders, back and legs. Constipated. Temperature 100. On February 10 his temperature was 104 and he complained of a slight pain, in his chest. No sign of pneumonia found. He also had a little cough without expectoration. For the next six days his temperature was irregular, between normal and 101. On February 16 he had a perfectly normal temperature and said that he was feeling very much better, so that the physician did not see him at all on the 17th. On the morning of February 18 he complained of headache and appeared rather dull, answering questions mostly with "Yes" or "No"; still no signs of pneumonia were found. When seen at 3 p. m. he showed partial aphasia and partial paralysis of the muscles of the right side of the face, but he was then able to walk and assisted himself while being moved to another room. At 8 p. m. he had complete aphasia and diminished grip in the right hand, but he could move both the right arm and leg and turn over in bed when asked to do so. He understood all that was said to him and cooperated readily, with the exception of talking. His temperature at 6 p. m. was 102.4. At 10.30 p. m. he had a severe attack of propulsive vomiting. I was asked to see the patient on February 19, when, after getting the foregoing history, the following condition was observed: The patient is dull, saying nothing. He protrudes tongue when requested. Pupils are equal and responsive. No oculo-motor paralysis. Right side of the face does not move; right arm is fully paralyzed except for very

slight movement of the fingers; paralysis of the right leg nearly complete. Sensation absent on paralyzed side. Complete aphasia. Knee jerks equal and normal. Is incontinent. Babinski reaction and ankle clonus on right side. Oppenheim and Mendel reaction on right. The heart sounds were clear and there was slight dulness outside the heart apex. No abnormal auscultatory sounds were heard. Respiration was shallow and the patient could not be made to cough or to take a long breath. In view of the septic temperature and the sudden, nearly complete paralysis with the reflex anomalies noted, in a young and previously healthy man, the opinion was expressed that he probably had a septic thrombosis, the infection probably originating in the chest. The blood count which yesterday showed 19,600, was to-day 13,200, with 93 per cent of polymorphonuclears. Lumbar puncture brought a clear fluid which was later reported sterile. Widal negative. Blood culture was also later reported as negative.

February 20: temperature at 6 a. m. was 102.2 and at 6 p. m. the same. He voided urine and feces in bed, and while he followed the nurses and physician with his eyes, he quite evidently did not know what was going on. However, if asked if his head ached and where it ached, he rubbed his hand over the right side of his head.

Two days later (February 21) I saw him again. The morning temperature was then 104.6. Pulse 92. Respiration 46. The paralysis of the right side was complete; pain sense absent. No paralysis on the left side. He swallows, but with difficulty, and the attempt causes coughing and choking. Says nothing and apparently does not recognize his sister, who has arrived from a distance. In the left back where the dulness was found two days ago there are fine râles over limited areas, warranting the diagnosis of broncho-pneumonia. The prognosis, in view of the worse cerebral condition, was considered highly unfavorable. The event, however, contradicted this prognosis, for, after five days of desperate illness, the temperature fell and improvement began. For the remaining, as well as for the earlier history I am indebted to the careful record of Dr. E. C. Noble, who was in charge of the case.

For the next three or four days the temperature remained elevated but in two days he swallowed a little better. On the morning of February 26 the temperature dropped to 99. He still was incontinent and very restless; aphasia and paralysis complete. Two days later he appeared to recognize the physician and his friends and very slightly moved the fingers of the right hand. No other movement of paralyzed side. Babinski and clonus present on right side. Knee jerks equal.

March 1, a. m., he slightly moved the right arm but not the foot; in p. m. he could flex the arm and move the foot a little.

March 3, he spoke for the first time, at seven o'clock. This was only a muffled sound in reply to some one saying "Good morning." He said nothing more until 10 p. m., when he distinctly asked "What time is it?" Temperature normal; incontinent of urine still.

March 4, no longer incontinent. Speech thick, no attempt made to make him talk, but he says a few words with effort and seems pleased at doing so.

March 10, speech has returned, also motions of right side. A slight Babinski and very slight ankle clonus remain.

March 20, steady improvement during the last ten days. Temperature normal; eating well; moves unaided from bed to chair. Is dressed for first time.

April 1, walking outdoors for last seven days and starts for Vermont. No paralysis, aphasia, Babinski nor clonus. Patellar reflexes equal and normal.

In marked contrast with the outcome of this case is one which the writer saw many years ago in a man of about thirty-five years of age, strong, of good habits, who had a grippe followed by pneumonia, in the course of which occurred a hemiplegia less severe in clinical character than the one last recorded and which resulted fatally.

It is important to recognize, clinically, then, that in a few cases cerebral symptoms may complicate pneumonia which may be, on the one hand, either those of grave organic lesion, of which the commonest is meningitis, or, on the other hand, of apparently toxic origin with little or no destruction of brain tissue. The enormous importance from the point of prognosis of this distinction is evident, but difficulty in diagnosis is sometimes insuperable. Lumbar puncture is of importance in excluding meningitis, though it is not an unfailing criterion. Examination of the fundus may be useful. Cases of encephalitis are not always to be distinguished from the functional cases and it is possible that many cases of hæmorrhagic encephalitis may recover. The prognosis, if one be assured of the inorganic toxic character of the disease, would be on the whole favorable, though it is not as roseate as is indicated by some of the authorities which I have quoted. The occurrence of the symptoms in a young healthy person is more suggestive of a toxic functional character than would be the case in aged people. The toxæmia is productive of diverse symptoms according as its incidence is upon the central or the peripheral nervous system.

VIII.

A FEW CASES ILLUSTRATING POINTS OF INTEREST
IN RENAL SURGERY.

BY PAUL THORNDIKE, M. D.

The intention of this paper is to make a brief clinical report of some cases of renal injury or disease, each one of which is of interest as a demonstration of some point in the pathology, diagnosis or treatment of renal conditions.

CASE 1. DECAPSULATION FOR NEPHRITIS.

Married woman, aged 30 years. A previous history of renal insufficiency following scarlet fever and measles was first indicated by the necessity for an artificially induced labor nine years before her present trouble. Her admission to the Boston City Hospital two weeks ago followed a seven months' pregnancy associated with severe headaches, œdema of the ankles, dyspnœa to the point of orthopnœa, and trouble with vision. There followed two convulsions and finally labor was induced and a dead child was born. Two weeks later (December 5, 1911) she entered the Boston City Hospital with all her symptoms still prominent, and with a physical examination showing a soft systolic murmur at the cardiac apex, a blood pressure of 205, and a pulse of 80, with a urine containing large traces of albumin, hyaline casts, epithelial cells from the kidney and a few fat droplets. From this time (December 5) until March 22, nearly four months, her history was that of gradual temporary improvements followed by sudden attacks of dyspnœa, vomiting and suppression of urine from no apparent cause and in spite of the best of care. In other words, periods of improvement, lasting for a week or so, were followed by crises from each of which the recovery was perhaps increasingly slow accompanied by increasing weakness. At this time she was transferred to a surgical service and both kidneys were decapsulated under slight ether anæsthesia and at one session (March 26). She passed 90 c.c. of urine the first day after operation, 900 c.c. on the second day, and from this day the amount gradually increased to normal and then beyond it. On April 15, less than three weeks after her operation, she was sent back to the medical service for further observation, at which time there was the slightest possible trace of albumin, no casts, no blood, few epithelial cells and a specific gravity of 1.007. A week later, just four weeks after operation, she was discharged with no symptoms, subjective or objective, no albumin in the urine, and stating that she felt better than for years.

Recent efforts to find out the patient's present condition were unsuccessful.

This case is reported because it illustrates the writer's idea of one important field of usefulness of decapsulation of the kidney. In chronic renal inflammation with uræmic symptoms where there are these repeated crises, from each of which the patient rallies with increasing difficulty and with increasing weakness, it seems as if something may be expected from this very much advertised procedure. In the case of the particular patient instanced it may be asked if the same result might not have happened without operation. This possibility cannot be denied, but the writer is sure that anyone who followed the progress of this patient during the months of her hospital residence would never for a moment grant such a supposition, and it was only after the complete hopelessness of any improvement had impressed itself upon all concerned with her medical care that decapsulation was considered. The value of the operation in these acute crises probably depends upon a change of pressure in the kidney and so a temporary bettering of the general circulation giving opportunity for the crisis to pass and making subsequent crises less likely to follow. In connection with this point it may be mentioned that it seems pretty definitely established that while a new capsule is quickly formed after decapsulation, such a capsule is often formed over a kidney much larger and more capable for work than it was at the time of the operation.

CASE 2. CONGENITAL ABSENCE OF ONE KIDNEY — RUPTURE BY INJURY — OPERATION — DEATH.

A man aged 26 years, a teamster by occupation, fell from a staging 15 feet to the ground, striking on his left side and back. He was immediately taken to the Boston City Hospital in a condition of acute shock, and examination revealed tenderness, marked voluntary and involuntary spasm with dulness on percussion in the left loin, with slight shifting dulness in the abdomen with a change in position. There was much fresh blood in the urine obtained from the bladder by catheter. The patient was put to bed with an ice bag to the loin and was given morphia, $\frac{1}{4}$ grain, subcutaneously. He grew rapidly worse, and as blood began to trickle from the meatus an operation was advised but refused. During the next twelve hours thirteen ounces of bloody urine (chiefly blood) came away, weakness increased and finally the patient consented to an operation. A quick nephrectomy was done and a large lacerated kidney with one end torn away, together with three smaller pieces of kidney tissue, were removed. The estimated weight was about 225 grams. The microscope showed hemorrhage throughout the kidney. At operation several ounces of blood mixed with urine poured from the incision when made. Following operation the patient gradually failed and died in three days, having passed no urine in spite of every effort to induce renal activity. A urinous odor was

noticed in the sweat from the end of the second day. No full autopsy was allowed but exploration through the wound showed the absence of a right kidney and ureter and no renal artery leaving the aorta at the usual spot. Diagnosis: congenital absence of one kidney.

This case is reported for the following reason: One reads reports of such rare cases of solitary kidney and occasionally of one where the diagnosis was made with the aid of a cystoscope, and the writer of such an article usually says, "Without the aid of a cystoscope and ureteral catheter I believe this kidney would have been removed." This is doubtless occasionally true, but here was a patient rapidly dying of shock and hemorrhage, whose general condition and whose bladder condition, by reason of the rapid bleeding into it, made a cystoscopy impossible and where the obvious surgical duty was a quick exposure of the seat of injury and a rapid effort to find and control hemorrhage.

The lesson to be learned from this report is not "remember to use the cystoscope" (that instrument needs no champion in this day and generation), but the lesson is "go slow"; "remember there is such a condition as a solitary kidney"; "remember that a very large proportion of cases of ruptured kidney get well without operation"; "remember that a suspicion, however started, of solitary kidney may subsequently be confirmed if the surgeon stays his hand, waits for a compelling operative indication and does not operate on every case of loin injury connected with blood in the urine." If he follows this latter plan he will be wrong more often than right, and he will be lucky if he does not meet rupture of a solitary kidney in the course of his career as an operating surgeon.

CASE 3. ACUTE HEMATOGENOUS INFECTION OF ONE KIDNEY.

A married woman about 50 years of age. Previous history unimportant. Two days before entrance to the Boston City Hospital was nauseated and last night had a pain in the right loin referred downward to the groin and not upward to the shoulder. During the night had three chills with vomiting, persistent headache, and slight fever. For two days has had frequency and smarting on urination. Physical examination shows a tenderness, also slight spasm, in the right flank, both anterior and posterior. A mass, possibly a kidney, can be felt between the hands in the right loin. Pressure on this mass makes acute pain. Urine contains trace of albumin. Temperature, 102.6; pulse, 120; white blood count 8500. Her chills continued. Ether was given; the usual renal incision made in the right loin and exposed a large soft kidney with numerous sharply circumscribed whitish

areas all through its cortex when incised. Kidney was removed, cigarette drain placed in the wound and on the fifth day urine became normal in character and quantity and the patient made an uninterrupted convalescence.

Report of Dr. F. B. Mallory, Pathologist.

Microscopical examination shows numerous areas of acute inflammatory reaction within and around the tubules both in the medulla and in the cortex. The exudation consists chiefly of polymorphonuclear leucocytes with a little serum and fibrin; endothelial leucocytes are fairly abundant in places. There are also lymphocytes in small numbers and a few eosinophiles. In some areas the tubules are distended with exudation. In other places the tubules and the adjoining tissue have been destroyed so that small abscesses exist. Colon-like bacilli are present in small numbers in some of the polymorphonuclear leucocytes.

The multiple lesions are characteristic of an ascending pyelonephritis. The infection probably occurred by way of the bladder and ureter. This conclusion is favored by the nature of the infecting organism (probably the colon bacillus) and by the multiplicity of the lesions. If the lesions were so numerous from hæmatogenous infection the other kidney would necessarily have been involved. It is practically impossible to have multiple lesions of hæmatogenous origin in one kidney without having them in the other at the same time. Examples of this in the kidney are acute miliary tuberculosis and acute miliary abscesses due to the staphylococcus pyogenes aureus.

Multiple infectious lesions in one kidney only are of ascending origin: usually from the bladder by way of the ureter, but sometimes from a single lesion of hæmatogenous origin which extends to the pelvis of the kidney and is then converted into an ascending pyelonephritis. Chronic tuberculous pyelonephritis may originate in either of these ways.

This case is reported for two reasons: First, because it illustrates the type of case which demands nephrectomy for its cure, and second, because it affords opportunity for a few words concerning the ascending as well as the hæmatogenous form of renal infection. Nephrectomy is almost universally recommended in cases of so-called hæmatogenous renal infection, and in this instance the involvement of renal tissue was so extensive and the areas of disease were so large that no lesser procedure could possibly suffice. It has been, however, the writer's fortune in one or two instances to find such kidneys in which the areas of infection took the form of small whitish spots evidently of embolic origin and all located superficially and immediately under the true capsule of the organ. In these cases a decapsulation with drainage of the wound of entrance sufficed for a speedy recovery. Dr. F. J. Cotton, in the "Annals of Surgery," November, 1911, reports a similar case, and such

may, I think, be regarded as examples of a not uncommon form of early renal infection. Nephrectomy, then, is by no means always necessary.

It has been shown by Dr. G. E. Brewer, of New York, and by others, that hæmatogenous infection of an injured kidney can be easily produced experimentally, but that such an infection can be confined to one kidney and at the same time be multiple in its manifestation is by no means so clear. As may be seen in the accompanying pathologist's report by Dr. F. B. Mallory this case is called an ascending infection because it is one-sided and is also multiple. To be of hæmatogenous origin the original focus of infection must have extended down to the renal pelvis and from there by ascending infections must have given rise to the other areas found.

CASE 4. A CONGENITALLY MISPLACED KIDNEY.

A married man, 31 years of age, has an indefinite history of pain in the left back combined with slight urinary irritation, covering a period of nine years past. For the last three or four years has noticed blood in the urine occasionally. During the last few months has lost much in weight and general health and the urine has been full of sediment and blood. Physical examination: In the left lower quadrant is a large tumor mass, tender to the touch. The cystoscope shows no efflux from the left ureter and the left ureteral catheter could not be passed. Indigo carmine test is normal from the right side but much delayed and very faint in color from the left side. The X-ray shows nothing definite. Cystoscopy with collargol injection into the pelvis was suggested but refused by the patient. Diagnosis: either pyonephrosis or abscess from disease of bone or other tissues in the neighborhood and connecting with the ureter. Congenital misplacement not considered. Operation, April 1, 1911. Vertical incision over the tumor mass. Abdomen opened and mass found adherent to all surrounding viscera; walled off with gauze and aspirated; much pus. Cavity incised and a pint of thick pus evacuated; cavity emptied and dried out and drainage tube inserted. Neither the limits of the large cavity nor the origin of the pus could be determined. Patient well and at work in one month with a small persisting sinus. During the following ten months the patient's condition was good, but the sinus never closed. Collargol injection with cystoscopy again refused, and a second operation was done February 5, 1912. Through a lumbar incision a careful search failed to reveal the left kidney in its proper place. A second incision was then made down through the sinus toward and as far as Poupart's ligament. The pelvis was exposed and a large mass was found in its left side, wholly below the pelvic brim. The mass contained pus which was evacuated in the process of its removal. The removal was very difficult and the mass found to be a pyonephrotic kidney containing several stones. Drains were placed into the loin and into the pelvis. Four days later the urine became normal and stayed so. Uninterrupted recovery was made and the patient is perfectly well up to date.

This case is reported, first, because of its rarity, for although the cystoscope, the ureteral catheter, and the X-ray photograph, with collargol injection into the renal pelvis, have made the ante-mortem diagnosis of such rare cases comparatively easy, the number of them is small and they all should be recorded; and second, as an illustration of the undoubted fact that such cases of congenital misplacement are often the real cause of the pathological conditions which pertain in the misplaced kidneys. It may be an hæmatogenous infection of the acute kind, it may be a permanent or intermittent hydro-nephrosis, or it may be, as in this case, a pyonephrosis with secondary stone formation, but the misplacement itself is a causative factor in most instances. In such cases as the one just reported the element of infection is so widespread throughout the kidney substance and the danger of rupturing the tumor and disseminating the pus during operation is so great that usually the retroperitoneal or lumbar incision is to be preferred as an avenue of approach, although this method renders the removal itself more difficult in most cases.

IX.

OPERATIVE TREATMENT OF FRACTURE OF THE PATELLA.

BY JOHN BAPST BLAKE, M. D.

From a series of thirty-three consecutive cases of fractured patella, in the Boston City Hospital, operated upon by the writer, the following conclusions are drawn:

1. All cases of "tear fracture" (due to indirect violence) in otherwise healthy patients are suitable for operation, but only under conditions of most rigid asepsis.

2. All cases of multiple fragmentation of the patella, without tear of the adjacent extensor aponeurosis (usually due to direct violence), should be treated conservatively, without operation.

3. The time of election for operation is the period from the fifth to the tenth day after the injury.

4. Wire should never be used, nor should the bony fragments ever be drilled, in fresh fractures.

5. Conversely, absorbable sutures, kangaroo or catgut, should be used, and nothing else, save in the skin.

6. The operation consists essentially in a careful cleansing of the joint; coaptation and repair of the torn capsule, suture of the torn periosteum of the patella and closure of the wound.

7. Bony union is desirable, but not essential; the tear in the capsule, not the fracture of the patella itself, is the disabling injury.

8. Gentle massage and passive motion may be begun on the twelfth or fourteenth day; the patient may be up on crutches after from seven to ten days, may go home in three weeks (wearing the ham splint). Active motion may begin, with care, in five weeks; the splint may be omitted in eight to ten weeks; and the patient may return to work in ten to twelve weeks.

9. The advantages of operative treatment are, more rapid and complete recovery, more accurate control of knee, greater range of extension and flexion. The disadvantages are the ever present dangers of sepsis and the shocking results and frequent fatalities consequent upon infection.

10. Compound fractures of the patella should be treated in the same manner, perhaps with a longer continued irrigation of hot salt solution. The results are surprisingly good.

X.

THE SURGEON AND THE PTOSIS PROBLEM.

BY F. B. LUND, M. D.

Some fifteen years ago the writer, attracted by the observation of certain remarkable instances of ptosis associated with movable kidney existing in certain subjects in the dissecting room at the Harvard Medical School, was led to make an investigation into the mechanism of ptosis and its symptomatology, especially in connection with movable kidney, which, at that time, was considered to be the only manifestation of ptosis admitting of surgical treatment. The connection between movable kidney and general ptosis of the intestines was not then so generally recognized as it is now, and many cases of movable kidney were being operated upon in which the symptoms, intestinal stasis, mucous diarrhoea, neurasthenia, emaciation, and others not dependent upon the ptosis of the kidney, but the general ptosis of the abdominal organs, were naturally not relieved by the operation upon one or both kidneys.

The conclusions reached in this paper which I quote were the following:

“A more general realization of the importance of enteroptosis as a factor in many conditions which are presented to physicians for treatment may, it seems fair to expect, lead to certain not unimportant results.

“First, a rational system of therapeutics may be more generally applied to a large class of cases of ‘nervous dyspepsia.’

“Second, the same treatment will probably relieve a large number of patients who are subjected to local gynecological treatment, with a view of benefiting general and gastrointestinal symptoms supposed to be ‘reflex’ to various local troubles.

“Third, a more rational means of prognosis in cases of movable kidney, and of decision as to mechanical or operative treatment may be possible. For instance, in the very large class of cases where movable kidney is complicated with enteroptosis,

although by suturing the kidney in position we may relieve the symptoms due to torsion of the renal vessels or ureter, and the like, we will probably find, as we all know from our own experience to be sometimes the case, that the general neurasthenic and gastro-intestinal symptoms may not be benefited by the operation. It is hardly fair to expect that suturing the kidney in position will cure dilatation of the stomach or ptosis of the other viscera. The propriety of following a nephrorraphy by measures calculated to increase and maintain increased abdominal pressure can hardly be questioned. Cases of movable kidney which are found on examination to be uncomplicated by enteroptosis will naturally stand more chance of benefit from nephrorraphy.

“Nephrorraphy, then, will relieve such symptoms as arise directly from the descent of the kidneys, and are due to torsion of the renal vein or twisting of the ureter, but it cannot be expected to cure the symptoms due to ptosis of the stomach and other viscera. I do not mean to imply that nephrorraphy is not indicated in cases where nephroptosis is associated with enteroptosis, as I believe the fixation of the kidneys if freely movable and causing symptoms to be one of the most important steps in the treatment of these cases, but that such an operation must be both preceded and followed by treatment of the general condition.

“Although we have no absolute data of the proportion of cases of movable kidney which are complicated with enteroptosis, the observations which I have made, although few in number, have led me to the belief that ptosis of the kidneys is almost always associated with more or less ptosis of the other abdominal viscera, and that slipping down of the kidney behind the peritoneum, without more or less general relaxation of the latter, and of the supporting ligaments of the viscera, is the exception rather than the rule.

“Careful attention to the subject in post-mortem rooms can alone determine the absolute frequency of relation of enteroptosis to movable kidney, and I cannot help thinking that attention to the subject will show that the condition is more frequent than has been heretofore believed.

“It is probable, also, that a routine physical examination for mobility of the kidneys and dilatation of the stomach in medical and gynecological clinics will disclose a more frequent occurrence of this condition than we have heretofore suspected,

and will greatly aid us to a rational and efficient treatment of many obscure and hitherto unexplained cases."

The time these conclusions were reached was twelve years after Glenard's classical description of the condition of enteroptosis in 1885. Glenard believed that nephroptosis was always a part of a general enteroptosis, and that the natural supports of the kidney were loosened by the dragging down of the loaded intestines in constipated patients, stretching the mesentery and loosening the retroperitoneal areolar tissue so that kidneys deprived of their support descended. Glenard's description of the symptoms, the dyspepsia, fermentation, constipation alternating with diarrhoea and mucous stools, emaciation, neurasthenia, etc., holds as good to-day as any of the descriptions which have been made by the later writers on the subject of the disease.

Ewald and Kuttner in 1890 studied the relation of movable kidney to ptosis of the stomach by distending the latter with gas and percussing its outline, and it was even in those early days recognized that there was a large class of cases in young women and girls who had never had the abdomen stretched by pregnancy, or other causes, and in whom the primary conditions could not be relaxation of the abdominal wall. The effect of tight lacing was believed to be, and undoubtedly was, a frequent cause of ptosis in young women, and the writer had (*loc. cit.*) noted the possibility of ptosis of the organs in the upper part of the abdomen, because of being dragged down by adhesions to those in the lower, *e. g.*, dilated and movable cæcum and ptotic transverse colon. Treves and others had noted these conditions at operation.

At the time of the writer's studies, in 1896, the question of the relief of the symptoms dependent upon a general ptosis of the stomach and intestines by surgery did not urgently present itself; the condition seemed too general, too complicated; there were too many organs involved, and too many unknown factors as to the condition being only a part of a general nervous weakness, etc., to make it wise, or even possible, to attack the condition by surgical measures which would seem in the first place safe, or, in the second place, even if safe, adequate to the relief of the symptoms. However, surgeons were found who were willing to attack the condition by measures for shortening the ligaments supporting the stomach, Beyea of Philadelphia being one of the first. His own results, as reported, seemed

fair, but other surgeons who tried them found the gastro-hepatic omentum too delicate a tissue to hold up a ptotic and dilated stomach with the dragging colon also, and the procedure was not generally adopted.

In 1898 Rovsing began to treat ptosis by the suture of the stomach to the abdominal wall above the umbilicus. This was avoided by many surgeons on account of the belief that it would cripple the stomach and that the gastro-colic omentum would not be sufficient to hold up the colon. Rovsing, however, has persisted in the practice and reports excellent results.

His method consists in passing three strong silk threads in and out along the anterior wall of the stomach, taking in the serous and part of the muscular coat, parallel to the lesser curvature, leaving the pyloric part of the stomach and the greater curvature free. The serous coat of the anterior surface is scarified, as is also the parietal peritoneum. The threads are then brought out through the abdominal wall and tied over a glass plate. Rovsing has now performed (1912) 163 of these operations, and other Scandinavian surgeons 93, making 256, of which 63 per cent are "cured," 12.8 per cent have been greatly relieved and there has been a mortality of 4.2 per cent.

In 76 of Rovsing's 163 cases a constipation which had lasted for years, and proved intractable to other forms of treatment, was cured. In cases where the gastro-colic omentum is greatly elongated a simple gastropexy does not elevate the colon sufficiently to cure the constipation, so that in these cases Rovsing shortens the gastro-colic omentum, picking it up with basting sutures, beginning in the serous coat of the colon and ending at the greater curvature.

Then Coffey's suspension of the colon and stomach by suturing the omentum to the abdominal wall was published and was not received enthusiastically by the surgical world.

For the cure of the gastric symptoms and dilatation accompanying ptosis of the stomach many surgeons in various parts of the world, believing that the cause of the symptoms was kinking at the duodenum, have performed gastroenterostomy, with disappointing results. The gastric fermentation and vomiting have been generally made worse, and few there be of experience who have not been compelled to separate these ill-advised anastomoses and restore the *status quo* in order to render life endurable to the patients.

Then X-ray and bismuth examination began to be applied to the study of ptosis, as well as other lesions of the intestinal tract, with the result of a notable increase in our facilities for the study of these cases and the elucidation of certain remarkable facts. It was found, for instance, as had long been suspected, that there is a marked difference in the position of the full and empty stomach, and of the full and empty colon; that in many patients in perfect health the full stomach may descend well into the false pelvis. In the case of the colon, truly remarkable angulations at the hepatic and more especially the splenic flexures have been noted without any noticeable effect on the condition of the patient or the movements of his bowels. In cases where these conditions exist in connection with constipation colics and intestinal fermentation, however, the question of angulations, at the pylorus, hepatic and splenic flexures, becomes often a matter for serious study. Adhesions of the ptotic viscera, colon and stomach to the pelvic organs, as a result of inflammation also, may, as has been often brought out in the writer's experience, severely cripple their functions.

In this connection Clark has suggested and performed, in cases where raw surfaces were left in the pelvis by operative procedures, to which the omentum is likely to become adherent, the fixation of the colon at a high level by Coffey's omentopexy, so as to prevent the omentum from becoming adherent and dragging down the colon. The writer performed Coffey's omentopexy once to elevate a ptotic colon which had become adherent in the pelvis after a pelvic operation and considerably crippled thereby. The result, although the operation was apparently performed with thoroughness, may be described as only a partial success. It seems to the writer true, however, that these ptoses, when complicated by adhesions, congenital, post-operative or otherwise, are more legitimate subjects for operation than the ptoses alone, as will be emphasized later in this paper.

The study of the congenital conditions which throw light upon ptosis has, of late years, proved of the greatest interest.

The failure of the ascending meso-colon to adhere to the abdominal wall, producing in the least instance a movable cæcum and in the greatest instance entire freedom of the ascending colon or even its median or left-sided position, may be noted and has been reported by Dr. C. H. Mayo, as has been observed although not reported by the writer. Partial con-

genital adhesions may produce bands across the ascending or descending colon or even across portions of the small intestine, as has been observed by the writer. Adequate and interesting discussion of the congenital origin of ptosis and other abnormalities of the intestinal canal may be found in the papers of Coffey and Clark, to which the reader is referred. Sharp angulations at hepatic or splenic flexure undoubtedly tend to produce constipation or intestinal stasis and this same stasis to cause intestinal fermentation and possibly, in some cases, infection of the intestinal wall sufficient to cause adhesions. The rich bacterial flora of the large intestine, particularly the cæcum, render this stagnation and fermentation particularly frequent. The drying out of the feces in the cæcum and ascending colon and the influence of gravity renders more strenuous muscular efforts necessary for their advancement. It has certainly been my experience as an operating surgeon to find that adhesions, both flat adhesions and bands, which fail to have any effect when they concern only the small intestine, are of most serious crippling power where the large intestine is concerned. Large portions of the small intestine may be glued together into balls, without affecting the progress of their contents, while a few adhesions about the cæcum and sigmoid may cripple the gut and make an invalid of the patient.

Jackson's membrane and other bands and veils across the cæcum, often angulating and obstructing the ascending colon, may be readily called to mind. The movable cæcum is almost always dilated, because hanging free in the pelvis, it has to lift its heavy, mushy load much further against gravity than does the usual cæcum, and is unequal to the task.

Movable cæcum is a congenital condition, as Clark believes colonic ptosis to be also, and it is interesting that associated with Jackson's membrane or colonic adhesions, there is almost always more or less mobility of the cæcum. Partial cæcal obstruction from the cæcal veil, has, as Harris has pointed out and my experience will bear out, a definite symptomatology somewhat different from appendicitis. The pain is not acute and colicky but constant and dragging, there is dyspepsia, constipation and intestinal fermentation. The pain covers a larger area, as does often the tenderness, than in chronic appendicitis. It is often made worse by exercise, but never becomes very acute. It may be relieved by certain exercises which facilitate motion of the viscera, such as horseback riding.

On palpation of the abdomen, gas can always be made to gurgle on pressing the large, distended cæcum against the pelvic brim, and in opening the abdomen for the relief of the condition, even after free catharsis, mushy feces will be found in the caput cæci, while all other portions of the abdomen are empty.

Roentgen examinations show the delay of the bismuth mass in the cæcum and the writhings of the latter as it endeavors to force up the mass between the veil, which is stretched into a narrow band as the loaded cæcum falls into the pelvis, and the pelvic brim. The way this band may compress and partially obstruct the ascending colon may be easily demonstrated at operation by drawing the cæcum with very moderate force down into the pelvis and observing how the band compresses the bowel against the pelvic brim.

To Wilms must be given the credit of calling attention to the importance of cæcum mobile and perfecting its treatment by fixation of the cæcum, a procedure combated by some authorities, but proven by a sufficient number to be of real value, especially when associated with removal of obstructing membranes extending across the ascending colon.

The subjoined figures, 1, 2 and 3, show X-rays taken eight, twelve and twenty-four hours after the ingestion of the bismuth meal in such a case, showing the retention of the bismuth in the cæcum and the presence of some bismuth in the appendix. The X-rays were taken by Dr. A. W. George. Figure 4 shows a sketch of the cæcum, showing the dilatation of the cæcum and the membrane, by Miss Blair. A so-called Lane kink is also shown. When, at operation, the cæcum, which after a thorough treatment with castor oil and enemata, was found to contain feces, was gently drawn downward across the pelvic brim, the membrane became stretched into a hard cord, which compressed the ascending colon against the pelvic wall and must have rendered the upward progress of its contents extremely difficult. The membrane was peeled off from within outward and sutured to the lateral abdominal wall so as to leave a broad, raw surface, to which the ascending colon and cæcum were sutured in turn, fixing the cæcum effectively and relieving the symptoms. Six similar cases have been operated upon by the writer.

The adhesions of the sigmoid, particularly at the junction between the ascending limb with the pelvic wall, forming a fixed point around which it is twisted as it falls over into the

pelvis, and in this way causing partial obstruction, is, to my mind, a very frequent cause of chronic constipation and may lead to severe dilatation of the sigmoid.



FIG 1.—X-ray taken eight hours after the ingestion of the bismuth meal.

Clark and others have preferred sigmoid-sigmoidostomy for these conditions, or even removed a redundant and dilated sigmoid. My own cases have been relieved by dividing the adhesions to the pelvic brim, and suturing the raw surfaces in

the opposite direction so as to cover them. These adhesions are important, as favoring the occasional dilatations of the sigmoid and also the acute volvulus seen not infrequently in the aged, and unless quickly relieved, resulting in gangrene. Congenital adhesions are believed by Clark to have an important influence in the production of those enormous dilatations of the colon known as Hirschsprung's disease.

The most radical of all those who have attempted the surgical treatment of ptosis has been Lane of London, who, following Metchnikoff's theory of the ill consequences of absorption from the ptotic colon, advocates and practises the entire removal of the ptotic colon and ileosigmoidostomy. In cases too feeble for ablation of the colon, ileosigmoidostomy is performed, and lately, I am informed, Lane almost always performs ileosigmoidostomy, and does not ablate the colon as a primary procedure. The total ablation of the colon is certainly a major operation to be performed for the indication of constipation. Removal of intestine for ptosis, however, is greatly facilitated by thinness of the patient and relaxation of the ligaments and is much safer and simpler than its removal in normal individuals. Ileosigmoidostomy, however, in proper hands is simple and safe, and has been, in my hands, efficient for chronic stasis from ptosis of the colon combined with multiple bands and adhesions, when removal of bands, suture of the colon to the anterior abdominal wall in such a manner as to take out the kinks, etc., had been tried without relief.

Lane's views of the importance of stasis as a predisposing cause of bone tuberculosis which had led him to operate upon the intestines in cases of hip disease, etc., hardly deserves or will attract imitators. His attribution of cystic disease of the breast and thyroid to ptosis as a cause lacks scientific proof. When we consider the results of the studies of Smith, referred to below, which may be said to have established the fact that ptosis is a gradually developed condition, adumbrated in childhood only by frailness, weakness of frame, lack of fat, etc., and that it develops gradually as the child grows to the adult, the actual ptosis and intestinal stasis (so far as dependent upon ptosis) only developing long after the bodily frailty with its concomitant symptoms, functional and nervous, have been recognized, how futile does it appear to attempt to cure these symptoms by the removal of the ptotic colon. Although, as Clark has pointed out, the colonic tract may be the prolific source of neurasthenic symptoms, still it has certain important functions to perform, among

others, the absorption of residual food products passed along from the small intestine. Its ablation should not, therefore, be done unless the certainty of relief corresponded with the



FIG. 2.—X-ray taken twelve hours after the ingestion of the bismuth meal.

magnitude of the operation, which it does not. Lane's career has been one of the most interesting in modern surgical history. His technical skill is of the highest order and his enthusiasm

contagious. Few can follow him, however, in the realms of surgical speculation. He has pointed the way, nevertheless, to several real steps in advance and taught us many things of value.

Coffey has given us a most masterly description of ptosis from all points of view, embryological, practical and theoretical, in a recent elaborate and well illustrated paper. He has recently made a tour of Europe and America with reference to the study of this disease, but has returned still persuaded that of operative procedures his own is by far the best. He abjures the colonic ablation of Lane and prefers milder measures.

He limits his operation for ptosis to those in which kinking at the duodenum and hepatic flexure cause obstruction of the duodenum and cæcum, respectively; what he calls a mid-line ptosis. He calls attention to the fact that in the late stages of ptosis, after the flexures of the colon have fallen down and at last have lost their angulation, a diarrhœa and not a constipation ensues. A proper query is, Do the nervous symptoms, dry skin, emaciation, etc., improve as soon as this relief of the hepatic kinks and consequent stasis takes place? We have not data enough to decide, but I trow not. And yet we are face to face with the fact that many have ptosis of great degree without symptoms.

His procedure of support of the cæcum by suture of the omentum close to its base transversely to the abdominal wall has the advantage that it does not cripple the intestine by actual suture of its muscular wall to the abdomen. In case the two layers of the great omentum have not adhered, it is necessary, in order to properly support the stomach, to include the posterior layer in this suture. By plastics on the muscles and fascia of the upper and lower abdominal wall, he enlarges the former and contracts the latter in an ingenious manner. His X-rays and case histories show good results. A brief characterization of his work could be made in the sentence that he does a great deal that is safe but nothing involving risk to the patient. As to the effectiveness of his work, it must have further trial in other hands.

In regard to the efficiency of this expansion of the upper and contraction of the lower bowel, while the latter may be efficient, it is hard to see how the former can do much good in the presence of the narrow chest and acute angle between the borders of

the ribs which these patients present. To the gymnastic methods which have been so thoroughly elaborated by Goldthwait of this city and Franklin Martin of Chicago, the relaxa-



FIG. 3.—X-ray taken twenty-four hours after the ingestion of the bismuth meal.

tion of the upper abdomen and contraction of the lower I think would best be relegated.

At the present time, tight lacing is thought to be of less importance in the etiology of ptosis, while congenital conditions

aided by faulty attitudes, poor nutrition, lack of proper exercise and muscular tone are believed to have a far greater influence in bringing on the narrow costal angle, contracted upper abdomen, etc., which characterize the subjects of this disease. The careful studies of Smith have shown that enteroptosis is rarely evident in children under 12 years, but that the enteroptotic habit of adult life finds its counterpart in the frail child, presenting lack of fat and slenderness of muscle, lack of vigor in bodily development. Any actual collapse in the thorax or diminution of the capacity of the upper abdomen is seen only in older children, and then only exceptionally, even in frail subjects. These studies concern chiefly the position of the stomach and kidneys, and are not quite conclusive in regard to the colon.

In these frail, weak children, whose weakness may, as far as we know, result from inherited tendencies, chronic or long continued acute disease, faulty diet, or what not, the presence of congenital lack of support of the viscera, movable cæcum, failure of adhesions of the meso-colon, and the continued action of gravity in the presence of faulty attitude in the erect position, may well be supposed to produce an enteroptosis which may be fairly considered to be the result of a combination of all these factors. Coffey's excellent delineation of the results of faulty position and loss of fat in allowing the kidney under the influence of intra-abdominal pressure deprived of its normal shelving support to gravitate into the lower abdomen may now be called to mind, as may also Goldthwait's similar studies.

The studies of this latter, of the effects of position and of nutrition, in aggravating conditions, the way for which have been paved by congenital abnormalities, have been of great value.

Goldthwait finds congenital stasis in many cases of chronic joint disease (arthritis) and treats his patients, even when bedridden, by postural methods, padding, etc., followed as soon as may be by gymnastic methods. The importance of standing and sitting up straight and keeping your shoulders back, which even we in our youth were taught, before ptosis was ever discovered, have received a new emphasis from the study of this complicated and difficult problem.

Now, as practical surgeons, what are we to get out of this mass of contradictory material reporting intestinal stasis, ptosis and the like?



FIG. 4.—A sketch of the cæcum, showing dilatation of the cæcum and the membrane.

In the first place, a most wholesome respect for the human organism as a whole, and the realization that measures, dietetic, medicinal and gymnastic addressed to the condition as a whole are to be adopted for the majority of cases. The effect of the personality of the surgeon on the mental condition of the patient, so efficient in the practice of many in cases of poor, weak, nervous humanity, is of great importance here. For expanding the upper and contracting the lower abdomen, gymnastics, regulation of diet and exercise, Coffey's operations *sub judice*.

FOR PTOSIS, PER SE, NO SURGERY AT ALL.

For constipation, when due, as it frequently is, to kinking of the colon, due to congenital conditions, acquired adhesions, or ptosis, or a combination of any two or all three of these factors, a rational surgical therapeutics may be cautiously applied. This may consist in the separation of adhesions, with closure of the raw surface in the opposite direction so as to prevent re-adhesions, in the division of the bands, the removal of membranes, in lateral anastomosis, in ileosigmoidostomy, or even in resection of a dilated cæcum and ascending colon, with the hepatic flexure and part of the transverse, as has been done by the writer in two cases, too recently to report on the results. The latter procedure commends itself as less radical than the ablation of the entire colon, and as sparing the omentum, and having comparatively little raw surface on the posterior abdominal wall to which small intestine might be adherent. It also, as pointed out by Bloodgood, relieves the drag of the loaded and movable ascending colon across the pylorus, which kinks the latter and cripples and dilates the stomach. A fold of peritoneum was dragged across the stomach in both the cases operated upon by the writer.

This procedure removes *in toto* the cesspool where stasis and fermentation chiefly take place, and leaves enough of the colon to perform its absorptive functions. It has been practiced by Finney, Mayo, Bloodgood and others.

Resection of the sigmoid may be indicated and may be successful. Clark, and doubtless others, have resected the transverse colon for ptosis in cases where the redundance was so great that it was thought that an omentopexy would not accomplish the desired result.

An interesting application of lateral anastomosis for the cure of a certain form of ptosis, namely, prolapse of the rectum, is

McArthur's sigmoido-sigmoidostomy for prolapse of the rectum, which has been successfully performed by the writer in a case which had resisted other treatment. So far as the writer's short experience goes, he has attempted in two cases to take out kinks in the colon by suture of the latter to the abdominal wall so as to straighten the angulation. One had to be followed by ileosigmoidostomy with relief to such an extent that the patient can follow her occupation as a nurse. A previous division of adhesions encircling the colon had given relief for six years, when the trouble returned, the kinks due to ptosis being reinforced by adhesions binding the descending and right portion of the transverse colon like a double-barreled gun. Separation of these adhesions and suture of the transverse colon to the abdominal wall failed to give relief, which was at last afforded, as stated above, by ileosigmoidostomy.

The procedures to be adopted in any case may be a matter for most careful judgment. Failure to relieve may bring discredit upon surgery, suffering and expense to the patient and chagrin to the surgeon. Careful study, large experience and a mastery of technique sufficient to render intestinal anastomosis and resections simple and safe, are prerequisites to the very moderate success which may be attained in this field. I say very moderate success, because even if fortunate enough to relieve a chronic constipation, the operation does not change the patient's mental and physical habits, moral tone, or the physical and financial environment which go so far in the production of the symptoms. The habitual use of cathartics, if the patient is in fair health and able to work, I do not consider a fair indication for operation. Discomfort sufficient to keep the patient from earning a livelihood, or in case the patient leads a sheltered life, to render him thoroughly miserable and a burden to himself and his relatives, seems to me a sufficient indication for operation.

There are two large classes in the community: General practitioners, who, for the sake of, as they believe, increasing their income, are willing to learn surgery on their private patients, and recent graduates of hospitals who assume that a superficial knowledge of technique renders them capable of coping with the problems of major surgery in a manner honest to their patients and honorable to themselves. For such, this field which may be entered timidly only by the best equipped should be taboo. It is more dangerous to enter it than to keep out of it.

Clark puts it very well when he says that symptoms, and severe symptoms alone, form an excuse for operating in this condition.

The history must show constipation unrelieved by medicine and referred by the symptoms and X-ray to a certain point and really dangerous to the health, if not to the life, of the individual; careful histories are essential.

The X-ray can be considered only an adjunct though often a most important one. Stasis it can show. But it must be carefully interpreted, or, as says Percy Brown, "the narrowings consequent upon compression of the lumen by the writhings of the bowel may be mistaken for the permanent narrowings of the extrinsic or intrinsic disease."

Ptois and kinks of all degrees may be shown by the X-rays, but unless associated with most definite symptoms of stasis would best be left severely alone. The normal angulation of the splenic flexure, as shown by the X-ray, almost always looks like a complete obstruction to the fecal current, the shadow being almost always interrupted at that point.

Recent cases have come to the writer's knowledge where an association of chronic constipation and an apparent obstruction at the hepatic flexure, as shown by the X-ray, were present. The lesions were, a hydronephrosis in one case, and a perinephritic abscess in the other. We hear of a diagnosis (*sic*) of cancer of the stomach being made by the X-ray, and the patient denied exploratory operation.

The diagnostic assumptions of certain exponents of the X-ray must be carefully checked by the clinician and the surgeon. That we are to operate for symptoms and symptoms alone we must not forget. In the language of Dr. Percy Brown, "The practitioner of the future is in danger, through such hopeful agents as these, of becoming a clinical scientist instead of a scientific clinician. His primary mission is entered on at the bedside and at the bedside he has little else to aid him than had his predecessors of earlier days, his wits. Let him, therefore, use them and then he shall be able to stretch forth his hand toward the laboratory, not beseechingly as one who is helpless, but with the authority born of knowledge, as becomes a master."

The above brief review is not an attempt to consider the subject exhaustively, a purpose for which a book of many volumes would be required. It is merely an attempt to sum

up what the writer believes should be our present attitude with regard to the employment of operative surgery in these cases. The field is most difficult and complicated, and affords many subjects for study as fascinating as they are difficult. When cases are presented to us for treatment, however, in this as in other fields, the careful study of the individual case associated with those indispensable guides, common sense and experience, will in certain instances enable us to do successful surgery.

In interpreting our end results, however, we must be particularly careful; cures will be rare. Even relief is a good deal. It is not an uncommon belief among surgeons that a careful review of the large number of cases reported by those who have operated freely in this field would show a large proportion of real failures from a therapeutic point of view. For this reason, conservatism and candor in reporting results are to be desired as well as optimism and courage in proceeding with this work.

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XI.

TREATMENT OF SUPERFICIAL SKIN CANCERS BY
PURE RADIUM BROMIDE.*

BY FRANCIS H. WILLIAMS, M. D., AND SAMUEL W. ELLSWORTH, M. D.

Until the cause of cancer is discovered and a better remedy for it found, the discriminating practitioner will employ the best means at his disposal according to the case to be treated, whether it be operation, caustics, X-rays, or some form of radio-activity. No one of these is adapted to all patients, nor always to all stages of the disease in the same patient. Surgery is necessary under some conditions and X-rays or the much safer radium is preferable under others.

The interest which the latter remedy has developed in Europe is attested by the already large amount of literature on this subject. In one book of five hundred pages there is given a list of more than one thousand references to papers of various kinds on radium, and these do not by any means include all that has been written regarding it during the past ten years. But this interest is more strikingly shown by the fact that in Europe treatment by radium is much sought. Sir William Ramsay told one of us recently that at the Radium Institute in London, which was opened only a year and a half ago, the staff had all it could do to take care of the numerous patients coming to it.

*Papers have been presented on this subject from time to time by one of us (Dr. Williams), and articles published, as follows:

A paper read at the meeting of the Boston Society of Medical Sciences, December 15, 1903, and published in the "Medical News," February 6, 1904.

"A comparison between the medical uses of the X-rays and the rays from the salts of radium." Read at the annual meeting of the Boston Society for Medical Improvement, January 18, 1904, and published in the "Boston Medical and Surgical Journal," February 25, 1904.

"Use of radium in some diseases of the eye." Published in the "Boston Medical and Surgical Journal," May 26, 1904.

"Early treatment of some superficial cancers, especially epitheliomas, by pure radium bromide rather than operation or X-rays." Presented, with a demonstration of more than twenty patients, at the Surgical Section of the Massachusetts Medical Society, June 9, 1908, and published in "Medical Communications of the Massachusetts Medical Society," 1908, XXI., 261-276, and "Journal of the American Medical Association," 1908, LI., 894-897.

A clinic for radium treatment in Paris, which was established prior to that in London, is largely attended. Antedating both of these by some years is the radium clinic at the Boston City Hospital, which was started in 1903, and the object of this paper is to draw the attention of the profession in this country to the beneficent results obtained there and in private practice by the use of radium in suitable cases of skin cancer, when employed in sufficient amount and strength. Experience is, of course, necessary, else there is danger either of doing harm or of failing to do good through lack of knowledge.

In the early days of its use the healing action of radium on superficial or other forms of cancer was doubted by many, and not unnaturally, as it seemed almost miraculous that it should have any power over a disease for which the chief remedy had been the knife, an admission in a way that there was no remedy. Later, many accepted the fact that radium was temporarily efficient in some of the superficial cancers, but they questioned the permanency of the results obtained.

The following table (I.) and illustrative cases show that if patients come early for treatment most of the superficial skin cancers will heal under radium. The permanency of the results is indicated in Table II. We cannot compare these, as we should like to do, with the results after operation, as we have not been able to find any tabulated statement of consecutive cases which show what measure of permanency has been obtained by this means. It is singular, when we consider how many years operations have been done, that there are not abundant data to indicate how soon and how frequently they may be followed by recurrences.

The cases of skin cancer here presented are consecutive, with the exception of five which have been omitted because they were beyond the reach of any remedy, and radium was used as a palliative only. The ages of the patients varied from twenty-four to ninety-one years.

Table I.

One Hundred and Eighty-One Cases of Skin Cancer Where the Treatment was Begun Before December 31, 1909.

SITE.	Total.	Healed.	Not Healed.	Under Treatment.	Discontinued Treatment.
Lip.....	23	19	1	.....	3
Eyelid.....	19	13	.....	1	* 5
Nose.....	45	40	† 2	1	2
Face.....	68	59	4	1	‡ 4
Ear.....	8	6	.....	.....	2
Neck.....	4	4	.....	.....	.....
Hand.....	6	6	.....	.....	.....
Inside lower lip.....	1	1	.....	.....	.....
Auditory canal.....	1	1	.....	.....	.....
Scalp.....	3	3	.....	.....	.....
Nose and orbit.....	1	1	.....	.....	.....
Nose, cheek and breast.....	1	1	.....	.....	.....
Nose, lip and ear.....	1	.....	.....	.....	1
Totals.....	181	154	7	3	§ 17

* In one case treatment was continued so long without healing that operation was advised and done.

† One patient not healed by X-rays or radium. Attendance too irregular.

‡ One patient died of "acute indigestion" while under treatment.

§ Of the seventeen who discontinued treatment, nine were improving.

Table II.

Duration of Healing of One Hundred and Fifty-four Cases on January 1, 1911.

YEARS.	Number Healed.	Number Recurred.	Number Died.	Total.
Less than 1 year.....	21	—	—	—
1 to 2 years.....	47	—	—	—
2 to 3 years.....	19	—	—	—
3 to 4 years.....	18	—	—	—
4 to 5 years.....	3	—	—	—
5 to 6 years.....	20	—	—	—
6 to 7 years.....	4	—	—	—
7 years or more.....	3	—	—	—
Totals.....	135	16	3	154

Of the 16 recurrences, 1 died of another disease during treatment, 2 healed under further treatment, 6 were under treatment, 3 discontinued treatment, 3 were advised to have operation, 1 delayed coming for further treatment until it was too late for radium to be of service.

The 3 deaths occurred prior to January 1, 1911, from some other disease.

In 3 of the 154 cases it was necessary to resort to operation following the radium treatment; on the other hand, there were fifteen cases in which operation failed and after which radium was successfully employed, and several of these had had more than one operation.

The cases given in the tables do not show the best results that could be obtained by radium if only those most adapted to its use had been chosen. Moreover, with our present experience those cited would probably have healed more promptly.

In January, 1913, an attempt was made to obtain reports from these patients, but they were so scattered that it was not possible to get a sufficient number to make it advisable to change Table II. So far as heard from, the reports were very favorable.

It would make this paper too long to give the record of all these patients, therefore it has seemed better to give illustrative cases, which naturally fall into groups. Some of these cases are not included in the tables, as they came for treatment after January 1, 1911.

Group I.— Small epitheliomas which have not been operated upon or treated by caustics or X-rays, where the glands are not implicated, and for which radium has been the only treatment.

Group II.— New growths about the eye, the site of which makes operation difficult, as it might be a serious matter to remove any considerable portion of the lid.

Group III.— Patients for whom other treatment, such as operation, X-rays, caustics, iodine, etc., had been resorted to first, and therefore treatment by radium usually extended over a longer period than in Group I., in some cases success being reached only after very persistent treatment.

Group IV.— Cases in which the epithelioma was too deep to be classed as superficial and too extensive to give radium its best opportunity, but for which other treatment had failed or the site made operation undesirable.

Group V.— Cases in which no treatment could bring about healing and for which radium was used simply to retard the growth or to keep the patient from the blank and impassable wall of hopelessness. In other words, where it was used to shorten the period of despair.

GROUP I.

Mr. F., 49 years old. Characteristic epithelioma on mucous membrane of lower lip, 1 cm. by $1\frac{1}{2}$ cm., a raised ulcerated surface with induration 1 cm. deep. Healed in four weeks with ten applications of radium. The induration began to diminish three days after the first application. The ulceration promptly became less indolent, and after five applications a narrow, slightly contracted circle of healed scar tissue began to appear around the edge, and the induration had disappeared. Still healed January 1, 1913, five years later.



BEFORE RADIUM TREATMENT.



AFTER RADIUM TREATMENT.

Mr. M., 56 years old. Epithelioma on mucous membrane of lower lip, 1 cm. by $3\frac{1}{2}$ cm. Healed in one month with seven applications of radium. Still healed January 1, 1913, five years later.

Mr. G., 65 years old. Epithelioma of nose of two or three years' duration, 1 cm. in diameter. Healed after five applications. Still healed January 1, 1913, five years later.

Mr. L., 68 years old. Epithelioma on mucous membrane of left side of lip, of three to four years' duration. Healed after three applications. Died as the result of an accident at sea.

Miss W., 70 years old. Epithelioma of forehead. Ulceration about 4 cm. in diameter, in part covered by a crust. Healed in three months with fourteen applications. Remained healed to the time of her death.

GROUP II.

Mr. D., 50 years old. Epithelioma above inner canthus of left eye, 1 cm. in diameter. Improvement was continuous from the beginning of radium treatment. No pain or irritation. Healed in seven weeks with eleven applications. Still healed January 1, 1913, five years later.

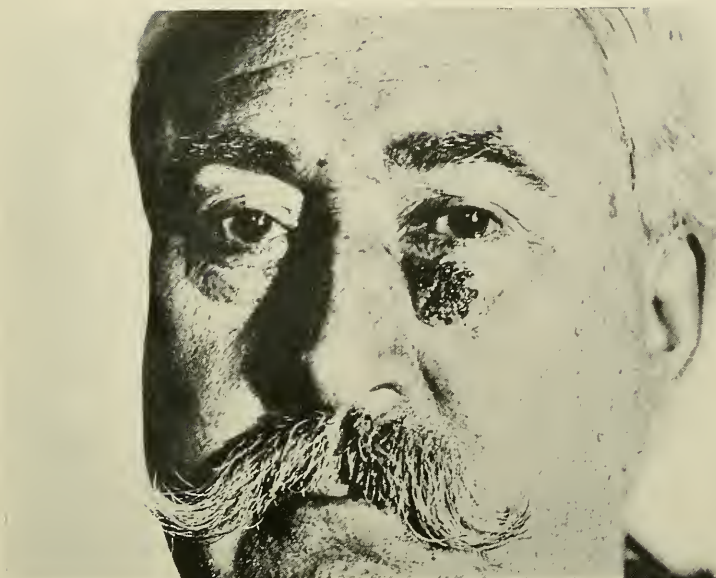
Mr. McL. Epithelioma of lower lid of right eye, 1 cm. long, raised. Operation in 1909, recurrence in six weeks. Healed after fifteen applications of radium. Still healed January 1, 1913, three years later. (Not included in the table.)

Mrs. B. Patient about 50 years old. New growth on the upper lid, which measured 1 cm. horizontally and $\frac{1}{2}$ cm. vertically. This was indurated and raised above the surface about 2 mm. The growth had begun six years previously, then grew more rapidly, and was operated upon. Just two months after the operation it returned and was larger than it had been at any time. This has improved promptly under radium, and disappeared after thirteen applications. (Not included in the table.)

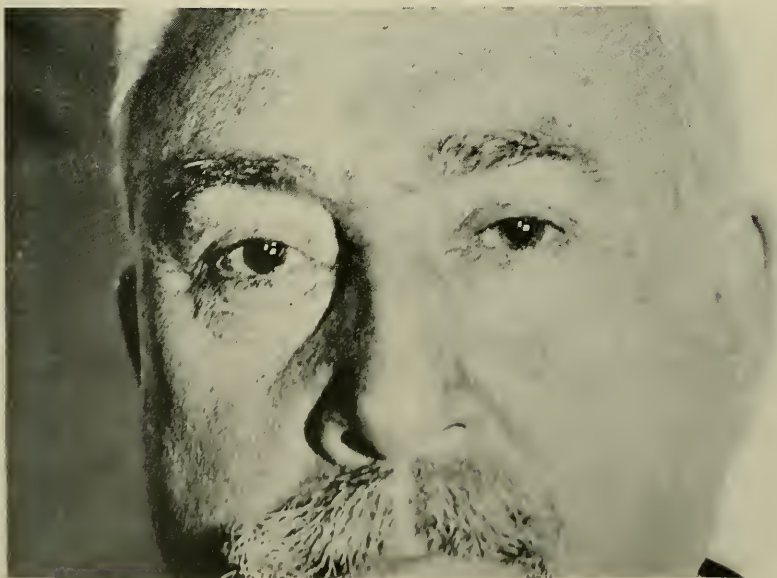
GROUP III.

Mr. T. Growth on the cheek which was operated upon, but recurred in six months and grew rapidly. It was then treated with caustics twice and healed in the center, leaving blisters outside, but recurred again in four or five weeks, and began to discharge and again grew rapidly until it was 2 cm. in diameter. Further operation was advised and the patient was told that it must be extensive and would cause paralysis on that side of the face. He declined operation, was treated by radium and the growth disappeared. This patient had also two new growths on the other side of the face, one about 6 mm. and the other about 12 mm. in diameter, which had not been treated in any way, and these yielded to radium in twelve applications. (Not included in the table.)

Mr. F., 45 years old. Indurated area $1\frac{1}{2}$ cm. wide and $1\frac{1}{2}$ cm. long, beginning at the outer canthus of the eye and extending on to the temple and cheek. The central portion was covered with a crust. Eleven years previously he broke the skin near the outer portion of the left eye, had erysipelas, and there was an area which did not heal well. Operation was done and since then he has had various kinds of treatment, X-rays, electric needle, etc., for one and one-half years, but no treatment for the past six months. This promptly began to heal under radium and has now only a very small spot of induration left. (Not included in the table.)



BEFORE RADIUM TREATMENT.



AFTER RADIUM TREATMENT.

GROUP IV.

Mr. R., 86 years old. Growth on the back of the hand near the wrist, which had been operated upon twice and recurred twice. When first seen it was a raised, granulating surface, about 4 cm. in diameter, with an indurated base of larger area. The case did not seem to be a very encouraging one for radium treatment, and had not operation failed twice this remedy would not have been considered for a moment, but under the circumstances there seemed nothing else to be done. It proved most satisfactory, the induration disappeared, healing took place, and remained permanent up to the death of the patient from old age a year and a half later.

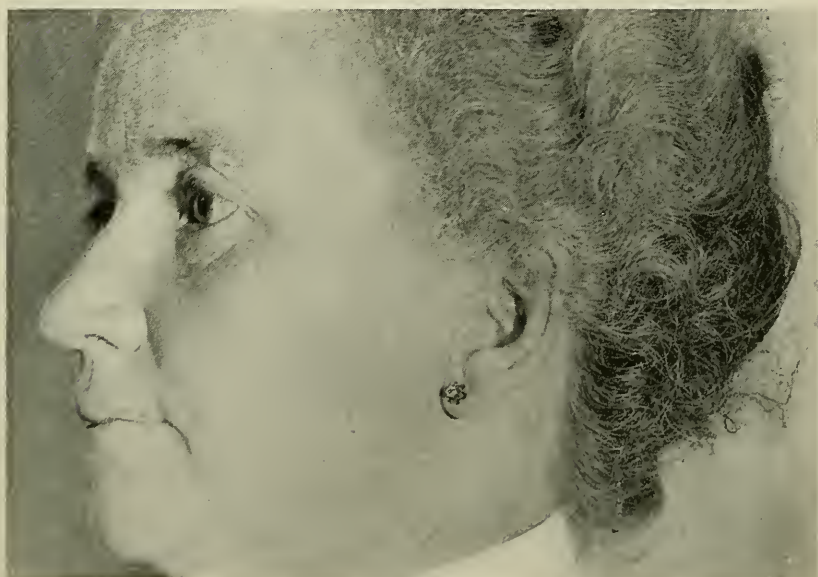
Miss G., 83 years old. Epithelioma of face, which she thinks began 40 years ago. It had grown rapidly of late, involved the left cheek, and so much of the upper lip on that side that only a narrow strip remained, and it seemed as if in a few days this might ulcerate across and leave the ends hanging. The diseased area, exposing a considerable portion of bones in the central deeper part, was a disagreeable ulcerating surface, so large that it seemed hopeless to attempt to treat it by radium, but the patient was unwilling to have operation, which would necessarily have been very extensive if it had, under the circumstances, been advisable. Under radium the ulceration has nearly healed and the edges of the large opening have puckered together, as if drawn by a purse-string, so that the upper lip is now perfectly presentable, and the opening above, between the cheek and the nose, so small and the former hideous appearance so improved that the patient would not be disturbing to others. This case is not included in the table, but is mentioned as being a good example of this group. She is still under treatment. The epithelioma has not yet wholly healed, but the patient is no longer in a pitiable condition, and the outlook is now favorable.

The above tables and illustrative cases demonstrate the efficiency of a proper quantity of pure radium bromide for superficial skin cancers, especially in the early stages, both as to healing and permanency of results, when it is the first and only treatment employed, and its usefulness even when handicapped by being employed after a recurrence following operation or operations, or after the use of caustics or the X-rays.

For the treatment of these cases 120 mgs. of pure radium bromide have been at our disposal and more than 20 grams of weaker preparations, but, as a rule, 50 mgs. of pure radium bromide in a capsule with a mica cover, placed in a lead container with a long handle, have been employed. From the beginning screens or filters of aluminum of varying thickness have been used when it was desirable to absorb some of the less penetrating rays in order that they might not reach the patient. Not more than two applications should be made a week, and the duration may vary from one or two to ten minutes according to the extent and depth of the disease, the



BEFORE RADIUM TREATMENT.



AFTER RADIUM TREATMENT

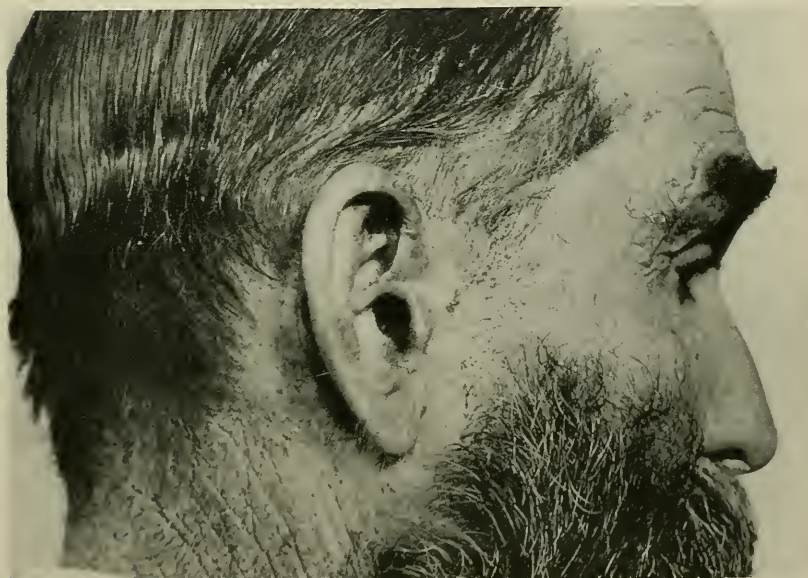
radium being moved about so that all parts are reached. In some cases the time of application may be extended to half an hour or even more, if the area is of considerable size, but, of course, this does not apply to the early cases. It is very difficult to state how many applications will be necessary in a given case. Now and then two or three are sufficient, but more frequently ten to fifteen are required, and sometimes twenty or more are needed. When, however, patients learn to come early the latter numbers can probably be reduced. A more vigorous use of radium, that is, the lengthening of each treatment, will also greatly lessen the number required, but this action might involve the risk of over-exposure. We have preferred to feel our way with the safer method. In short, no definite rules as to duration and number of applications can be laid down to cover all cases; experience and judgment are the best guides. As with other efficient remedies, success may follow the use of radium in the hands of one practitioner and failure in those of another.

Improvement usually takes place within three weeks, thus indicating that the treatment is likely to be successful, but a growth may heal after two or three applications. (See Group I., Mr. L., page 82.) The initial improvement may consist simply in the arrest of the growth and in signs of drying up, or in a freer discharge. If radium as an initial remedy, in sufficient quantity and suitably employed, does not bring about marked *improvement* within three or four weeks it would, as a rule, be better to choose some other method, but this is rarely necessary if the case is at all a proper one for treatment by radium. If, however, this remedy is unsuccessful, the delay thus caused is not sufficient to be detrimental to the patient. When radium is used after recurrence following operation, or other treatment, a longer time is usually required to cause a disappearance of the new growth than when it is the primary remedy. Rapidly growing and discharging new growths respond to radium more quickly than those of an indolent type. If one of the latter kind is healing very slowly, a different treatment may be considered, but if the cosmetic results are in question or an operation has been done and a recurrence taken place, persistence with radium may be wiser.

In cases which do not yield to radium, it is well to bear in mind that the disease may be of syphilitic origin and to try specific treatment.



BEFORE RADIUM TREATMENT.



AFTER RADIUM TREATMENT.

If a patient is otherwise diseased, or is of low vitality, radium is handicapped. The following case illustrates perhaps the first point named:

Mr. J., 58 years of age. Epithelioma of the lip of two years' duration. (Not included in the table.) Patient suffering from a serious kidney trouble and warned that under these circumstances radium might not be successful. Treatment by this remedy at first brought about some improvement, but it came more slowly than is usual in ordinary cases and when, after continued treatment, the growth did not heal, operation was advised and done. It is too soon to say what the result of the operation will be.

Those who have been operated upon for cancer, even of the breast, should be seen at stated intervals, and if there is any sign of recurrence, such as spots of induration in or near the scar, they should be treated by radium, as in some cases, at least, it has been found more efficient than any other treatment we have used in checking a recurrence of this character.

Judging by the number of persons with small new growths that we have successfully treated with radium after recurrences following an operation, this remedy has the advantage in many cases. Recurrences occur after any method of treatment, but we believe less frequently after radium than after operation. Should they occur after the use of radium, experience thus far shows that, as a rule, they yield to further treatment by this remedy.

Sometimes it is feared that treating a cancer in one place may cause its appearance elsewhere, but so far as we have observed, this has not happened in any of the patients suitable for radium treatment. This seems to be another advantage of this method.

Glands, tongue, mouth, tonsils.—When the glands are involved no time should be lost by using radium from the outside. For this purpose and in this way it is unsuitable. We have not had much experience with new growths in the mouth, tongue or tonsils, but so far as it has gone radium has not healed them. To be of service the treatment must be begun in a very early stage, and as patients are not aware of the seriousness of the disease, they delay seeking advice until the growth has become too extensive to be materially benefited by radium.

There is no danger from radium in the hands of those who understand its use and it has a great advantage over the X-rays in that the output of its radiations is uniform in amount and quality, whereas that from an X-ray tube may be very uneven

as regards both of these. This possible variability of output is one reason why injury has resulted from the use of the X-rays.

Our experience of the last nine to ten years demonstrates that radium should be used in the treatment of early skin cancers, especially if the new growth is on the eyelid, as operation might leave the patient with a lid so small or so large that it would harass him through life. The cosmetic results are excellent and the application painless. For the latter reason the patient is not led to a perhaps serious or even fatal delay, as may be the case when a dreaded operation is in question. Radium will also cause some growths to heal that are extensive and even inoperable, and while these show its power and efficiency, every endeavor, of course, should be made to prevent the occurrence of larger growths by using radium early. In the treatment of early skin cancers radium finds a great opportunity. It is important that physicians and surgeons should realize the value of this remedy. Recently one of us reported to the physician who had sent a patient for radium treatment that the growth had disappeared after two applications. The physician was gratified, as he had had misgivings in recommending radium to his patient after the surgeon had strongly advocated operation.

Skin lesions should not be neglected, for though they may lie dormant for a time, they may, on the other hand, if left untreated, lead to serious trouble by becoming irritated, or from some other cause. Many surgeons advocate operation for any skin lesion which might even be suspected of being or becoming malignant, but as many of these small lesions heal under radium, this painless remedy should be used first. If unsuccessful and operation becomes necessary, the delay will not injure the patient.

Keloids.—Our experience with keloids shows that radium is an excellent remedy for them if used in season. All those of moderate size which we have treated have done well, though in some cases operation and other forms of treatment had been tried first without success.

Radium is also of value in other skin diseases, such as eczema, birthmarks, warty growths, psoriasis, and the like.

CONCLUSIONS.

1. The application of pure radium bromide in sufficient amount, properly used, is a harmless, painless and efficient

method of treating early superficial new growths. Radium is well adapted to the treatment of cancers of the face, as the cosmetic results are excellent, and particularly to cancers of the eyelids, where operation may offer special difficulties and disadvantages. With proper care there is no danger to the eye.

2. Operation is still considered to-day the method of choice in early skin cancers by most practitioners, but the results obtained here and abroad show, we believe, that radium should be used first in early cases and operation reserved for such cases as are not readily controlled by it.

3. Radium is more successful when it is the first treatment employed than when it is used after operation, X-rays or other forms of treatment, although even under these circumstances it does well.

4. The number of treatments required in some cases is from two or three to ten, while in others more than twenty are needed.

5. Many people dread the knife, even for a simple operation, and fearing surgical interference will be advised, delay coming for treatment, thus lessening the chances of recovery. Radium is free from this disadvantage as its action is painless.

6. The analgesic action of radium is noteworthy.

7. For keloids, unless extensive, radium is by far the best treatment known to us.

8. Where radium is obtainable, it would be well to use it for skin lesions of small area which do not heal readily under simple applications.

9. All powerful remedies have dangers, but they can be avoided if care is taken. During the seventeen years the X-rays have been used at the Boston City Hospital no patient has been burned, nor have any untoward results occurred in about ten years during which radium has been employed there.

ILLUSTRATIVE CUTS.

The cuts accompanying this article are illustrative of some of the results in patients treated by radium.

XII.

A FEW IMPORTANT POINTS IN X-RAY EXAMINATION OF THE DIGESTIVE TRACT.*

BY FRANKLIN W. WHITE, M. D.

This method can tell us so many things about the digestive tract that we must all use it and become familiar with it. I do not mean that we must all become radiologists, but that we must have X-ray plates taken of many of our patients and examine these plates and become familiar with their interpretation.

The study of the chemical factors of digestion has made little progress of late; the study of the mechanical factors has made very rapid strides, chiefly as a result of X-ray work.

It is by far the most valuable method of examination of the digestive tract recently developed.

The wonderful results which have been obtained by this method, its unquestioned high value in the diagnosis of the position, size and shape of the esophagus, stomach and bowel, its importance as a test of motility of these organs and as a discoverer of disease has led to the greatest enthusiasm for the method by those who have used it.

In the following statement, appearing in a leading X-ray journal, "In all diseases of the stomach a Roentgen examination has entirely supplanted laparotomy as a means of diagnosis and as a guide to operability," we see the pardonable enthusiasm of experts for a new method, but such conclusions are likely to meet with some doubt and some just criticism.

The X-ray investigation of the digestive tract is not easy. The interpretation of the plates especially requires large experience and caution. Artifacts are abundant, false interpretations are easy, and there is much debatable ground. In building up a system of diagnosis on X-ray signs, we must carefully gather our data and revise it constantly with growing experience.

* Read at the Fifteenth Annual Meeting of the American Gastro-Enterological Association at Atlantic City, June, 1912.

I believe the best work in this field will be done with the close cooperation of radiologists and clinicians. The radiologist has gathered his data with great skill. The clinician must study these data with care and help in interpreting them; each has much to learn from the other about the diagnosis of diseases of the digestive organs. We will leave matters of technique to the radiologist (such things as which position, vertical or horizontal, gives the best distribution of bismuth and avoids undesirable pressure upon the organs to be examined; the relative advantages of plate or screen, etc.) and content ourselves with the examination and interpretation of some of the results obtained, and their comparison with older methods of examination.

The old methods of determining the size, shape and position of the stomach and bowel by inflation with air or water are left hopelessly behind. They were very crude, and gave at most a rough idea of the size and position of the stomach, and sometimes of the colon, in a distended state. The X-ray method gives us a wealth and accuracy of detail heretofore undreamed of. It has given us entirely new ideas of the shape and position of the living stomach, and of its appearance when partly or wholly filled with food, the positions of the lesser curvature, pylorus, etc. Contractions, adhesions, peristalsis, the size and position of ulcers and tumors are often shown with great accuracy. The exact outline of the entire large intestine is given in a way which is hopeless of imitation by any other method. If we wish *exact detailed* information about the size, shape and position of the esophagus, stomach and bowel, we all realize that it cannot be obtained during life except by an X-ray examination.

We will pass over much of the valuable data gathered in this field and speak only of a few points.

SHAPE AND POSITION OF STOMACH.

In comparing the shape of the stomach obtained by inflation with the X-ray picture after a bismuth meal, we find a large, rounded outline of inflation, and a smaller outline with the X-ray with much greater variety of form a lower position of the lower border and more variation in position with the patient standing or lying. It is not necessary to give up using the inflation method now that we have found one which is so

much better. Inflation is very simple and easy and inexpensive, and gives us a certain amount of information.

In studying the shape of the stomach with the X-ray it is rarely safe to base a diagnosis on a single plate. Where so much stress is laid on minute details of outline it is usually necessary to take a series of plates in which accidental changes and artifacts are ruled out and we are able to decide which changes are constant and important.

Artifacts are easily produced. The pressure of the patient against the table will shove the stomach all about; pseudo hour-glass stomach is easily produced with a patient lying on the belly or back by the pressure of the spine across the stomach. The best position seems to be either erect or prone with the chest and abdomen supported to avoid pressure.

There is much variety in the shape and position of normal stomachs, hook-shaped, horn-shaped, and so-called text-book stomachs. As most of these details are well known, I will pass over them briefly.

The normal appearance of the pylorus and the first portion of the duodenum, the so-called "cap," are very important in the diagnosis of cancer and ulcer at the pylorus, which deform the shadow. We will speak of this later.

The tone of the stomach is indicated by the form and the distribution of the contents. While the normal stomach embraces its contents and always fills up to the cardiac portion, and gradually widens on filling, the atonic stomach is like a flaccid bag, with the contents entirely at the bottom and with the median part of the stomach more or less collapsed, and gradually fills up from below.

In so-called gastroptosis we find that the stomach as a whole does not drop down. The cardiac end of the stomach is fixed and we have simply a ptosis of the middle and pyloric end of the stomach, which is unusually mobile and swings downward and to the left, dragging the first portion of the duodenum after it, so that we find many patients whose pylorus is in the median line, or even to the left of it. In atonic dilatation the stomach sags vertically down into the pelvis. In chronic dilatation from obstruction of the pylorus, with hypertrophy of the muscle wall, the stomach is more globular in outline.

With reference to the size of the stomach, increase in vertical length is always due to ptosis and atony. Increase in all

dimensions to stenosis or the swallowing of air, or inflation for diagnosis. Decrease in size may be due to many causes; to disuse in inanition or starvation, or stenosis of the esophagus, to rapid emptying from gastroenterostomy, or insufficiency of the pylorus associated with sub-acidity, or from shrinkage of the wall from infiltration with cancer or ulcer, or to hypertonicity. This contraction frequently converts a normal hook-shaped stomach into the horn-shaped.

In gastric ulcer we may get many changes. A displacement of the pylorus upward and to the left, due to shrinkage of the wall, with shortening of the lesser curvature, intermittent transverse contractions associated with florid ulcer; permanent transverse contractions due to scar tissue forming the hour-glass stomach; this latter is one of the most brilliant demonstrations of the X-ray. Adhesion of the stomach to the liver may be shown by an absence of palpatory mobility with good respiratory mobility.

The use of a local tender point in connection with the X-ray examination easily leads to error. The tender point is often found to lie outside the filled stomach.

A shadow due to the sticking of bismuth to the surface of a flat peptic ulcer seems to be a rare event of little diagnostic value. Haudek has not seen it once in ten years' experience in his clinic, where more than 2,000 stomach cases are yearly examined. This seems to be the almost universal experience of radiologists in this country. Even with the ordinary crater-formed ulcer it is rare that any remains of bismuth are seen after the stomach is empty. An ulcer which has penetrated through the gastric wall may give rise to a special appearance, an outgrowth or pouch of the bismuth shadow with an air bubble at its summit, with retention of bismuth and immobility to palpation and pressure.

In cancer of the stomach an early diagnosis by the X-ray seems almost impossible. In clearly defined cases it gives us much information about the site and extent and operability of the growth. The most typical appearance is a marked irregular defect in the gastric shadow.

The examination of the duodenum is very important and frequently unsatisfactory. The first portion may point backward or be hidden behind the stomach, or may be deformed by tension upon it, and the second and third portions are often not easy to identify as intestinal peristalsis is so active that

they are found empty. The duodenum, contrary to our previous ideas, is a relatively mobile organ and in ptosis of the pylorus the first portion elongates remarkably.

Cole has called especial attention to the first portion of the duodenum which is dilated into a so-called "cap," which sits, as it were, on the pylorus, and radiologically should be considered part of the stomach, since its contraction corresponds with the gastric cycle and is entirely unlike the small rapid peristalsis of the bowel. The acidity of its contents and the location here of 90 per cent of the duodenal ulcers indicate its surgical importance. The so-called "cap" varies in size, shape and position in different persons. The pyloric sphincter is shown in clear pictures as a clear space, an eighth to a quarter of an inch wide, between the lower end of the stomach and the "cap" of the duodenum, through the middle of which a slender thread of bismuth runs. During diastole of the stomach the food may drop away from the pylorus. This clear space must not be interpreted as adhesions or obstruction.

SHAPE AND POSITION OF INTESTINES.

It is difficult to get clear outlines of the small intestine, owing to the rapid passage of bismuth through it, but brilliant pictures of the colon are easily obtained, either by giving the bismuth by mouth or enema. The first is the method of choice for studying the rate of passage of the bismuth through the stomach and intestine, and the second the method of choice for quickly outlining the large intestine. An enema of one pint will pass up the large bowel to the ileocecal valve in from two to five minutes, and is easily retained. The position of every portion of the large bowel is wonderfully shown, and the exact position and degree of stenosis may be brilliantly demonstrated. The cecum is shown to be an organ of great mobility and frequent low position. It often crosses the sacro-iliac line and may reach the median line. The bismuth enema seems to me the most valuable method we have of detecting and locating stricture, cancerous and benign, of the sigmoid and colon. On the other hand, I know from personal experience that partial or intermittent obstruction by adhesions and bands, even where the whole sigmoid is tied up in a mass of adhesions, may entirely escape detection by the X-ray. This is probably not true of obstruction due to tumors or annular strictures. On the other hand, artifacts and accidental outlines are easily obtained and

may mislead the unwary. The picture in the colon may be modified by impacted feces which give abnormal contours, prevent filling of the cecum, etc. There is frequently an empty or apparently narrowed place where the free sigmoid joins the firmly attached ascending colon. This must be remembered in trying to diagnose obstruction to the lower bowel. The angulation of the splenic structure is often surprisingly sharp and pseudo Lane kinks are not rare. I have several times had occasion to advise against operation which was proposed as a result of misinterpretation of X-ray pictures of the bowel. Conservatism is needed until our data are more definite.

In many cases the X-ray can give us only an indication for exploration; in occasional cases we may perhaps expect a really early diagnosis of cancer of the bowel, and in other cases an accurate localization of stenosis. It will surely be of much aid in the differential diagnosis of tumors, spasm and adhesions as a cause of obstruction of the bowel. It is of great help in the study of chronic constipation in separating the atonic from the organic obstructive cases and in showing us in just what part of the intestine the delay in the passage of feces occurs.

SECRETION.

When we come to a study of the *functions* of the stomach and bowel our older methods make a far better showing. Tests of secretion are very important in diagnosis. Secretion, absorption, fermentation, must still be studied by examination of stomach contents and of the feces. The X-ray tests of secretion thus far proposed are rough and unsatisfactory. Schwartz's method of testing the time of digestion of a fibroderm pepsin bismuth capsule, or Schlesinger's method of measuring the amount of free HCl by giving a dose of sodium bicarbonate and estimating the amount of gas produced, are very crude and seem unlikely to replace the older methods of test meals and examination of stomach contents.

MOTILITY OF THE STOMACH.

The X-ray can give us much valuable information about the motility of the stomach and many of its advocates proclaim it as the only satisfactory test of motility and regard tests with the stomach tube as inaccurate, since small residues in the stomach may be neglected.

The motility of the stomach may be measured by the size of the residue in the stomach two, four, six, twelve or twenty-four hours after a bismuth meal, or by comparing the size of the stomach residue with the amount in the bowel; or when the stomach is empty the position of the head and tail of the bismuth column gives valuable indication of the motility of the stomach and bowel.

The normal stomach may be counted upon to empty itself of a bismuth meal in six hours or less, therefore bismuth residue at the end of six hours is important in diagnosis. Large residues usually mean stenosis of the pylorus; small residues are usually due to atony or spasm associated with ulcer.

There seems to be considerable variation in results and some uncertainty of conclusion here, which is perhaps only natural since the amount of bismuth used and the amount and kind of food given must affect the results with different technique. A standard bismuth meal, like the standard Ewald-Boas test breakfast, would no doubt clear up some minor differences. There is a close relation between the tonus and motility, as we might expect, but much difference of opinion exists about details. The hyper-tonic stomach may empty in two or three hours, the normal stomach in from three to five hours, and the atonic in from four to eight or more hours, variously estimated. Haudek's statement that simple atonic delay in emptying never lasts as long as six hours does not agree with my own recent experience that fully half the cases of simple ptosis have an eight to ten hour residue.

In ulcer a similar difference of opinion exists. Haudek finds that almost every florid gastric ulcer disturbs the motility of the stomach by causing spasm of the pylorus. He has never found a gastric ulcer without this delay, and considers a small residue after six hours with hyperacidity almost characteristic of ulcer. Ulcer in other parts of the stomach may cause such spasm of the pylorus that the bismuth is retained two to four times the normal period, even up to twenty-four hours, while operation shows the pyloric walls perfectly normal. Haudek finds no case of spasm of the pylorus and no case of six-hour delay of bismuth residue without serious alteration of the stomach wall. Eppinger and Schwartz, on the contrary, report a case of a tubercular girl of sixteen with much vomiting and a spastic hour-glass shaped stomach, which contained a bismuth residue at the end of twenty-four hours in the fundus. When this

spasm was relieved by atropine the stomach took a normal shape and emptied itself of bismuth in two hours. The autopsy showed that the mucous membrane of the stomach was normal, without ulcer, erosion or scar. The short duration of the case, only a few weeks in all, gave no chance for an ulcer to heal and disappear.

Bardachzi, in contrast to Haudek's work, has recently reported a series of twenty-eight cases of proved peptic ulcer in more than half of which the stomach was found empty in six hours after the bismuth meal.

Hypermotility of the stomach is almost always associated with achylia, if the pylorus is free.

Cases with marked stenosis of the pylorus usually show delayed motility, and if the stomach is empty in six hours stenosis can usually be ruled out, but even here there are exceptions. I know of two cases of stenosis of the pylorus down to lead pencil size, one of which emptied in five and the other in five and one-half hours.

Even a little residue after twenty-four hours is considered absolute proof by many of organic stenosis, but I have one patient at present under observation, well nourished and almost without symptoms, whose stomach empties itself entirely of a coarse test supper in twelve hours, and yet the stomach shows a well-marked bismuth residue after twenty-four hours. I have seen several other cases of twenty-four hour bismuth residue, unexplained even at operation. Residues after shorter intervals, from six to twenty-four hours, are frequently regarded as lesser grades of stenosis, so-called relative stenosis. This group will include many cases of simple atony.

In cancer of the stomach there is usually delayed motility, if the tumor is near the pylorus, but we may have good motility even with advanced tumors of the pylorus, especially if they are ulcerating.

In the face of so much variability in results in the same disease, the results of X-ray tests of motility must be interpreted with great caution. Typical changes of motility, *together with other changes*, are very valuable and give us clear indications. Slight changes in motility, or apparently normal results, may lead to great difficulties in diagnosis.

Comparisons between the X-ray and other methods of testing the motility of the stomach, such as the use of a test supper, and the aspiration of fasting contents, are very interesting.

In making this comparison we must consider the power of the stomach to pass on ordinary food as our standard, and if the power of the stomach to empty itself of bismuth paste differs widely from this, so much the worse for the bismuth method. Fortunately, both methods give the same result in the majority of cases. There are many interesting differences, however, which may be explained in different ways, and which need further study.

In cases with large gross fasting residue after twelve hours there is usually marked disturbance of motility in the X-ray examination. In cases with small gross residue the X-ray usually shows disturbed motility, but sometimes in cases with marked fasting residue, characteristic vomitus, visible peristalsis, a clear clinical picture of obstruction, bismuth passes along relatively rapidly, and the stomach is found empty within six hours.

How are we to explain these differences in the passage of bismuth and of ordinary food? Perhaps by the different kinds and amount of work which they give the stomach to do. The muscle may be capable of passing out the smooth bismuth paste, and incapable of passing out the coarse mass of ordinary food. It has been suggested by one radiologist that the bismuth may act like a foreign body and stimulate muscular contraction.

On the other hand, how shall we explain the long delay of bismuth in a stomach which passes, or appears to pass on ordinary food in a normal time? Is it possible that the bismuth remains sticking to the wall while ordinary food passes on, or is it possible, as has been recently suggested to me by a radiologist, that in such cases the bismuth test is really more delicate and reliable, and that we actually miss food residue in our twelve-hour tests with the stomach tube through our inability to get it out through the tube, and call these stomachs empty and normal when they really are not? Personally I do not believe this is the case, as I always thoroughly wash out these fasting stomachs, and it seems hardly credible that food residue could be missed where this precaution is taken.

PERISTALSIS OF THE STOMACH.

Peristalsis is best studied by the screen and hence will not be seen by most of us, but it is often well indicated on the plate, and thus deserves a few words.

This is a sign which can practically only be studied by means of the X-ray, and is a very variable factor in digestion, depending, as it does, on emotion and appetite and kind of food, and mistaken conclusions are very easy. Abnormal peristalsis alone is not enough for diagnosis.

The normal peristalsis in the stomach is unobstructed, commonly three to six waves, which seem surprisingly deep at times. Normal peristalsis may be obstructed by anything which deforms or stiffens the stomach wall, such as cancer, ulcer or adhesions. We usually get diminished peristalsis in atony. Increased peristalsis is often found in hyperacidity, ulcer and obstructed pylorus.

MOTILITY OF THE BOWEL.

The duodenum, as a rule, empties rapidly, and marked stasis of the bismuth meal is so unusual that it is always striking and significant.

It may be due to the deformity caused by chronic ulcer, adhesions, or cancer, or sharp kinking over the peritoneal band at the duodeno-jejunal junction.

The presence of *simple* duodenal ulcer has little effect on the passage of bismuth through the duodenum; its rate may be normal or more rapid than normal.

In the duodenal cases I have seen the X-ray has been of greatest help in demonstrating the deformity of the first portion of the duodenum due to chronic ulcer and in showing stasis in the duodenum due to adhesions.

The time of passage of the bismuth meal through the intestine is very important and interesting in connection with the diagnosis and location of the causes of chronic constipation and chronic intestinal obstruction. The "time-table of the bismuth train" is easy to understand. Naturally, there is much normal variation in different individuals and with different kinds of food and different amounts of bismuth.

The head of the bismuth column normally reaches the cecum in four to five hours, the hepatic flexure in five to eight hours, and the splenic flexure in seven to twenty-four hours. The end of the bismuth column follows four to five hours behind. The bismuth meal has normally left the stomach entirely in six hours, and wholly passed the small intestine in nine hours; in eight to sixteen hours practically all the bismuth should be in

the descending colon, and in twenty-eight to thirty-two hours in the pelvic colon, where it remains till emptied out by defecation.

It is interesting to find that most cases of constipation do not depart from the normal schedule till the colon is reached, and many not till the pelvic colon is reached. In the majority of functional cases constipation means faulty defecation, not sluggish bowels as a whole, and it is obvious that enemas are usually more needed than cathartics, which often hurry the food through the whole bowel with unnecessary irritation and disturbance, merely for the sake of emptying the rectum.

There are several contributory causes in atonic constipation, such as abnormal length and sagging of the transverse colon, rarely of the sigmoid, and simple kinking of the flexures. The latter has been much emphasized as a cause of constipation, but I have not been sure of it in any cases I have seen. The kinks have often appeared very sharp in the pictures, especially the splenic, but have been passed on time by the bismuth. (I am referring here to simple kinks due to the sagging of the bowel from its attachment, not to the kinks due to adhesions.)

In atonic constipation of the ascending colon, which type is less common, there is stagnation of bismuth in the cecum and ascending colon with dilatation and pouching; this is also a favorite site for adhesions starting from chronic appendicitis.

In my own experience the X-ray has proved most useful in separating the medical from the surgical cases of constipation or obstruction, those due to atony or faulty diet from those due to adhesions or tumors.

In one patient, who had had several years of unsuccessful medical treatment for severe constipation and debility by one of our best physicians, an X-ray examination gave an immediate diagnosis of marked constriction and deformity of the ascending colon due to adhesions. An operation confirmed the diagnosis and promptly relieved the condition.

At first it was a little disappointing to send a patient with chronic constipation for X-ray examination and get a normal report, but I soon appreciated the value of ruling out an organic cause in such cases.

It does not seem to me necessary to make the X-ray a part of the routine examination in all digestive cases, nor to dispense with any of the older forms of examination because we have a new and valuable one.

In the majority of cases the clinical history and the ordinary physical examination, including the stomach contents and feces, are all that we need for diagnosis, and there is no need to put our patients to the trouble and expense of a further special examination, but in many even of these cases, where expense is not a great object, the X-ray gives interesting and valuable confirmatory evidence.

We must remember that several plates must be taken as a rule in abdominal cases and often quite a series, for only constant variation from the normal outline has value in diagnosis.

On the other hand, in many cases the X-ray is a very essential part of the examination and gives us clear and definite information not otherwise obtainable, and occasionally may be worth more than all the rest of the examination put together and far more than the price paid for it.

I have seen cases wrongly diagnosed by careful and expert physicians undergo months of useless treatment, and then have the right diagnosis made by a single X-ray examination with prompt recovery of the patient.

The examination in cases of disease of the esophagus is not complete in my opinion without the use of the X-ray.

I now use the X-ray habitually in all cases of disease of the stomach where the diagnosis is in doubt, or where the results of careful treatment are unsatisfactory without obvious cause. I believe that most cases of marked chronic constipation, especially those which do not yield to treatment, should have an X-ray examination.

We must not be disappointed if the X-ray occasionally shows us nothing at all in very troublesome cases. This frequently happens in functional cases with most trying symptoms of long duration.

None but experienced radiologists with absolutely first-class apparatus can be relied upon to take uniformly good abdominal pictures. Men who take good bone, joint and chest pictures may utterly fail below the diaphragm.

The hope has been expressed that the X-ray will take the place of the stomach tube, since most people would rather swallow bismuth paste than a tube. We still need the tube since the X-ray can give no information about secretion, pathological products of the wall, such as mucus, blood, etc., data essential to diagnosis; and, furthermore, X-ray data about motility, while usually reliable, are sometimes confusing.

The X-ray is a part of the physical examination, and needs to be so used to give best results. The X-ray alone would leave us hopelessly in the lurch in the vast number of gastric and intestinal neuroses, which make up the majority of our digestive cases (gastric hyperacidity and achylia, nervous vomiting, hyperæsthesia, gastralgia, intestinal neuroses, nervous diarrhœas, enteralgia), as well as in acute and chronic catarrh of the stomach and bowel, simple peptic and intestinal ulcer, parasites, etc.

We must recognize the limitations as well as the value of this remarkable method of examination.

XIII.

THE CLOSURE OF OBSTINATE PERINEAL FISTULÆ
FOLLOWING OPERATION FOR STRICTURE
OF URETHRA. THE PREVENTION OF
THESE FISTULÆ.*

BY HOWARD A. LOTHROP, M. D.

As a general rule it is essential to discover and remove the cause in treating lesions of a surgical nature, and unless that is done the effort will fail. This is particularly true of cases of obstinate perineal fistulæ secondary to lesions of the prostate gland and urethra. Except in the rare cases where tuberculosis and carcinoma are present, the persisting cause is a mechanical one. Like any fluid, urine will follow the course of least resistance. Therefore, if there exists a urethra with incomplete wall, accompanied by more or less distal obstruction, one cannot expect the urine to follow the natural channel. Hence, many perineal wounds are either very slow to heal or may remain open indefinitely.

In trying to ascertain the causes of these obstinate and troublesome fistulæ, let us consider some of the types of lesions which are followed by this complication.

Group 1, Cases of Urinary Extravasation.—These are generally the result of stricture. There is a varying degree of local infiltration, the parts become infected, and the less resistant tissues become necrotic. Meanwhile, the patient may become very toxic and his condition critical unless incisions are made or openings in the skin appear spontaneously. If resolution should follow, a fistula would result and persist indefinitely, because the underlying cause (stricture) still persists. If, however, such a case of extravasation were operated upon simply by free incisions and nothing further done to relieve the stricture, owing perhaps to the serious toxic condition, there would be the same chance of a chronic fistula as though the opening were spontaneous.

* Reprinted from "The Boston Medical and Surgical Journal," February 6, 1913, page 188.

It frequently happens in this class of cases, owing to the distortion of parts and the sloughing, that no guide can be passed into the bladder and that in the effort to find the urethra it is extensively injured and perhaps destroyed for some distance or a considerable portion of it sidetracked by the catheter, if passed through the penile urethra into the bladder. Finally, the catheter may have been inserted into the bladder only through the perineum and prostatic urethra. These circumstances tend to establish obstinate perineal drainage.

In dealing with these cases of urinary extravasation, the first indication is the establishment of free drainage from the tissues, particularly if the condition is critical, but, ultimately, of course, the stricture must be incised. This should be done at the first operation if the condition of the patient warrants, provided the operation is not too prolonged and the effort not attended with too great difficulty or unnecessary injury to the urethra. The bladder should be drained in these cases, as in all others, by a catheter which includes the whole urethra, and the opening in the perineum should serve to drain only the adjacent tissues.

Group 2, Fistulæ after Prostatectomy by the Perineal Route.—After prostatectomy by the perineal route, chronic and sometimes permanent fistulæ are not uncommon. In view of the frequent extensive destruction of the membranous and prostatic urethra and the neglect to keep open the remaining portion of the anterior urethra, it is surprising that the urine finds its way into the penile urethra as well as it does. In some cases careful operators are able to remove the gland without material injury to the urethra but, as a rule, it is considerably torn. Many resort solely to perineal drainage and occasionally insert considerable packing into the wound and neglect the distal portion of the urethra which, of course, remains collapsed. After these drains are removed the greater portion of the urine will escape through the wound, but will decrease gradually as the wound tends to close and the distal opening in the urethra remains patent. If granulations tend to obstruct the latter they offer resistance, and a fistula may persist.

If, on the other hand, the operation be performed with care, so as to cause a minimum of urethral injury, and a catheter for bladder drainage be placed so as to include the whole urethra, and a light gauze packing be left in the wound and removed as soon as hemorrhage is arrested, then the conditions

are most favorable for early and permanent wound closure. The soft parts close around the catheter, where the urethra may be deficient, and the approximated surfaces become glued together by granulation tissue. In many cases the wound may be nearly closed with large, mass, silkworm gut sutures, and, by means of seepage for thirty-six to forty-eight hours, all exudate and fluids be promptly removed and thereby absorption prevented. The patient may be propped up in bed during this period. If there is no contra-indication, the catheter should remain in place at least one week.

Group 3, Fistulæ Following Operation for Stricture.— This complication not infrequently follows external urethrotomy, depending upon various circumstances. If we have to deal with a passable stricture, it is possible to obtain relief by intra-urethral methods, such as gradual dilation or internal urethrotomy, irrespective of whether the stricture is situated in the penile or membranous urethra. Internal urethrotomy is the accepted method of treating penile strictures, but is generally condemned for deep strictures because of the danger of infecting the perineal tissues, and this complication has occasionally proved serious. As a rule, however, internal treatment of the urethra is not followed by urinary extravasation or sepsis, even when the crude and now discarded method of divulsion of deep strictures was used. The usual method of treating deep passable strictures which do not yield to gradual dilatation is by external urethrotomy, and this is the only way if no guide can be passed. The resulting injury to the urethra will depend upon the care of the operator and upon the presence or absence of a guide and upon the subsequent tearing in introducing the catheter for drainage. Most surgeons insert the catheter through the whole urethra, but the wound variation is considerable as to the extent of incision or laceration of the urethra and perineal tissues and the amount of subsequent packing or closure of these tissues. Some remove the catheter very early and some keep the wound open with repeated, extensive packing. If a guide has been passed, the only object of a perineal incision is to guard against infection; hence, all that is required is a small incision in the perineum down to the urethra, performed after the stricture has been cut with the Maisonneuve instrument and sounds passed to the desired size; if an external urethrotomy is done without a guide the perineal wound can be all but closed, and thus allow

ample drainage. Later the wound could be opened easily if indicated. Hence, freshly incised tissues are approximated and heal quickly when held in apposition with mass sutures of silkworm gut, which should not be removed for at least a week. The catheter should remain this length of time also, and repeatedly when removed there is little or no escape of urine through the nearly healed perineal wound in uncomplicated cases. The importance of leaving a minimum opening for drainage in clean cases and the proper retention of the catheter are essential for rapid and permanent healing. This is further demonstrated by the fact that success in plastic operations for cure of hypospadias depends upon wound closure and catheter retention until healed. Their tendency to fistula formation is well known by those who operate upon these obstinate cases. Prevention of recurrence of stricture will depend upon the faithfulness of the patient in attending to subsequent passing of sounds for an indefinite period.

So much for factors which tend to produce perineal fistulæ and for measures for prevention of the same.

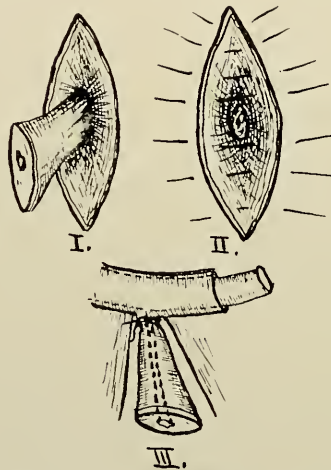
Method of Relieving These Cases.—As already mentioned, the fistula persists for mechanical reasons, the urine following the path of least resistance. If there is resistance to the stream anywhere in the urethra distal to the opening which leads to the perineum, the fistula will tend to persist and the granulations fail to close it. Hence, all distal strictures must be relieved by full sound dilatation. Sometimes the introduction of a catheter for permanent drainage of bladder for a couple of weeks may avail. If these simple measures fail, some sort of perineal operation must be resorted to. These fistulæ have often been opened down to the urethra and curetted, caustics applied, and other means resorted to, only to be followed by failure.

Technic.—Each case may present some special feature, but the following general technic has never failed of speedy relief in the hands of the writer.

The operation should be deferred until all acute signs have subsided and only the fistulous tract remains. A guide should be passed through the whole urethra into the bladder. If there is no tight stricture, a moderate sized steel sound (French 24) should be selected so as to distend the urethra at the fistulous opening; otherwise a small guide should be used. Any stricture in the penile urethra should next be divided with

the Otis or Maisonneuve instrument. Any narrowing at or near the fistulous opening, which is usually in the membranous urethra, should next be divided internally and preferably with the Maisonneuve instrument. Then a steel sound, French 24, is passed and the patient put in the lithotomy position.

If no guide can be passed into the bladder, one should be introduced to the point of stricture, and the patient put in the above position. Next, the direction and length of the fistulous tract should be determined with a small probe. An oval incision is then made in the perineum around the opening of the fistula, leaving a margin of skin, one-third of an inch wide, around it. If needed, a little more room may be gained by making an incision in the antero-posterior direction at either



- I. Fistulous tract dissected down to the urethra.
- II. Tract excised and ligated at the urethra. Sutures placed.
- III. Diagrammatic side-view showing tract dissected and ligated at the urethra, which is distended with a steel sound.

end of the oval one, but this is not often the case. The next step is the careful dissection of the tract so as to excise it without opening it until the urethra is reached. Its wall should be kept reasonably thin, but should contain ample tissue so as not to break when the necessary traction is used. The dissecting will be chiefly through scar tissue. Frequent use of the probe will indicate the direction of the fistula or some sort of a guide may be left in the tract during the dissection. Stay sutures or some instrument should be used during the dissection for traction, and the dissection is nearly bloodless. The

tract will vary from one to two inches in length. When the urethra has been reached a ligature of No. 1 chromicized catgut should be tied around the base of the tract, which is practically a tube, and the distal portion excised. Where it has been possible to insert a soft rubber catheter for permanent drainage prior to dissecting out the tract, this proves to be the best technic, because the catheter is as good a guide as the steel sound and, being already in position, there is no subsequent danger of injury after the parts have been dissected. Finally, the cut edges of the stump (tract) may be sutured with plain catgut. Then the walls of the incision are held in approximation with three or four interrupted, buried sutures of plain catgut. The edges of the skin, including some of the deeper tissues, are sutured with silkworm gut or silver wire *en masse* so as to close the perineal wound. Owing to the fact that the dissection has been through scar tissue, there is but little chance for infection or infiltration. In thin subjects, where the fistulous tract is short, perineal drainage is not indicated, but, as a precaution in certain cases, a very narrow strip of rubber dam may be inserted for twenty-four hours. The silkworm gut sutures should not be removed for about ten days. The after-treatment does not differ from that of any patient wearing a catheter for bladder drainage. The perineal wound must be inspected daily and kept clean by lotions, wet dressings, or a little boric ointment, as each case may require. The catheter must be kept clean and in place for about ten days. At the end of this time the wound should be about healed, but, if a few drops of urine should escape, this condition will persist only a few days. As after any stricture operation, sounds should be continued in the usual way.

If no guide can be passed prior to beginning the perineal operation, the technic is a little more difficult in order not to wound the urethra unnecessarily, but the general procedure is the same. A blunt guide should be passed to the stricture and the tract dissected down to the urethra and, instead of its being ligated at this time, it should be split open its full length, when a probe and then a slightly curved, small director may be passed into the urethra in either direction. In the groove of the director a small Otis urethrotomy knife may be passed, dividing the stricture. After the passage of sounds the rubber catheter is to be inserted, the tract ligated and sutured and the wound closed as above described.

The appended cases are examples of the two conditions which may be met:

Case 1.—This man, 38 years old, and in good general health, had been operated upon successfully eight years before for stricture. In December, 1910, he entered the Boston City Hospital. Examination showed the presence of an impassable, deep stricture and a perineal fistula of about seven weeks' duration, through which all of his urine passed. He was operated upon by one of my colleagues, who divided the stricture after enlarging the perineal wound and seeking the urethra with a guide. In so doing the urethra was opened for about two inches. The sinus was curetted and the wound packed after a catheter had been inserted through the whole urethra for bladder drainage. The catheter was removed in about seven days after which sounds were passed. It was one month later before any urine was passed through the penis. At the end of three months there remained a perineal fistula through which most of the urine escaped, although a French 28 sound could be passed.

The above was the condition when I saw this patient and the following operation was performed for the closure of the fistula. A small probe in the fistula came in contact with a steel sound previously passed, and the tract was about one inch long. With a Maisonneuve instrument several narrow places in the deep penile and membranous urethra were divided and then dilated to the size of a French 30 sound, and a soft rubber catheter, French 28, introduced with a stilette and left for permanent drainage. Patient was then put in the lithotomy position. Steps were carried out as given above in detail and briefly were as follows: Oval incision around the opening of the fistula, leaving a narrow margin of skin, a little enlargement of the wound antero-posteriorly at either end of the oval incision, then a careful excision of the fistulous tract down to the urethra. The tract was then ligated with No. 1 chromicized catgut and excised, a strand of gut being left long to act as a drain. The wound was nearly closed with buried, plain catgut sutures and large mass sutures of silkworm gut for the skin and deeper tissues. Nothing but scar tissue was exposed by this dissection, which made a conical cavity narrowing at the urethra. The convalescence was uninterrupted. On the eighth day there was a slight leak of urine from the wound. Catheter removed on the eleventh day and the stitches on the fourteenth day, at which time a few drops of urine escaped through a small perineal opening. A French 28 sound was passed on the seventeenth day and every five days thereafter. On the twenty-third day following operation the perineal opening was closed and remained permanently so and patient was passing a normal stream. Pathological examination of the excised tract showed only scar tissue.

Case 2.—A man, 48 years old, operated upon six years ago for stricture. The perineal wound healed, but one year later a local abscess formed and a discharging urinary fistula has since persisted. Examination shows a redundant scar in the center of which is a small opening leading to the urethra. He has also an impassable stricture and most of the urine passes through the fistula. He was operated upon April 12, 1912, at the Boston City Hospital. The technic differs from that used in the above case because no urethral guide could be passed. Briefly, it was as follows: A guide was

passed down to a deep stricture. The fistulous tract was dissected out its full length and it was then split open anteriorly down to the urethra. A probe was passed into the bladder, then a small grooved director, on which an Otis urethrotomy knife was passed, thus cutting a moderate stricture proximal to the opening in the urethra. In a similar manner, a probe and then a director were passed into the penile urethra through the small fistulous opening, using care not to enlarge it, and the deep, penile stricture incised. A Maisonneuve instrument was easily passed and the knife used to insure a full division of all strictures. The urethra was dilated with a French 30 sound and then a No. 28 soft rubber catheter introduced with a stilette. During all this manipulation great care was exercised not to injure the urethra unduly nor enlarge its fistulous opening. Finally, the base of the tract was ligated and excised, as in Case 1, and the wound closed except for a strip of rubber tissue, one-eighth of an inch wide, which was removed on the second day. The catheter was removed on the fourteenth day. This wound healed by first intention, there being no escape of urine or exudate. It remained permanently closed, and the patient passed a normal stream.

XIV.

A REPORT OF TWO CASES RE-INFECTIONED WITH
SYPHILIS FOLLOWING TREATMENT BY
SALVARSAN.*

BY JOHN H. CUNNINGHAM, JR., M. D.

Since the introduction of salvarsan (September, 1909) as a therapeutic measure in the treatment of human syphilis, many thousand patients have received the drug.

In the opinion of those competent to appreciate the character of the various forms of this disease, and who have the facilities for carrying on this new treatment in a scientific manner, it is generally admitted that this new drug has a pronounced immediate effect upon the lesions, that a negative sero-reaction is not always produced by a single dose, that a negative sero-reaction may again become positive, and that lesions do sometimes recur. In many instances, however, a single dose of the drug is followed by a disappearance of the symptoms and lesions and a negative sero-reaction results. The point of interest in this latter group of cases is whether or not they are entirely freed of the disease. There have appeared in the medical literature a few instances in which patients in this group have again received a primary lesion which has been followed by a typical secondary eruption at the usual period and a strongly positive sero-reaction; in other words, these patients have all the evidence of again contracting the disease. Such instances are as yet few and for this reason the following two cases are recorded:

Case 1.—A young lady 20 years old. Primary lesion on lower lip appeared about October 1, 1911, followed by a profuse macular and papular eruption all over body in the sixth week following the primary lesion. Sero-reaction (Wassermann and Noguchi) November 20, strongly positive. On November 22, 1911, .09 gm. salvarsan administered intravenously. At this time induration was present at the site of the primary

* Reprinted from "The Boston Medical and Surgical Journal," Vol. clxvi., No. 25, p. 929, June 20, 1912.

lesion on lip. Bubo present under left jaw, eruption profuse and a few mucous patches present in mouth. In ten days all symptoms and lesions of disease were absent. Sero-reaction (Wassermann and Noguchi), January 25, 1912, negative. At this time there was no evidence of the disease. On March 26, 1912, patient appeared with a characteristic general macular eruption similar to the usual secondary eruption of macular type. This eruption had been present a few days. It was then learned that she had had a genital sore for the past several weeks. Examination revealed a small ulcerated, slightly indurated sore on the left labium minus. The sero-reaction (Wassermann and Noguchi), March 28, 1912, both strongly positive. On April 6, 1912, a dose of .09 gm. salvarsan given intravenously. Nine days later the eruption and primary lesion had disappeared.

On May 21, the Wassermann and Noguchi tests were still positive.

Case 2.—A man 28 years old. Typical syphilitic chancre appeared on penis February 16, 1911. A typical general macular eruption appeared in the sixth week following the appearance of the primary lesion. On April 12, 1911, sero-reaction (Wassermann and Noguchi) strongly positive. On April 21, 1911, .06 gm. salvarsan given intravenously. At this time the patient showed a general macular eruption, the right tonsil considerably swollen, left less so, tonsils and pharynx reddened, not ulcerated. A small suppurating bubo present in both groins from secondary infection of chancre. The general condition was only fair. Two weeks following the administration of salvarsan the patient was free from symptoms and lesions. On June 2, 1911, sero-reaction (Wassermann and Noguchi) both negative. On November 9, 1911, the patient again appeared with a typical chancre on the foreskin and a general profuse macular eruption, most pronounced on the posterior and inner surfaces of the legs and arms. There was one mucous patch on the lower lip. Sero-reaction (Wassermann and Noguchi) both positive, November 11, 1911. The general condition was better than at the time of the previous administration of salvarsan. On November 15, 1911, .06 gm. salvarsan given intravenously. Fifteen days later all lesions had disappeared. On December 30, 1911, sero-reactions were still positive.

The above cited cases have received no mercury at any time. It is the writer's belief from the cycle of events that both these patients were cured of the first infection by a single dose of salvarsan.

XV.

THE VALUE OF INTRA-UTERINE DOUCHES, PACK-
ING AND ANTISEPTICS IN THE TREATMENT
OF MISCARRIAGE. A STUDY OF THE
RESULTS IN TWO THOUSAND CASES.*

BY ERNEST B. YOUNG, M. D., AND JOHN T. WILLIAMS, M. D.†

The use of intra-uterine medication owes its origin to Hippocrates,¹ who made use of injections into the uterine cavity for the treatment of metrorrhagia, and to wash out pieces of placenta. According to Kob,² Galen was also familiar with this practice and was the first to employ it in the treatment of hæmorrhage during the puerperium.

Although other eminent physicians advised and employed intra-uterine injections, chiefly for non-puerperal diseases, it was not until the demonstration of the infectious origin of puerperal fever by Holmes,³ in 1843, and Semmelweiss,⁴ in 1847, and the dawn of the antiseptic and aseptic era, that their use for the prevention and treatment of puerperal sepsis became widespread.

Bonnet,⁵ in 1850, was the first to employ them in a case of puerperal infection, but with unsuccessful result. Von Gruenwaldt⁶ appears to have been the first to adopt their general use in puerperal sepsis, and met with such success that he subsequently instituted the practice of giving an intra-uterine douche to every patient two or three hours after delivery as a prophylactic measure.

As the employment of intra-uterine douches increased, reports of peritonitis and sudden death following their use led Auvard⁷ to devise a return flow douche tube, and Olshausen⁸ to expound the theory of air embolism.

The prophylactic use of intra-uterine douches in uninfected cases was soon abandoned except after operative labors and

* Reprinted from the "Boston Medical and Surgical Journal," Vol. clxvi., No. 10, pp. 364-367, March 7, 1912.

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miscarriages. At first various antiseptics were employed,—chloride of lime, chlorine water, thymol, salicylic acid, boracic acid, permanganate of potash, carbolic acid and corrosive sublimate,—but with the popularization of the last two antiseptics in general surgery, the use of the others for intra-uterine douches was gradually abandoned, and reports of poisoning by the absorption of carbolic acid and corrosive sublimate led to the substitution by most obstetricians of sterile water or salt solution. In 1896, Corossa⁹ introduced alcohol as an intra-uterine antiseptic, and in 1910, Polak¹⁰ advocated the use of a gauze strip saturated with tincture of iodine as an intra-uterine antiseptic in infected cases.

Packing the uterus for the purpose of controlling hæmorrhage was first described by Leroux,¹¹ in 1776, but little attention seems to have been paid to it until 1887, when Dürrssen¹² introduced the use of uterine packing after curettage for miscarriage and later for post-partum hæmorrhage. Dürrssen's writings soon led to the general acceptance of this form of treatment. He used iodoform gauze, which is still popular in spite of occasional reports of poisoning. The first instance of poisoning from the use of iodoform in the uterine cavity was reported by Dr. Elbridge G. Cutler,¹³ of Boston, in 1886, who at the same time collected seventy-seven published cases of poisoning from its use in other wounds.

In a previous article the writers¹⁴ have discussed the results of the treatment of 2,000 cases of miscarriage. The present paper is based upon the same material as the former, but deals only with the results of certain methods commonly employed in the care of such cases, attempting to show their relative worth, in so far as it is possible.

The number of cases does not total quite 2,000, as those admitted with advanced sepsis and those in which no operative procedure was undertaken have been excluded, in order that conditions in all instances might be as nearly identical as possible. Obviously neither cases with advanced sepsis nor those in whom operative treatment was unnecessary have any bearing upon the subject under consideration.

While a number of observers have reported their results in the treatment of miscarriage, the writers have been unable to find in the literature a comparison, under otherwise similar conditions, of the points with which this paper attempts to deal

Although cultures were taken in a large number of our cases, we shall not consider the bacteriological findings in this paper because the wide variety of organisms present in different cases would make the results too complicated to be of value. Among the cultures taken from the uterine cavity in ninety-seven infected cases of miscarriage, twenty-eight different organisms or combinations of organisms were recovered. The largest number showed the streptococcus, which was present as a pure culture in only twenty-two instances, but it is interesting to note that, in these few cases, the findings were essentially the same as in the entire series.

A temperature of over 100.4° F., all other possible causes of elevation of temperature having been excluded by a thorough physical examination, is agreed upon by the majority of writers¹⁵ as evidence of infection; therefore the term "infected" as used in this paper will apply to cases admitted with such a temperature, but in which the infection was apparently limited to the uterine contents and decidua. By clean cases will be understood those with essentially normal temperature, even though cultures taken from the uterine cavity in some of these revealed the presence of bacteria. The occurrence of the same temperature (100.4° F.) at any time during the convalescence is taken as the standard of morbidity in clean cases. Among the infected cases, those in which the temperature did not fall to normal within forty-eight hours after curettage are considered as morbid.

The attempt is made in this paper to aid in the solution of five problems:

1. Is there any danger in the intra-uterine douche?
2. Is the intra-uterine douche of any mechanical value after the products of conception have been removed?
3. Is there any advantage in antiseptic douches over sterile water or salt solution?
4. What is the value of swabbing the cavity of the uterus with tincture iodine?
5. Does packing the uterine cavity, to control hæmorrhage, increase liability to sepsis?

1. THE DANGER OF INTRA-UTERINE DOUCHES.

The danger of irrigation fluid being forced into the Fallopian tubes, if an effective return flow is maintained, has been refuted

by the experiments of Vidal de Cassis, Astros and Petit¹⁶ on the cadaver. Nevertheless, in our series there were distinctly more instances of salpingitis following intra-uterine douches, especially among the infected cases, where organisms were of course present in increased numbers.

Below are the tabulated results:

	Number Cases.	Number with Salpingitis.	Percentage Salpingitis.
Clean cases:			
Uterus irrigated.....	896	3	0.33
Not irrigated.....	267	2	0.75
Infected cases:			
Uterus irrigated.....	410	12	3.9
Not irrigated.....	55	0	0

In the history of the Gynecological Service there has occurred one case of general peritonitis and one of pulmonary embolism following intra-uterine irrigation. It is impossible to assert that these untoward events were the direct result of this treatment; yet a glance at the table above does not make the possibility of such an accident appear groundless, particularly in the infected cases.

It may occur to the reader that only the more severe types were irrigated and hence the more frequent salpingitis and greater morbidity, but this is not substantiated by a close study of the series.

2. THE MECHANICAL VALUE OF INTRA-UTERINE DOUCHES.

The primary value of any intra-uterine douche is in mechanically removing small shreds, blood clot and as many as possible of the organisms present in the cavity of the uterus, while the action of an antiseptic, which it may contain, is secondary.

Any advantage which the intra-uterine douche may confer in bettering the end results is best decided by the comparison of a series of cases in which the uterus was irrigated with sterile water or salt solution and one in which the cavity was simply wiped with sterile gauze. These cases treated with antiseptic douches or medicated gauze must be excluded, since the anti-

septics employed might influence the result. The following table shows the result of this study:

	Number Cases.	Number Morbid.	Percentage Morbidity.
Clean cases:			
Uterus irrigated.....	345	15	4.3
Not irrigated.....	136	7	5.1
Infected cases:			
Uterus irrigated.....	138	16	11.6
Not irrigated.....	48	3	6.2

This comparison shows that no great advantage is obtained by irrigation over simple wiping of the cavity in clean cases, while in the infected the percentage of morbidity is nearly twice as great among those irrigated as among those in which the uterus was wiped out with sterile gauze.

We are unable to offer any explanation, unless the organisms are more widely disseminated by irrigation, but feel justified in the conclusion that, in our own series, the intra-uterine douche has offered no mechanical advantage in the treatment of such cases, nor do the end results appear to justify its continued use as a routine in this class of cases.

3. THE VALUE OF ANTISEPTIC DOUCHES.

A comparison of the use of different antiseptic and simple sterile intra-uterine douches is shown in the following table:

	Number Cases.	Morbidity in Puerperium.	Percentage Morbidity.
Clean cases:			
$\frac{1}{2}$ per cent formalin.....	7	1	0
1 to 5,000 corrosive.....	305	27	8.8
50 per cent alcohol.....	239	11	4.6
Salt solution.....	345	15	4.3
Infected cases:			
$\frac{1}{2}$ per cent formalin.....	10	2	20.0
1 to 5,000 corrosive.....	143	28	19.5
50 per cent alcohol.....	119	22	18.4
Salt solution.....	138	16	11.6

It is at once apparent that plain sterile salt solution gave better results than any of the antiseptic solutions tried.

A possible explanation of this fact is that each of the antiseptics favored the coagulation of albumin, thus sealing up the sinuses and raw surfaces and preventing the escape of a certain number of organisms, while salt solution and sterile water prevented clotting to a certain extent and favored free drainage.

In the clean cases the morbidity after the corrosive intra-uterine irrigations is nearly twice that of either alcohol or salt solution, while even the small difference between the results after alcohol and salt solution should lead us to select the latter.

The outcome in the infected cases shows that salt solution is again by all means to be preferred for an intra-uterine douche, since the morbidity is much less after its use.

The number irrigated with formalin is too small for any conclusions of much value, but is given for completeness.

4. THE VALUE OF IODINE.

We have seen that irrigation of the uterine cavity with antiseptic solutions has given no better results than irrigation with plain sterile salt solution, and that as good, if not better, results have been obtained when the uterus has not been douched but simply wiped with sterile gauze. One further antiseptic remains to be considered, namely, iodine.

This has been used in two forms, iodoform (10 per cent) and tincture of iodine. These have been applied by swabbing the uterine cavity with gauze saturated with the preparation. In many instances, considered in the next section, the uterus has also been packed with iodoform gauze for twenty-four hours. Where the tincture has been used, a strip of sterile gauze saturated with the solution has been left in the cavity from one to three hours in some cases.

The actual value of this has not been determined.

One case among thirty-eight in which an iodine strip was left in the uterus, and one case in twenty-eight which were simply swabbed out with iodine and the cavity left empty, had a morbid convalescence. This is not sufficient data to warrant definite conclusions, but the method seems of value. The statistics from the use of iodine preparations follow:

	Number Cases.	Number Morbid.	Percentage Morbidity.
Clean cases:			
Tincture of iodine.....	50	1	2
Iodoform.....	24	0	0
Infected cases:			
Tincture of iodine.....	25	1	4
Iodoform.....	5	1	20

Tincture of iodine has given the best results of any antiseptic used in the uterus, and these figures are also better than those obtained without the use of antiseptics. The statistics given by iodoform are also good but not equal to those by the stronger preparation. The diffusibility and powers of penetration of tincture of iodine appear to overcome the disadvantages of the alcoholic solution.

5. INTRA-UTERINE PACKING.

In the earlier days of the Gynecological Service practically all cases were packed after curettage, to control possible hæmorrhage. This was gradually discarded as a routine measure, and at present is employed only for unusual bleeding. There are certain border-line cases, however, bleeding more freely than the average, where the operator feels more comfortable to tampon the uterus, especially if the patient is far from medical aid.

Antiseptic packing has been employed as a prophylactic in "clean" and as a therapeutic measure in "infected" cases. The results are shown in the table below:

CLEAN CASES.

TREATMENT.	Number Cases.	Morbid Puerperium.	Percentage Morbidity.
Packed with iodoform gauze.....	398	22	5.5
Packed with gauze saturated with 50 per cent alcohol,	29	1	3.4
Packed with plain sterile gauze.....	285	23	8.0
Left empty.....	396	16	4.0

INFECTED CASES.

TREATMENT.	Number Cases.	Morbid Puerperium.	Percentage Morbidity.
Packed with iodoform gauze.....	174	29	16.6
Packed with gauze saturated with 50 per cent alcohol,	30	6	20.0
Packed with plain sterile gauze.....	121	10	8.2
Left empty.....	159	17	10.7

In the apparently clean cases the use of gauze treated with an antiseptic seems superior to the plain sterile gauze, although in infected cases exactly the reverse is true. The explanation of this fact is probably that in the former group the introduction of an antiseptic destroys the few bacteria which are often present or introduced during an operative procedure, while in the latter the antiseptic is powerless to cope with the larger numbers of and more widely distributed organisms and also lessens the draining power of the gauze. It is also probable that it acts in the same manner as the antiseptic in irrigation. The table shows far less morbidity in infected cases treated with a tampon of plain gauze or where the uterine cavity is left empty. Because of the irritating properties of strong iodine solutions, iodine saturated gauze has not been used to pack the uterus for hæmorrhage, nor when used for its antiseptic effect has it been allowed to remain in the uterus more than three hours. Therefore we have no basis of comparison between tincture of iodine and the other antiseptics which we have employed for this purpose. A weaker iodine solution (3 or 5 per cent) might be safely tried; but we have no statistics to establish its value.

Of those antiseptics which have been used to saturate gauze packing at the Boston City Hospital, alcohol has given the best results, but, as we have shown, in infected cases plain sterile gauze is superior to any antiseptic gauze which has been employed.

CONCLUSIONS.

1. Salpingitis has been more common after intra-uterine douches.
2. Intra-uterine douches of sterile water or salt solution have not given as good results as simply wiping the uterine cavity with sterile gauze.

3. Antiseptic douches have given poorer results than simple sterile solutions.

4. Swabbing the uterine cavity with tincture of iodine has given the best results.

5. Packing the uterus to control hæmorrhage does not greatly increase the liability to infection.

6. For packing, gauze saturated with 50 per cent alcohol in "clean" and plain sterile gauze in "infected" cases have given the most satisfactory results.

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XVI.

LIVER CELL CARCINOMA.

BY R. S. AUSTIN, M. D.

Primary carcinoma of the liver, although not of very common occurrence, has made its appearance in the literature with increasing frequency for the past half-century. During the last twenty years several single instances or small groups of them have been reported each year.

Certain aspects of this new growth have provoked considerable discussion, for instance, its cause and its relation to cirrhosis of the liver, but in regard to its origin a unanimity of opinion prevails. It is evident that the normal liver possesses but two varieties of epithelial cells from which carcinoma may arise, the liver cells of the trabeculæ or cords and the lining cells of the bile ducts. Another possible source for primary carcinoma of the liver should, however, be mentioned, that is, misplaced cells; an example of such a carcinoma arising from them is the adrenal cell tumor which is occasionally primary in the liver.

According to Eggel,¹ who made a collection of the cases reported up to 1901, the liver-cell type of carcinoma is about five or six times as common as the bile duct variety. Of the liver-cell type three gross forms are generally recognized, multiple nodules, one large mass (massive type), and a diffuse or infiltrating growth. The multiple nodular form is much the most common, comprising about two-thirds of the cases. Liver cell carcinoma frequently produces metastases which may be found in the vessels of the liver, in the gall passages, in the lungs, in the kidneys, or in the peritoneal cavity. Jaundice and ascites frequently are present.

It is to be expected that the cells of a liver cell carcinoma will tend to differentiate like liver cells. This they do, having the size, shape and general appearance of liver cells, and, in some cases, showing secretion of bile and the formation of bile capillaries between the cells.

The most fertile field for controversy in regard to primary carcinoma of the liver has been its relation to cirrhosis, which, according to Hanot and Gilbert,² occurs in a third of the cases. Some writers view the cirrhosis as a result of the carcinoma, others as a cause, while a few consider the two as occurring at the same time. The arguments in favor of these various opinions appear to be largely theoretical.

Even more given to theory are the views put forth as to the cause of this tumor. Writers have reported tumors of the liver in which they claimed that transitions from normal liver to liver cell carcinoma could be seen. In a recent article Loehlein³ gives the opinion expressed by several writers that liver cell carcinoma develops from an adenoma, which in turn results from the overgrowth of hyperplastic nodules stimulated by extensive destruction of liver tissue. The evidence in favor of these theories as to the cause of primary carcinoma of the liver is not convincing.

The tumor to be reported in this paper occurred in a man of seventy-eight, well developed but emaciated. Beside the tumor in the liver the autopsy showed broncho-pneumonia, probably terminal, and slight arteriosclerosis, most marked on the aortic valve. There was no evidence of jaundice or ascites.

The liver was somewhat enlarged. Its surface was studded with numerous whitish nodules, mostly round in form, the largest 2.5 cm. in diameter. Some of these nodules were raised as much as 1 cm. above the liver surface. On section the cut surface of the liver showed numerous, very firm nodules, less than 1 cm. to 4 cm. in diameter. Most of these nodules were white or yellowish white, but a few were distinctly yellowish green. Some were softened at their centers. The left lobe presented many more of the nodules than the right lobe; they were most numerous in the right portion of the left lobe, where they were closely grouped, often confluent, so that very little liver tissue was visible. In the middle of this portion of the left lobe were two nodules of a distinctly yellowish green color.

There were no metastases found in any other part of the body.

Microscopical examination of the liver reveals a tumor growing in roundish or irregular masses of various sizes. Occasionally the cells are arranged in the form of trabeculæ or cords. In many places the tumor is evidently growing expansively at the expense of the surrounding liver trabeculæ,

which are compressed, atrophied, or degenerated. In places the tumor grows in finger-like projections, infiltrating the adjacent liver tissue.

The tumor masses are, for the most part, composed of rather large cuboidal cells lying close together. Where the tumor is apparently growing under favorable conditions there is little connective tissue stroma, but in some areas the tumor masses have become atrophied and degenerated, and here the stroma is much more marked, being thick and dense.

In contrast to the degenerated portions of the tumor there are many areas very rich in mitoses, which are most numerous where the cells are largest.

A typical cell of the tumor is cuboidal in outline, is somewhat larger than a liver cell, has a granular cytoplasm, and possesses a fairly large, round or oval nucleus of the vesicular type. In each nucleus is a comparatively large, round, distinct nucleolus.

Fat drops are seen in the cytoplasm of many of the tumor cells, particularly in the atrophied or degenerated portions of the tumor. The picture often resembles very closely that seen in so-called fatty infiltration of the liver.

In some of the tumor masses cells are found which contain bile, and between the closely packed cells in these areas minute bile capillaries containing inspissated bile can be detected. The walls of the bile capillaries are brought out very sharply in sections stained with phosphotungstic acid-hematoxylin. In the same field mitosis and bile capillaries may be seen near together.

When the tumor, growing in irregularly round masses, showing large cells and containing many mitoses, is seen in the same field with typical liver trabeculæ, it is not difficult to tell them apart, but there seem to be all gradations of type between the two, so that occasionally it is well-nigh impossible to say which may be occupying a given field. Nowhere, however, can any direct transition from normal trabeculæ to definite tumor be made out. Moreover, in the light of recent investigations, such a transition is not to be expected because it is now well established that a tumor grows only by proliferation of its own cells, not by a transformation of normal cells into tumor cells.

The rapidity with which portions of this tumor are growing, evidenced by the numerous mitoses, combined with the infiltra-

tive nature of the growth and its effect on surrounding liver tissue, indicates clearly its malignant character.

In order to demonstrate that this tumor is a liver cell carcinoma it will be necessary to show that its cells possess enough of the characteristics of liver cells to make reasonable the assumption that the tumor originated from liver cells.

In regard to their general appearance the tumor cells have the cuboidal shape, granular cytoplasm and round or oval nuclei possessed by liver cells. Their size, however, is usually larger. They may contain fat drops in the cytoplasm as may liver cells. Their arrangement, to be sure, is for the most part in roundish, irregular masses, but in places it resembles the trabeculæ of the liver.

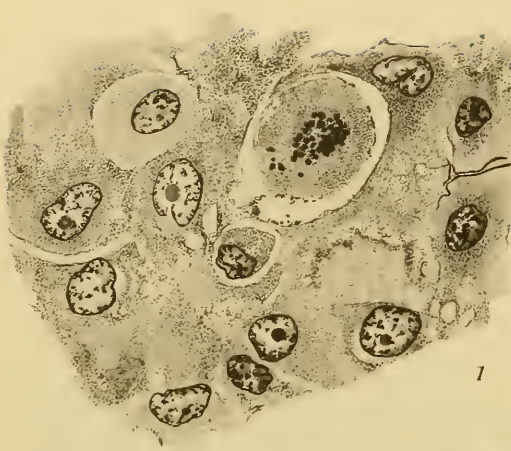
The most conclusive evidence in favor of the cells of this tumor having originated from liver cells is the occurrence of bile in the cytoplasm of many of the cells and the existence of bile capillaries between them, these minute capillaries often containing inspissated masses of bile. The secretion of bile and the possession of bile capillaries are characteristics of no other cells but liver cells. These peculiarities in connection with the morphology of the tumor cells, by establishing their nature, differentiates this primary carcinoma of the liver from the bile duct variety.

While this tumor would be considered, according to the ordinary classification, one of the multiple nodular type, there is no question but that it arose from some one primary focus and has spread through the liver, forming multiple nodules. The primary focus could not be definitely determined, but probably lay in the left lobe.

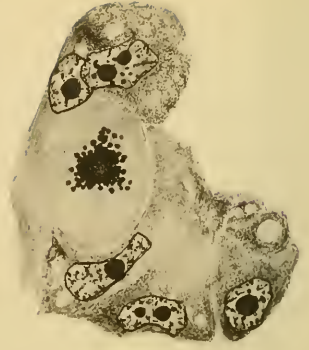
In regard to cirrhosis occurring in primary carcinoma of the liver, of which so much has been written, it would seem that the increase of connective tissue about degenerated or atrophied masses of this tumor is simply a thickening of the stroma, largely by contraction, and not a genuine primary cirrhotic process. Since carcinoma stimulates connective tissue to form a stroma for itself it seems a simpler explanation of the connective tissue in this case to consider it the stroma of the tumor rather than a cirrhosis.

SUMMARY AND CONCLUSION.

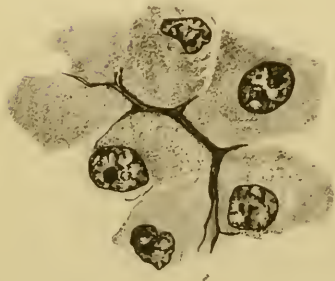
The cells of the new growth here reported have the morphological characteristics of liver cells, including the formation of



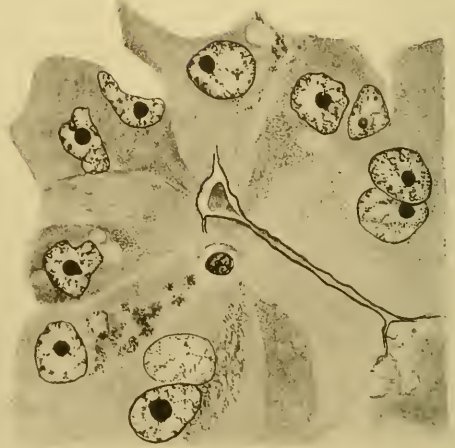
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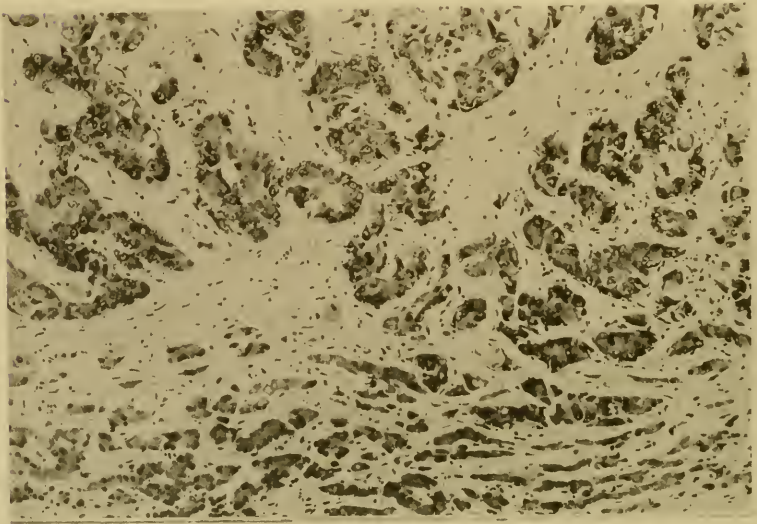
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5

bile capillaries and the secretion of bile. Therefore, it seems reasonable to assume that this tumor is a primary liver cell carcinoma.

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DESCRIPTION OF FIGURES 1 TO 5, PLATE V.

FIG. 1.— Mitosis in a tumor cell with bile capillary formation close to it.

FIG. 2.— Mitosis in a tumor cell.

FIG. 3.— Bile capillaries between tumor cells.

FIG. 4. Collection of tumor cells showing a bile capillary containing inspissated bile.

FIG. 5.— Photomicrograph of periphery of tumor nodule showing contrast between clumps of tumor cells and liver trabeculae. It also shows the tumor infiltrating the liver tissue.

XVII.

CHLOROMA.*

BY ALEX. M. BURGESS, M. D.

INTRODUCTION.

This communication is a discussion of chloroma, based on the detailed study of a case and a critical review of the literature on the subject. The material from another case has also been examined and the results of this examination are included in this paper. For this I am indebted to Dr. S. B. Wolbach. The study of chloroma is of value as an aid to the interpretation of the nature of leukemia.

The name chloroma has been applied to certain tumors of rare occurrence which are characterized by a definitely green color. The nature of this color has not been explained. These tumors have been described as connected usually with the periosteum, often involving the bone marrow, and sometimes occurring in lymph nodes and elsewhere in the body. Chloroma, then, has until fairly recently been considered a pathological entity, a definite tumor whose origin and nature, however, have been in doubt.

REVIEW OF LITERATURE.

There are in the neighborhood of sixty cases reported in the literature (eighty cases were found reported or referred to). Some of these reports are very meager, while others are detailed. In every instance the disease ran an acute course, usually lasting weeks or months, and only once reaching one and one-half years' duration. In the majority of instances the disease has occurred in children, in a few, in infants, and in a fair number in adults.

The occurrence of the disease in a few patients between the ages of thirty and fifty-two brings the average age up to

* Reprinted from "The Journal of Medical Research," Vol. XXVII., No. 2 (New Series, Vol. XXII., No. 2), pp. 133-155, November, 1912.

about twenty-three years. It has occurred in males more often than in females. The most constant symptoms are weakness, anemia, and a tendency to hæmorrhage. Exophthalmos has very frequently been present and has been found to be due to the presence of green tumors in the orbital fossæ. The diagnosis has been made during life in several instances by noting the presence of green nodules in the skin or elsewhere. At autopsy the tumors have been found in various parts of the body. In almost all of the cases nodules have been found attached to the periosteum, often that of the skull, ribs or sternum. Whenever thorough examination was made, the bone marrow was found to be markedly altered, though often not of a green color (green bone marrow noted in five instances). Three cases showed merely green marrow and no tumors elsewhere; one other, green marrow and periosteal tumors; while usually the distribution of the tumors was more general. Among the more common locations, other than the periosteum and bone marrow, where the tumors have been found, may be mentioned lymph nodes, kidneys, tonsils and skin.

In a few cases it was noted that the blood clot in the heart was distinctly greenish, and in one the sedimented leucocytes formed a green layer.

On account of its appearance under the microscope chloroma has, until recent years, been regarded as belonging to the tumors of lymphoblastic origin. Indeed, the microscopical diagnosis on many of the early cases is recorded as "lymphosarcoma." At present many pathologists believe that at least one type of chloroma arises from the cells of the lymphocyte series.

In every instance in which the blood has been examined the stained specimen has shown the picture of leukemia. The "white count" has usually been very high, the highest recorded count being 1,880,000. A few have shown nearly the normal figures and once a count of but 800 white cells was noted at a late stage of the disease, although the count had previously been 10,000 (Pribram). A high grade of anemia has usually been present. As in ordinary acute leukemia the white count as well as the blood picture has shown noticeable variations at different stages.

The predominating cell in the stained specimens has always been described as a large or moderately large mononuclear cell. The blood picture of small-cell lymphatic leukemia has

never been seen in chloroma. In thirty cases in which reports as to the examination of the stained blood are recorded, twelve show a high percentage (60 to 95 per cent) of mononuclear cells with nongranular cytoplasm and no granular mononuclears; eight show a preponderance of nongranular and a small proportion (less than 10 per cent) of granular mononuclears, while in ten cases the granular cells, myelocytes, are in excess and vary from 10 to 54 per cent (or are simply stated to predominate). Thus the records may be said to present in every instance either the picture of what is ordinarily called "acute lymphatic" leukemia, or of acute myelogenous leukemia; or some stage of variation between the two.

The same variation is seen in the cells of the green nodules. In the majority of the reports, indeed, the histological description is indefinite and incomplete. In a few, however, the cytoplasm of the cells composing the nodules is definitely stated to be nongranular. In a larger number nongranular cells are said to predominate, although mononuclears with eosinophilic or neutrophilic granules are noted as present. Furthermore, an equal number of cases are reported as showing a definite preponderance of cells containing either eosinophilic or neutrophilic granules. In some of these the cells are practically all granular.

While in most instances the predominance of cells with granular cytoplasm corresponds to a fairly high percentage of such cells in the blood, this is not true in all. Dock and Warthin state that the blood of their patient showed about 80 per cent of "marrow lymphocytes" and .4 per cent to 1.9 per cent of myelocyte, while the examination of the chloroma nodules revealed the fact that the majority of the cells contained eosinophilic granules.

The situation, then, allows of two interpretations:

1. That chloroma is of two types, (*a*) the lymphatic, corresponding to lymphatic leukemia, and (*b*) the myelogenous, corresponding to myelogenous leukemia.

2. That chloroma is not of two types, but is always myeloblastic. This view of the matter necessitates the classification of the large mononuclear cell with nongranular cytoplasm, which in the majority of instances predominates in the blood and in the tumors as a myeloblast; *i. e.*, a young undifferentiated cell of the myelocyte series which has not yet developed in its cytoplasm the granules characteristic of the myelocyte.

These two views on the subject of chloroma are also applicable to the ordinary acute leukemias. When the blood smear has been characterized by the predominance of the large non-granular mononuclear, the so-called "large lymphocyte" of Ehrlich, or "marrow lymphocyte," the diagnosis has ordinarily been acute lymphatic leukemia. Much evidence, however, has been presented to show that this nongranular cell is often in reality an undifferentiated myelocyte, or, as named by Nägeli, a myeloblast.

The question, then, of the histological nature and origin of the so-called "acute lymphatic" leukemia, whether or not chloroma nodules are present, resolves itself into a determination of the status of the so-called large lymphocyte. The confusion as to the true nature of this cell is apparently due to the fact that morphologically it resembles both the normal lymphoblast of the lymph nodule and the normal myeloblast of the bone marrow. In fact the only definite morphological difference between these two types of undifferentiated cells is the presence in the former of minute granules which Schridde has demonstrated by a special staining method. These granules, however, are not found in any but normal cells of the lymphocyte series and cannot be regarded as of value in differentiating the abnormal cells of acute leukemia. By reason of this close morphological resemblance the lymphoblast and the myeloblast have been regarded as identical by many observers and grouped under the term "large lymphocyte," those in the marrow being called "marrow lymphocytes." Studies of the normal tissues, however, seem to point strongly to the fact that these two types of undifferentiated cells are distinct.

If this is true it is probable that a given case of acute leukemia in which large, nongranular cells predominate is either acute lymphatic or acute myelogenous and never "mixed." In determining the type in a given case one must be guided by the presence of an increase of more highly developed cells of either the lymphocyte or the myelocyte series. In the absence of a sufficiently large proportion of such cells one must decide if possible by a comparative study of other similar cases in which some of the cells show more differentiation.

As far as the cases of chloroma are concerned, the view that they are all of one type and are characterized by the invasion of blood and tissues by one kind of cell in a more or less differentiated state is upheld by such a comparative

study of the case reports. As is evident from what has been already stated, the records of the blood examinations show that the cases form a complete series and that all variations between the picture characterized by a high percentage of nongranular mononuclears ("large lymphocytes"), and those in which myelocytes predominate, are present. The same applies to the cases of acute leukemia without chloroma nodules. To this may be added the fact that in all these cases the bone marrow is involved. The type cell, then, must be the myeloblast in various stages of development.

This view is also strengthened by the fact that the ratio of granular to nongranular cells is often noticeably altered in the same case. This is particularly well shown in a case reported by Kleineberger, in which the blood picture, after having remained for two years that of chronic myelogenous leukemia, changed to that ordinarily called acute lymphatic. The "large lymphocytes" increased from 7 per cent to 78 per cent and the myelocytes fell from 16 per cent to 6 per cent. The same author notes another case in which the "large lymphocytes" were increased from 6 per cent to 28 per cent following treatment with the X-ray.

Careful studies of the origin of normal myelocytes in the bone marrow have shown that the parent cells are characterized by large, usually vesicular nuclei, and by basic staining nongranular cytoplasm. In other words, they are practically indistinguishable morphologically from the cells of the germinal centers of the lymph nodule.

Thus, from a purely morphological standpoint, it seems probable that chloroma as well as most cases of acute leukemia are of myeloblastic origin, inasmuch as they present in varying proportions cells of the morphology of the myeloblast in all the different stages of its development into the myelocyte.

A certain amount of biological evidence has also recently been presented which seems to support this view. It has been shown by various tests that the polymorphonuclear leucocytes and their progenitors, the myelocytes of the bone marrow, contain an oxidizing substance. The most satisfactory of these tests is that known as "indophenol synthesis." The formation of indophenol, a blue dye (naphthol blue), takes place when dimethylparaphenylenediamine and alpha naphthol are brought together in the presence of an oxidizing agent. If to a mixture of these substances pus cells or bone marrow

cells are added, the dye is precipitated as blue granules in the cytoplasm of the cells. Schultze, Kriebich and others have shown that lymphocytes do not give the reaction. Opinions differ as to whether or not the reaction is given by the undifferentiated myeloblast. Dunn found it negative in a case of diagnosed "acute lymphatic" leukemia, while Schultze, on the other hand, reports two such cases which, on account of the presence of a slight degree of the reaction, he classes as myelogenous. Apparently the reaction is given only by the myeloblasts as they become somewhat differentiated. Its absence from the cells in a given case must then be considered purely negative evidence as to the origin of those cells, while, on the other hand, cells which give it even to a slight degree must be considered of the myelocyte series. The "indophenol synthesis" test for oxydase, then, has simply shown so far that certain of the cases formerly classed as acute lymphatic leukemia must be considered as myelogenous.

Further evidence bearing on the same subject is furnished by tests as to the presence of a proteid-splitting enzyme in the cells in cases of the so-called acute lymphatic type of leukemia. Enzymes of this nature, which act in an alkaline medium, have been shown to be present in pus, in the leucocytes of normal blood and polymorphonuclear leucocytosis, and also in chronic myelogenous leukemia. Cells from a normal lymph node, on the other hand, and also those from a case of chronic small-cell lymphatic leukemia, have, in the same way, been shown to have no such action in an alkaline medium. By applying the same tests to the blood in cases of acute leukemia of the "large lymphocyte" type, this digestion of proteid in an alkaline medium has been found to take place. Indeed, in one such case reported by Longcope and Cooke, the "large lymphocytes" comprised from 90 per cent to 94 per cent of all the white cells in the blood. The cells, then, in the cases of acute leukemia tested by this method showed a property which is present in myelocytes and polymorphonuclear leucocytes and is constantly absent from lymphocytes. While it is not possible to assume that true lymphatic leukemia of a large-cell type cannot occur, the above evidence points to the fact that many and probably most of the cases diagnosed as such are in reality myelogenous.

We may, then, conclude from a study of the literature (1) that chloroma is probably always myelogenous in origin

and (2) that most cases of acute leukemia, including a large proportion of those ordinarily diagnosed as lymphatic, are of the same nature.

As regards the question of the essential nature of myelogenous leukemia, the opinion of the writer is based especially upon the histological study of the cases reported in this paper, and of two similar acute cases which, however, did not show the green nodules. It has long been held that myelogenous leukemia is a malignant tumor whose origin is in the bone marrow, and whose type cell is the myelocyte or myeloblast. It is the belief of the writer that the following reports contain evidence strongly supporting this view.

REPORT OF A CASE.

Clinical Note.—G. C., male, 19 years old. Baker. Height, six feet five inches. Very well developed. Best weight, one hundred and ninety pounds three weeks before entrance. Symptoms began eight days before entrance to Boston City Hospital and consisted principally of weakness, backache, nose-bleed and cough with sputum. Entered hospital January 15, 1912. Duration in hospital two weeks. Temperature reached 105° F. three days before death. Blood examination January 25, four days before death:

Red blood corpuscles, 1,090,000.

Hemoglobin, 45 per cent.

White corpuscles — (at entrance to hospital was 58,600. Not recorded January 25).

Differential count:

Polymorphonuclear leucocytes	28.8
Eosinophiles	11.47
“Large lymphocytes”	3.7
Small lymphocytes	6.2
Myelocytes	49.6
Neutrophilic	31.0
Basophilic	13.0
Eosinophilic	4.0

Clinical diagnosis: Myelogenous leukemia.

Autopsy.—Twelve and one-half hours postmortem. Body is that of a well developed and nourished white man of very large stature. Features, hands and feet are large in proportion. There is apparently very little subcutaneous fat, as if the patient had recently lost weight. Muscular development good. Over both arms are scattered a number of petechial ecchymoses. There is noticeable fulness of the throat in the region of the thyroid. The right side of the sacrum bears a superficial ulceration about 3 cm. in diameter. Both big toes are markedly bent outward, and both first metacarpophalangeal joints are enlarged. Rigor mortis is present. There is little or no lividity of the dependent parts of the body and no edema. Pupils 7 mm. and equal. There is a moderate amount of

dried blood about the mouth and nose. The gums show a bluish discoloration near the edge along the lower incisors. No swelling or ulcerations. An area of softening is present between the two middle upper incisors. This bleeds on pressure.

Peritoneal Cavity.—The abdominal wall is 1 cm. in thickness and contains very little fat. The peritoneal surface is everywhere smooth and glistening. There is no fluid in the peritoneal cavity. The stomach and intestines are distended throughout. The appendix measures 7.5 cm. in length and lies free in the peritoneal cavity behind the cecum. Mesenteric lymph nodes are prominent and most of them are reddish to brownish red on section. (Those around the head of the pancreas are described with the pancreas.) The liver edge lies 5 cm. below the tip of the ensiform cartilage and 5 cm. below the costal border in the mid-clavicular line. The spleen lies well above the costal border and is freely movable. Diaphragm, left side, fifth rib; right side, fourth rib. On removing the sternum and costal cartilages section of the ribs allows the escape from their cut ends of a mixed brownish and reddish, puriform material. On the under surface of the sternum and costal cartilages are several masses of soft tissue which in consistence and appearance resemble somewhat flattened and enlarged lymph nodes, and are in color a delicate pea-green. They lie just to the right of the sternum or on its lower surface. No connection can be made out between them and the marrow of the sternum, which resembles that of the ribs.

Pleural Cavities.—Both cavities contain little or no fluid, but a moderate amount of fibrin is present over the surface of the upper part of the lower lobe of the left lung and the posterior portions of the upper, middle and lower lobe of the right lung.

Pericardial Cavity.—Contains about 100 cubic cm. of clear fluid. On the outside of the aorta, about 1.5 cm. from the aortic valves and just beneath the pericardium, is a nodule 8 mm. in diameter which is distinctly pea-green in color. It is of the consistence of a normal lymph node. A whitish area of about 3 cm. diameter (“milk spot”) lies over the right ventricle beneath the pericardium.

Heart.—Weight, 430 grams. All the chambers of the heart, especially those on the right side, are moderately dilated with fluid blood and post-mortem clot, some of which is of the yellow “chicken-fat” variety, but much grayer than that which is ordinarily seen. The myocardium is uniformly raspberry red and shows no lesions. Intima of coronary arteries smooth.

Measurements:

Tricuspid valve	14.5 cm.
Pulmonary valve	9 cm.
Mitral valve	12 cm.
Aortic valve	8 cm.
Left ventricle	1.1 cm.
Right ventricle	3 mm.

The aorta, just above the aortic valve, shows a few small, whitish, raised areas, none of them over 3 mm. in diameter. The anterior cusp of the mitral valve bears, half way between its base and its edge, a transverse, whitish, thickened area 1 cm. in length and 1 mm. in width.

Lungs.—The upper half of the lower lobe of the left lung, as well as the posterior portions of the upper, middle and lower lobes of the right lung, are dark in color, firm and noncrepitant. On section their cut surface is finely granular. On the diaphragmatic surface of the lower lobe of the left lung, near its posterior border and lying just beneath the pleural surface, are two firm, whitish nodules about 3 mm. to 4 mm. in diameter. Several small blood vessels meet at the points where these nodules are located. Peribronchial lymph nodes are enlarged, brownish red to greenish brown, and contain a moderate amount of carbon pigment.

Spleen.—Much enlarged. Weight, 480 grams. Its surface is smooth; color, raspberry red, and its consistence very soft. On section the cut surface is also raspberry red and is thickly studded with more grayish areas, about 2 mm. in diameter and resembling grains of sago. Connective tissue attached to the outside of the spleen at and near its hilum, and that around some of the larger vessels in the substance of the spleen, is of a delicate pea-green color.

Gastrointestinal Tract.—Stomach distended with light brown fluid. Duodenum and small intestine are distended throughout with gas and brown fluid. The large intestine contains a moderate amount of formed feces and some black, tarry material distributed in small masses and visible through the intestinal wall as dark areas less than 1 cm. in diameter. These last occur especially in the sigmoid and rectum.

Pancreas.—Is firm, yellowish, and normal on section. The lymph nodes near the head of the pancreas are enlarged and green in color.

Liver.—Greatly enlarged. Weight, 3,160 grams. Surface smooth. Color brownish red. Consistence normal. On section the color is brownish red (rather redder than the surface), and the cut surface is indistinctly marked with lighter mottlings. Every area of connective tissue surrounding divisions of the portal vein, hepatic artery, and bile duct is, in color, a delicate pea green. The gall bladder is filled with viscid brownish bile. Bile passages are not obstructed.

Kidneys.—Extremely enlarged. Weight, together, 640 grams. The left kidney is much the larger and weighs 410 grams. Its surface is nodular and shows through the capsule numerous dark, apparently hæmorrhagic areas in the centers of yellowish green nodules 2 mm. to 1.5 cm. in diameter. These nodules are raised 1 mm. to 2 mm. above the normal surface of the kidney and are closely crowded together. On section the cortex averages 1.2 cm. in width and is almost entirely replaced by areas of pea-green tissue, which are, for the most part, confluent and show small, hæmorrhagic areas at their centers. The pyramids are apparently not involved. The right kidney shows a similar condition, but the green areas are more discrete and are fewer in number.

Adrenals.—Negative.

Bladder.—Contains about 200 cubic cm. of slightly cloudy urine. There are a number of small ecchymoses in and near the trigonum.

Genital Organs.—Prostate not enlarged. It is negative on section. Seminal vesicles negative. Testes are negative on section, but the tubules do not string out as they do normally when pulled with the forceps.

Aorta.—Intima smooth throughout its length, except for the areas near the aortic valve noted above.

Retroperitoneal Tissues.—Retroperitoneal lymph nodes along the aorta are much enlarged and are pea green or green mixed with dull red in color. Just above the lower pole of the left kidney is a triangular mass of rather soft tissue of the same green color. It measures about 6 by 3 by 2 cm. and is uniformly green on section. A similar mass resembling a lymph node in size and shape occurs near the hilum of the left kidney. Retroperitoneal fat tissue is very scarce.

Posterior Wall of Thorax.—Protruding from each side of the spinal column opposite the bodies of the seventh and eighth dorsal vertebræ are two firm, dome-shaped masses, apparently about 3 cm. or 4 cm. wide and about 5 cm. in depth. The pleural surface over these is perfectly smooth. On section they are delicate pea green in color and firm in consistence. Further dissection of the tissues at each side of the spinal column shows that these green masses extend for 12 cm. or 13 cm. anteroposteriorly from the fifth or sixth dorsal vertebra to the attachment of the diaphragm. The green tissue extends between the transverse processes of the vertebræ and is continuous with soft material of the same color which lies over the dura, around the spinal cord, and is described later. Attached to the lower border of the seventh rib and about 7 cm. to the right of the median line is a mass of similar tissue whose green color is apparent when viewed through the overlying pleura. It measures about 3 by 1.5 by .8 cm. A similar but smaller mass is attached to another rib, just above and external to this one.

Organs of Neck.—Thyroid weighs 65 grams. Negative on section. Tongue shows marked hyperplasia of lymphoid tissue on its posterior third. The epiglottis and larynx bear a loosely attached fibrinous exudate, most marked over the vocal cords.

Bone Marrow of Femur is brownish red to grayish red and softened. Nowhere green. No fat.

Head (Dr. A. A. Hornor).—Scalp is covered with a heavy growth of black hair, and is fairly adherent to the calvarium. Calvarium not remarkable. Dura mater over the vertex of the brain is not noteworthy. Superior longitudinal sinus contains a small amount of fluid blood and "currant jelly" clot. Pia mater is everywhere translucent and easily separated from the brain. On removal of brain there is seen, immediately beneath the dura, in the angles formed by the posterior margin of the foramen magnum and inferior occipital crest on either side, an oval mass, 2 cm. in diameter, which is a light pea green in color and of the consistence of an ordinary lymph node. Several similar but smaller masses are seen attached to the under surface of the dura upon its removal.

Brain.—Weight, 1,580 grams. On section of the cerebrum the lateral ventricles are seen to contain about 10 cubic cm. of clear, colorless fluid; the right choroid plexus is not remarkable; the left choroid plexus presents a spherical mass, 4 mm. in diameter, which is delicate pea green in color. Further sectioning of the cerebrum, basal nuclei, brain stem and cerebellum reveals nothing noteworthy.

Spinal Cord.—On removal of the spinous processes and portion of the laminae there is seen, in the extradural space, a green mass extending from the seventh cervical to the fourth thoracic vertebra. This mass is of the consistence of bone marrow already described, delicate pea green in

color and directly continuous with the tumor already described as lying along either side of the vertebral column in the thorax. The pia covering the spinal cord presents rather large blood vessels. Section of the cord is negative.

Urine, obtained post-mortem, does not contain Bence-Jones' body.

ANATOMICAL DIAGNOSES.

Chloroma with multiple metastases.

Acute myelogenous leukemia.

Lobar pneumonia.

Acute fibrinous pleuritis.

Acute fibrinous laryngitis.

Chronic mitral endocarditis, arteriosclerotic type.

Arteriosclerosis (slight).

NOTE.—The green color described in the tissues in the above account fades completely in about ten minutes when exposed to the air.

Summary of autopsy findings:

1. Pea-green tissue in following situations:

Attached to sternum and ribs.

Lymph nodes.

Spleen.

Liver.

Kidneys.

Retroperitoneal tissues.

Posterior wall of thorax along vertebral column.

Dura.

Choroid plexus.

Spinal canal.

2. Whitish nodules on surface of lungs.

3. Lobar pneumonia and acute laryngitis.

4. Bone marrow of sternum, ribs, and femur brownish to grayish red and softened. Nowhere green. No fat.

5. Blood clot in heart much grayer than normal.

MICROSCOPICAL EXAMINATION.

Blood.—Examination of the blood seen in the vessels in the sections of various organs shows that most of the white corpuscles are mononuclears, usually with fairly abundant cytoplasm. In size the majority are somewhat larger than the average polymorphonuclear leucocyte. The following are the main types:

1. Cell containing a large vesicular nucleus and a relatively small amount of nongranular, basic-staining cytoplasm. A small proportion are of this type.

2. Cell similar to that just described, but having a few basic-staining granules in its cytoplasm. This type is also relatively uncommon.

The majority of the cells are about equally divided between the following three groups:

3. Cell with a moderate or large amount of cytoplasm which contains numerous weakly basophilic granules.

4. Cell similar to the last described, but containing in its cytoplasm one or more collections of fine eosin-staining granules or coarse eosin-staining masses.

5. Cells whose cytoplasm is filled with neutrophilic or eosinophilic granules.

The nuclei of the mononuclear cells vary from round or nearly round vesicular forms to irregular, reniform or lobed forms. Rarely a cell is seen which contains two distinct nuclei. Mitotic figures in the mononuclear granular cells in the blood stream are seen occasionally. All stages of transition between the granular mononuclear cells (myelocytes) and the polymorphonuclear leucocytes can be made out.

Examination of a blood film taken almost a week before death and stained with Wright's modification of Leishman's stain shows a much smaller proportion of granular mononuclear cells. The following differential count was made from this specimen:

Polymorphonuclear neutrophiles, 12.5 per cent.

Polymorphonuclear eosinophiles, 8.5 per cent.

Transitional cells between myelocytes and polymorphonuclears, 9 per cent.

Mononuclear nongranular cells, 36.5 per cent (small, 13; medium, 21; large, 2.5).

Mononuclear cells containing a few to numerous granules, 20 per cent (small, 1.5; medium, 16; large, 2.5).

Myelocytes (fully developed), 8 per cent.

Small lymphocytes, 7 per cent.

The relatively larger proportion of nongranular cells in this specimen is probably due to the fact that this film was several days old when stained.

Tumors (histological examination).—The green tumor tissue consists of mononuclear cells similar to those seen in the blood stream. Mitoses of these cells are numerous in most of the sections. A few of these cells are apparently nongranular, but most of them contain fine granulations in their cytoplasm. As in the blood, many contain small collections of eosinophilic granules near the nucleus. In some of the green tissue half the cells, or even more than half, are eosinophiles. In the

nodules in the kidney, for instance, about 50 per cent of the cells contain eosinophilic granules. Here, as elsewhere, areas occur where almost all the cells are eosinophilic. In many places cells are seen throughout the tumor tissue which are apparently degenerating as they stain rather diffusely with eosin. Polymorphonuclear cells are numerous in some parts of the tissues. In all the larger masses of tumor are found a number of large phagocytic endothelial leucocytes laden with eosin-staining cell detritus.

Heart.—Muscle apparently normal. A few small areas of infiltration, with cells such as those described above as predominating in the blood and comprising the tumor tissue. An occasional mast cell is present in the interstitial tissue. Mitral valve shows marked fibrous thickening.

Lung.—The alveoli are filled with a cellular exudate in which polymorphonuclear forms outnumber the mononuclear about three to one. Of the mononuclears almost all contain either neutrophilic or eosinophilic granules. The nongranular mononuclear cells, especially those with large vesicular nuclei, are very rare in the exudate, but are present in large numbers in the capillaries of the alveolar walls. Of the polymorphonuclears many are evidently immature and transitional between mononuclear and polymorphonuclear. Fibrin is present in varying amounts. Large numbers of streptococci are found in certain parts of the affected areas. Some of these have been ingested by polymorphonuclears and apparently rarely by mononuclear cells. Large phagocytic cells laden with carbon pigment and showing vacuoles in their cytoplasm (probably fat) occur in fairly large numbers in some of the alveoli.

Whitish Nodules on Lung.—These are made up of the same sort of cells as in the tissue of the green masses elsewhere, but are covered by a layer of dense fibrous tissue. This probably accounts for the absence of a green color in the gross.

Spleen.—The histological structure of the green tissue seen about some of the larger vessels corresponds to that of the tumor tissue elsewhere. Cells similar to those of the tumors and of the circulation fill the splenic pulp. Some of these cells have been ingested by phagocytic endothelial leucocytes. In some instances five or six apparently living cells have been so ingested. Many of the lymphoid nodules have been replaced and others markedly encroached upon by the tumor cells.

Liver.—The same kind of cells fill the periportal spaces and encroach, to a varying extent, upon the hepatic parenchyma. Eosinophiles comprise at least 50 per cent of these cells. Polymorphonuclear forms are numerous at the centers of the areas of periportal infiltration. Liver cells apparently normal.

Kidney.—About 50 per cent of tumor cells contain fine eosinophilic granules. Most of the nodules contain areas of hemorrhage. Kidney tubules and glomeruli are surrounded by infiltrating tumor cells. Mitoses common. Here, as elsewhere, an occasional large-granule eosinophile is seen.

Adrenal.—Negative.

Bladder.—A few mast cells.

Prostate.—Negative.

Testes.—Some edema. A few glands are producing spermatozoa. A few mast cells in interstitial tissue. Some small areas of tumor infiltration (eosinophilic cells 5 to 10 per cent).

Tongue.—Small area of tumor infiltration beneath epithelium.

Larynx.—Bears an acute fibrinous exudate, a thick layer of fibrin in the meshes of which are leucocytes, mostly polynuclear.

Diaphragm.—Negative.

Lymph Nodes.—Lymphoid tissue partly or completely replaced by tumor cells without destroying topography of the node. In the lobules of the nodes the tumor cells which lie at the periphery are, most of them, basophilic, some are non-granular, others contain weakly basophilic granules and many show small clusters of eosinophilic granules. Nearer the centers of the lobules more of the cells are full of fine eosinophilic granules. In the central portion of most of the lobules a large number of the cells are polymorphonuclear and a very large proportion of them are full of fine eosinophilic granules. Masses of eosin-staining detritus occur in this situation. It is in most cases ingested by phagocytic endothelial leucocytes. Mitoses are of frequent occurrence throughout. Apparently the less differentiated forms are those which occur at the periphery of the lobules.

Sternum.—Tumor cells fill the marrow and apparently invade the periosteum.

Bone Marrow of Femur.—Histologically the tissue resembles that of the green tumors, except that it contains very numerous and extensive areas of congestion of the capillaries with red blood corpuscles. This probably accounts for the

red rather than green color of the marrow in the gross. (This applies also to the marrow of the sternum.)

Tissues about Thoracic Vertebrae.—These tissues, which in the gross were green and firm in consistency, show muscle, fat and connective tissue infiltrated with tumor cells. Mitoses are fairly numerous. The majority of the tumor cells are granular and a fair proportion are eosinophilic.

Extradural Green Tissue in Spinal Canal.—Histologically like tumor elsewhere. Mitoses fairly numerous. The tumor possesses a very delicate connective tissue stroma and new-formed capillaries are present.

Dural Tumors.—Histologically like tumor tissue elsewhere.

Spinal Cord.—Areas of degeneration of nerve fibers with slight infiltration with endothelial leucocytes which are taking up the myelin. Some neuroglia proliferation. Lesion is bilateral, but not symmetrical.

Cerebrum.—Negative.

Choroid Plexus.—Tissue between vessels filled with tumor cells.

Cerebellum.—Negative.

Pons.—Negative.

Pituitary.—Negative.

SUMMARY OF MICROSCOPICAL FINDINGS.

Summarized briefly, the case presents the following features of interest microscopically:

1. Infiltration of normal structures and formation of independent nodules and masses by cells which resemble myelocytes in their various stages of development.

2. Multiplication of similar cells in the blood.

3. Evidence of the biological relation of these cells to the myelocyte — polymorphonuclear series, inasmuch as the more differentiated (granular) forms have been attracted into the alveoli of the lung as a part of the acute inflammatory exudate surrounding the bacteria.

Oxydase Reaction.—The oxydase reaction was found to be strongly positive in the cells of the tumor nodules and in the similar cells in the blood stream. The test was applied to frozen sections of tissue fixed in 10 per cent formalin solution.

In Dr. Wolbach's case the reaction was also positive, although the tissue had been preserved for three years in 10 per cent formalin.

Control tests on the following cells were performed:

Normal blood. Lymphocytes, negative; large mononuclears, negative; polymorphonuclears, positive.

Normal lymph node. Lymphocytes, all negative.

Miliary tuberculosis. Endothelial leucocytes, all negative.

Leiomyoma of uterus. Smooth muscle cells, negative; tissue mast-cells, positive.

Lymphoblastoma (lymphosarcoma). Tumor cells, negative.

The myeloblasts in various stages of differentiation in a case of acute myelogenous leukemia (formaldehyde tissue preserved one and one-fourth years) gave a positive reaction both in the blood vessels and in widespread infiltrations which were present in the kidney.

NOTE ON DR. WOLBACH'S CASE.

Summary of autopsy findings: Green masses in following locations:
Breasts.— Multiple nodules.

Attached to sternum and infiltrating intercostal muscles — several nodules.

Heart.— Posterior wall of left auricle and interauricular septum — three nodules.

Lymph nodes about head of pancreas, peribronchial and retroperitoneal.

Pancreas.— Two nodules in substance of tail.

Kidneys.— Multiple small nodules 2 mm. to 1.5 cm. in diameter.

Prevertebral Tissue.— Mass of firm green tissue measuring 5 by 3 by 4 cm.

No evidence of any lesion in liver or spleen.

Exophthalmos.— Marked.

NOTE.— Permission for this autopsy was obtained with great difficulty and the time limit was very short. Incision of chest and abdomen only was allowed. A complete examination was therefore impossible.

Blood.— The blood picture in general differs from that in the other case in some respects. The proportion of cells with relatively scant non-granular cytoplasm and large vesicular nuclei is much greater. The granular cells, which comprise almost half the mononuclears, are most of them weakly basophilic or neutrophilic. Eosinophiles are rare. Polymorphonuclear eosinophiles with fairly large granules are common. Cells with a peripheral arrangement of chromatin in their nuclei and basic cytoplasm are of fairly frequent occurrence. Some of these contain large eosinophilic granules. Cells in mitosis are not rare in the blood stream.

Tumors.— The cells of which the tumors are composed correspond to the mononuclears in the blood stream. They have as a rule relatively large vesicular nuclei and scant cytoplasm. About half of them contain weakly basophilic or neutrophilic granules. Mitoses are rather rare. In the kidney nodules, the percentage of granular cells is somewhat higher and the number of mitotic figures is larger.

The Color in Chloroma.— The nature of the green color which characterizes chloroma still remains in doubt. In the

cases reported it is variously described as "light green," "pea green," "greenish yellow," and "olive green." The presence of the color must be dependent upon the presence of the abnormal cells, as not only the nodules but blood clot and sedimented leucocytes were found to be green in certain cases, as already noted. The presence of red blood corpuscles apparently masks the green color as seen in the bone marrow and spleen of most cases. The idea has been expressed that the green color is dependent upon the presence of a large proportion of cells with nongranular cytoplasm. In this connection it may be noted that in the case reported by Rosenblum the tumors were whitish instead of green and were said to be composed practically entirely of granular cells, while the green color was limited to parts of the bone marrow. Some authors also have considered that the occurrence, in the stained specimens, of finely granular material which has been called "blood dust" is connected with the production of the green color.

The color in all cases is said to fade rapidly on exposure to light and air. Some report that it is to some degree preserved in formaldehyde solution. It has been reported also that the faded color could be restored by the application of reducing agents. Trevithick, on the contrary, found that it returned after treatment with peroxide of hydrogen, even after months in formaldehyde solution.

As already noted in the case herein reported, the color faded rapidly on exposure to air. It was, however, preserved to a very slight degree in certain of the tissues fixed by formaldehyde and by Kaiserling's method. Treated with hydrogen peroxide the formaldehyde tissue regained in a few seconds almost its original color. This color, however, faded in several minutes if the specimen remained in the peroxide of hydrogen solution. It was found, furthermore, that if the specimen to which the color had been restored by hydrogen peroxide was treated with hydrochloric acid the color disappeared and could be, to a certain extent, again restored by the addition of a solution of potassium hydroxide. Potassium hydroxide solution alone, also, restored the color to formaldehyde material, but much more slowly and less completely than did peroxide of hydrogen. The color, when restored, was not preserved by glycerine or "Kaiserling III." solution. A strong solution of sodium bicarbonate preserved the color in one instance for several weeks. Sodium bicarbonate alone restored

the color effectively to some of the tissue after a treatment of twenty-four hours or more. The color does not seem to be markedly affected by exposure to diffuse daylight. There was found to be no evidence of solubility of coloring matter in alcohol or ether.

Tissue from Dr. Wolbach's case, which had remained in 10 per cent formalin solution for over three years, also acquired a distinctly brighter green on the application of hydrogen peroxide.

Neoplastic Nature of Leukemia.—In the case reported in this article the cells possess the following characteristics which justify their classification as true tumor cells:

A. Rapid multiplication without evidence of a physiological reason for it.

B. Invasion and destruction of normal structures.

C. Ability to cause a vascularized stroma to be formed from the normal fibroblasts and capillaries to support and nourish them (the invading cells). This is shown in the sections of the soft masses of tumor tissue found in the spinal canal in the extradural space. The case, then, may be said to present the picture of a rapidly growing neoplasm which probably arose somewhere in the bone marrow, as its cells resemble myelocytes, and which has invaded the blood and the tissues forming tumor nodules in various parts of the body.

This case differs from other cases of acute myelogenous leukemia only in the extent of invasion of the normal tissues. "Leukemic infiltrations" are common in the acute cases of myelogenous leukemia and sometimes definite nodules are found. The writer has noted in one acute case of recent occurrence marked invasion of the interstitial tissues of the kidneys and of the fat and connective tissues about the lymph nodes by the myelogenous cells. Furthermore, chronic myelogenous leukemia differs from acute in that the cells are more fully differentiated and, perhaps on this account, are less capable of invading normal tissues other than blood and bone marrow. In view of these considerations we may say that myelogenous leukemia is a tumor whose type cell is the myeloblast, and which therefore arises in all probability somewhere in the bone marrow. The term myeloblastoma, suggested by Dock and Warthin for certain cases of chloroma, is a suitable one to include all types of myelogenous leukemia. In the slowly growing forms the cells become highly differentiated,

resembling the normal myelocytes of the bone marrow, and apparently can invade blood and bone marrow only. In the more rapidly growing forms the tumor cells are usually, many of them, relatively undifferentiated and can invade various tissues and form larger or smaller tumor masses.

SUMMARY AND CONCLUSIONS.

1. The tumors to which the term chloroma has been applied do not constitute a pathological entity. On the contrary, they represent a part of the pathological process in one type of acute myelogenous leukemia.

2. Chloroma has not been shown to have any relation to true lymphatic leukemia.

3. Myelogenous leukemia is a blood metastasis of a true tumor whose origin is in the bone marrow and whose cells invade the blood stream and bone marrow.

4. In certain cases in which the cells are, most of them, relatively undifferentiated and multiply rapidly, other tissues are invaded. Sometimes in this way definite nodules or masses of tumor cells are formed. These masses, if green, are called chloroma.

[My thanks are due to Dr. F. B. Mallory for his interested supervision of this work and to Dr. S. B. Wolbach for his kindness in lending me the material from his case.]

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XVIII.

THE INFECTIOUS LESIONS OF BLOOD VESSELS.*

BY F. B. MALLORY, M. D.

By the infectious lesions of blood vessels I mean those which are due to the immediate presence of pathogenic micro-organisms of one kind or another. The lesions may be slight and even insignificant or so severe that complete occlusion or destruction of the vessel involved may be the final result. Their histological structure and appearance vary as greatly as in the lesions occurring in other organs and tissues. They depend on the nature of the infecting micro-organisms and of these there is, of course, a great variety. The severe acute lesions due to the so-called pus-cocci, terminating in complete destruction of the vessel wall and usually in abscess formation, are of frequent occurrence and the easiest to find. They are often very numerous and occur in a great variety of organs and tissues.

The most interesting lesions, at least from a histological point of view, are those which are due to micro-organisms which die out readily after infection of the vessel wall is started or are only mildly toxic and persist more or less indefinitely. It is particularly to lesions of this milder type that I desire to call your attention.

After a few preliminary and fairly obvious statements I shall present what I have to say briefly from the biological point of view, attempting to show the way in which the various lesions of infectious origin in blood vessels arise and the peculiarities of their development. I will then demonstrate by means of lantern slides made from photomicrographs as many of the points to which I have called especial attention as I am able to.

The anatomy of blood vessels requires here but a passing word. Each of them consists of a tube lined with flat endothelial cells. The lumen of the tube may vary in size from

* A lecture delivered before the Harvey Society of New York City, December 18, 1912.

a capillary to the aorta. All the vessels except possibly the smallest are strengthened by a layer of fibroblasts outside of the endothelium. These fibroblasts produce fibrogliia and collagen fibrils and also elastin which appears in the form of fibrils and plates. The larger vessels contain smooth muscle cells. The manner and proportion in which these two types of cells, the fibroblast and the smooth muscle cell, are combined in the walls of blood vessels vary greatly, depending apparently on the function of the vessel.

The nutrition of blood vessels is furnished on the inner or lumen side by imbibition from the circulating blood and on the outside by small vessels which penetrate the wall a certain distance.

It is obvious that blood vessels may be infected either on the outside from acute processes adjoining or surrounding them, or from within in consequence of organisms having obtained access to the circulating blood and causing a septicemia. Some infectious agents invade the blood vessels only from within, but most of them, like the streptococcus and the tubercle bacillus, may attack the vessels from either side.

The injury which may be produced in a vessel wall varies greatly, from changes so slight that they may be difficult to demonstrate up to partial or complete necrosis. It may be followed by hemorrhage, by aneurism formation, by inflammatory exudation and repair, or by complete destruction.

The inflammatory reaction to infections of the blood vessels is the same as in other organs and tissues. It may be due (1) to the organism itself, (2) to the toxin derived from it, or (3) to the injured cells. It is sometimes easy to distinguish these three forms of reaction but at other times it is not, as they are often variously combined.

The counteraction of an injurious agent and its toxin and the removal of necrotic cells is delegated to the serum and the chemical substances which it contains, and to four of the cellular elements of the blood, the polymorphonuclear and endothelial leucocytes, the lymphocytes and more rarely the eosinophiles. Mast-cells seem to play practically no part at all. On these cells, so far as we know, rests the main defence of the body. They counteract injurious toxins of all sorts, so far as they can, by the production of chemical substances or antibodies of different kinds. Only those leucocytes are attracted to an infectious agent which are able to render the most effective

service. Some organisms call out only the polymorphonuclear leucocyte, others only the endothelial leucocyte, while still others attract these two or even all four forms in various proportions.

Collections of leucocytes sometimes occur beneath the lining endothelium of blood vessels. They are usually due to toxins diffusing from organisms in the surrounding tissues and filtering through the vessel wall. Thus, polymorphonuclear leucocytes often accumulate in large numbers in this location, especially in arteries; for instance, in the lung in lobar pneumonia, in the meninges in acute infectious processes, and in many different organs and tissues in infections due to the glanders bacillus (Fig. 8). Sometimes endothelial leucocytes, and often lymphocytes, may collect in the same situation. These three types of leucocytes may be combined in different proportions.

As a result of the inflammatory reaction to many organisms much fibrin is often formed from the exuded serum or from that circulating within the vessel. It is useful in some respects, but is always a complicating and often a very injurious element. Unless many polymorphonuclear and endothelial leucocytes are attracted and the fibrin is dissolved by ferments eliminated by them, it stimulates fibroblasts to proliferate. It does not of itself attract leucocytes. The fibrin may form in abundance in the wall of a vessel, in the perivascular tissue, or within the lumen as a thrombus which may partially or completely occlude it. Of its harmful effects I shall speak in a moment.

Hemorrhage is a frequent complication of infectious lesions, especially when the organism, as, for instance, the anthrax bacillus, is strongly toxic (Fig. 7). Injury of the wall may permit hemorrhage so quickly that little else is seen but the blood around the vessels, and death may occur before much of any inflammatory reaction has had time to take place.

Repair of blood vessels takes place as in other tissues. If only a part of the wall has been injured, and little or no fibrin has formed, almost complete restoration may take place. The necrotic cells and their fibrils are gradually dissolved by the action of polymorphonuclear and endothelial leucocytes and absorbed. The hardest materials to dispose of are the elastic and collagen fibrils. They become surrounded by endothelial leucocytes, which often enlarge and may become

multinucleated, forming foreign body giant cells just as they do around necrotic bone, where they are known as osteoclasts.

As already stated, fibrin often forms a great complication in the repair of blood vessels. It may be present in the wall or outside of it, or within the lumen. If it is not dissolved by the fermentative action of the leucocytes attracted into the lesion it stimulates proliferation of the fibroblasts adjoining it. This power of fibrin to stimulate proliferation of fibroblasts is perhaps not so generally understood and appreciated as it should be. Its action is probably only nutritive. The fibrin which forms on the surface of the lung or heart in acute infectious processes, involving the pleural and pericardial cavities, is commonly replaced by the growth into it of capillary blood vessels and fibroblasts (the process usually termed organization). In many situations, however, this replacement of fibrin is performed entirely by fibroblasts, especially in those locations where no capillary vessels are near the fibrin, as over the surface of the spleen and within the larger blood vessels. In this way thick plates of fibrous tissue may be formed on the spleen and large thrombi organized within arteries and veins (Fig. 1).

The elevated plaques of fibrous tissue on the intimal surface of the aorta are usually, perhaps always, formed in this way (Fig. 2), and not as the result of regeneration, or, as Thoma once taught, in consequence of nature's tendency to fill up depressions in the vessel wall and preserve an even lumen. Depressions or erosions on the inner surface of the aorta will persist for years unless fibrin forms over the surface and stimulates the growth of fibroblasts to bridge over the defect. Occasionally two or more layers of fibrin form at different times over the same site. The connective tissue replacing them can be recognized like the layers marking the annual growth of a tree.

So far as thrombi within the vessels is concerned, the lining endothelial cells quickly cover over the surface of any fibrin within the lumen and dip down into any fissures present in it, but, so far as my observations go, never form capillaries which penetrate the fibrin. Such vessels arise only from the capillaries entering the vessels from without.

Only the endothelial cells and the fibroblasts in a blood vessel regenerate. Apparently the smooth muscle cells never do. Under certain conditions, as in syphilis, continued injury

and regeneration of fibroblasts often lead to marked increase of the connective tissue. The increase of connective tissue in the walls of blood vessels due to proliferation of the fibroblasts as the result of continued or chronic injury, and therefore to be classed as regenerative, and that due to direct stimulation by fibrin is of the greatest importance to these structures, because it may greatly impair or completely destroy their function of carrying nutrition to the tissues.

Infectious lesions due to a septicemia tend to be distributed more or less uniformly throughout the body. They may be few in number or very numerous. Acute generalized miliary tuberculosis furnishes a very good example of the distribution and varying number of the lesions which may be produced, because they all start as lesions of the blood vessels, chiefly the capillaries, although we do not ordinarily think of them in that way.

Lesions of the vessels start wherever the micro-organisms find lodgment and as a rule enlarge as long as the infectious agent thrives and the patient lives. Some organisms develop and produce lesions in certain organs and tissues more readily than in others; thus the staphylococcus aureus in the kidney and heart and the tubercle bacillus in the lung and liver. Some organisms infect only capillaries and sometimes only those in certain organs, while others, like the leprosy bacillus, may start in vessels of any character.

The streptococcus perhaps more than any other of the pus producing organisms causes, when present in the circulation, a variety of lesions, which may vary even in the same patient from simple necrosis followed by repair, because the cocci die out, to complete destruction of the wall and abscess formation. Four cases due to organisms which were not very virulent, and which readily died out in the lesions they caused, will illustrate the character and termination of the infectious lesions of the milder type.

In the first, a girl eight years old, death occurred from acute purulent arthritis secondary to scarlet fever and diphtheria and due to the streptococcus pyogenes. Multiple acute infectious lesions of the blood vessels were found in the heart (Fig. 3), kidneys and liver. They all showed practically the same kind of histological change, necrosis of a part of the vessel wall, with considerable fibrin formation and the accumulation of numerous polymorphonuclear and endothelial leucocytes

and some lymphocytes in the perivascular tissue adjoining the site of the injury. But little fibrin was deposited as thrombus within the vessels. It was either in the wall or on the outside. In one of the arteries in the heart the injured wall had yielded to the blood pressure, forming an aneurism of infectious origin (Fig. 4).

The second patient was a male, nineteen years of age, who died from typical acute articular rheumatism of two weeks' duration, complicated at the end with lobar pneumonia. There was a slight mitral endocarditis in addition. Numerous lesions were found in the heart, occurring in the walls of the arteries and extending into the surrounding connective tissue. They were milder in type than in the preceding case and evidently in the stage of repair. Some showed considerable fibrin and numerous endothelial leucocytes (Fig. 5). Strands of collagen fibrils left by necrotic fibroblasts were surrounded by them in places. Alongside some of the vessels focal cellular areas of connective tissue, due to proliferation of the fibroblasts, were present, surrounded and infiltrated by a few lymphocytes (Fig. 6). These are the lesions considered characteristic of acute articular rheumatism. They do not differ from those already described except in intensity.

In a third case, recently reported by Palfrey and Ayer, the patient, a woman aged thirty-three years, died from chronic infectious endocarditis of the mitral valve, due to a streptococcus corresponding in type to that described by Poynton and Payne. The heart showed a number of infectious lesions in the walls of the blood vessels and in the surrounding connective tissue. Some were acute and others healing. The important point is that all stages in the development of lesions corresponding to those described in the first two cases were present.

In the liver and kidneys and in muscle tissue from a case of periarteritis nodosa reported by Longcope, some of the lesions are acute and exactly like those described in case one. Others are in all stages of repair. The lesion is peculiar only in one respect: Evidently much fibrin was formed within and outside of the vessels and has led to marked proliferation of fibroblasts, so that the walls of some of the vessels are greatly thickened. Many are also completely occluded by thrombus formation.

These four cases illustrate very clearly the different types of infectious lesions produced in blood vessels by organisms,

usually varieties of the streptococcus, which are not too virulent and which die out quickly after causing an injury, thus giving opportunity for repair. It seems fair to conclude that the lesion often found in the heart in acute articular rheumatism is characteristic, not of that disease, but only of an acute infectious process which started in the walls of blood vessels and extended to the adjoining connective tissue. Similar lesions may occur in the heart in other infections which have not presented the symptoms characteristic of acute articular rheumatism.

Certain other micro-organisms which more or less frequently infect blood vessels require especial consideration, because the lesions which they cause differ in some respects from those which I have already described. They are the bacilli of glanders, tuberculosis and leprosy, and the treponema pallidum. In order to understand fully the lesions which they produce it will be necessary to describe briefly the nature of the inflammatory reaction which each of these infectious agents brings about in the human body.

The reaction to the glanders bacillus differs least from that of the ordinary so-called pus-cocci. The micro-organism usually multiplies abundantly in the lesions and gives rise to a strong toxin which gradually causes necrosis of all the surrounding cells. The inflammatory reaction in the tissues consists of an exudation of serum and of numerous polymorphonuclear and endothelial leucocytes. Usually but little fibrin is formed. The result is abscess formation. The distinguishing and apparently characteristic feature of the inflammatory reaction, which renders it possible to recognize the lesions histologically with at least a fair degree of certainty, is the presence of large cells with large lobulated or sometimes with multiple nuclei. These large cells develop from the endothelial leucocytes apparently as the result of the action of the toxin derived from the bacilli. The toxin seems to affect these leucocytes in much the same way that the diphtheria toxin sometimes affects epithelial cells, producing direct division of the nuclei and increase in the amount of cytoplasm.

The blood vessels are often infected in glanders. When they are involved from without, the vessel wall may gradually undergo necrosis and polymorphonuclear leucocytes may collect in large numbers beneath the lining endothelium (Fig. 8). The characteristic lesions are formed, however, within the

vessels, most often in veins, by the immediate presence of the bacilli. The cellular reaction of polymorphonuclear and endothelial leucocytes around them, together with the formation of more or less fibrin, lead to obstruction of the vessels and often to extension of the thrombotic process along them. Involvement of the surrounding tissue by direct extension and abscess formation is the usual termination. The interesting point is that the large multilobulated cells already described are usually present in these cellular thrombi.

The inflammatory reaction to the tubercle bacillus is best studied in cases of acute miliary tuberculosis. As a rule all stages in the development of the lesions can be found. The bacilli escaping into the blood stream from some primary focus, whether they are free or within polymorphonuclear leucocytes, are quickly taken up by the endothelial cells lining the blood vessels, usually the capillaries, less often the larger vessels, the veins and arteries. The liver furnishes perhaps the best material for study, but the process can be followed in the lung and other organs and occasionally even in the capillaries of the glomeruli of the kidney.

The bacilli do not cause, certainly at first, any apparent injury to the endothelial cells. They often multiply within them, although never to the extent that leprosy bacilli do, except in avian tuberculosis. The toxin emanating from them attracts endothelial leucocytes which collect in the sinusoids and surround the cell originally infected, forming the early miliary tubercle, which at this stage cannot be told histologically from that developing around a dead and dissolving typhoid bacillus except by the presence of the tubercle bacilli. The tubercle bacillus may multiply rapidly and gradually invade, apparently by direct growth, these endothelial leucocytes in its immediate neighborhood, or more often multiply slowly, so that each lesion contains only a few or even only a single organism. The miliary tubercle represents the limit to which the attractive influence of the toxin extends out from the bacilli in the lesion. The function of the endothelial leucocytes is reparative. They are the cell best fitted to counteract chemically the toxin derived from the tubercle bacillus.

Sometimes polymorphonuclear leucocytes are attracted in small or large numbers around the tubercle bacillus, especially with certain strains which multiply rapidly.

The further progress in the development of the miliary

tubercle is as follows: The endothelial leucocytes attracted around the cell originally infected gradually occlude the sinuoids and cut off the circulation, thus diminishing the supply of nutrition to the cells in the center of the lesion. The liver cells undergo necrosis first and then the more resistant fibroblasts and endothelial cells. The products from these necrotic cells also attract leucocytes to dissolve and remove them and to counteract the injurious substances arising from them just as happens, for example, around a bland infarct. As soon as necrosis of fibroblasts has occurred proliferation of the surrounding fibroblasts begins. Apparently they are the only cells which regenerate. They soon form a zone around the tubercle, provided the latter is not developing too rapidly, under which circumstances no regeneration may occur. The periphery of the tubercle is usually infiltrated with a certain number of lymphocytes and occasionally with a few eosinophiles. Some of the endothelial leucocytes usually fuse to form one or more foreign body giant cells, apparently around the fatty substances derived from the tubercle bacilli. Similar giant cells will develop in experimental lesions produced by injecting the fat or wax extracted chemically from cultures of the bacillus.

Fibrin often forms in considerable quantity in miliary tubercles after necrosis has occurred and may play some part in the repair of the lesion by stimulating the fibroblasts to proliferate.

It is evident from this statement that in the early miliary tubercle the so-called epithelioid cells are endothelial leucocytes. In the older tubercles many of them may be fibroblasts and if the bacilli die out the endothelial leucocytes disappear and continued regeneration of the fibroblasts results in the so-called fibrous tubercle which finally terminates in a small mass of hyaline fibrous connective tissue.

The necrosis in tuberculosis is certainly due in large part, if not entirely, to endothelial leucocytes attracted by the toxin infiltrating the blood and lymph vessels and lymph spaces and cutting off nutrition. As a rule the tissue cells disappear first, the leucocytes last. On this account the landmarks in necrotic tissue of tuberculous origin are usually more or less completely obliterated.

The lymphocytes in and around tuberculous lesions are perhaps attracted more by products derived from the necrotic cells than from the tubercle bacillus.

The miliary tubercle goes on developing peripherally in more or less perfect, spherical form practically only in the brain. The reason of this is that in most organs and tissues the tubercle bacilli quickly gain entrance to blood or lymph spaces or epithelial-lined cavities and spread rapidly through them.

It is the anatomical structure of organs and tissues which is chiefly responsible for the great variety of gross appearances presented by the lesions due to the tubercle bacillus. Compare, for example, the caseous mass of a solitary tubercle of the brain with the fibrinopurulent type of meningitis which may be produced as soon as the same organism reaches the surface of the brain and gains access to the abundant nutrition furnished in the wide lymph spaces of the meninges.

The reaction in these larger cavities of various kinds is essentially the same as in the miliary tubercle. The endothelial leucocyte is the most important cell in counteracting the injurious influence of the tubercle bacillus and its toxin, although when the organisms multiply rapidly the polymorphonuclear leucocytes may play an active part. Serum often collects in considerable amount and much fibrin may be formed from it, as for instance in the alveoli of the lung. This fibrin often leads to organization within the alveoli just as it does in the pleural and pericardial cavities. Much of the fibrous tissue in old tuberculous lesions of the lungs is evidently of this origin. Naturally some of it is later destroyed again if tubercle bacilli remain behind after organization because they start new lesions. Lymphocytes often mingle in the exudation in considerable numbers.

With this understanding of the reaction of the body to the injurious effect produced by the tubercle bacillus, the tuberculous lesions of blood vessels may be presented in a few words. Lesions in the capillaries are very common and have already been covered in the description of the miliary tubercle. In the terminal veins of the spleen the endothelial leucocytes sometimes collect in such large numbers as to distend and occlude them. They form what may be called endothelial cell thrombi.

The larger blood vessels, both veins and arteries, are most often infected from without by direct extension of tuberculous lesions surrounding them. Such infections of the vessels can frequently be found in the meninges and in the lungs. The bacilli may invade the intima and give rise to miliary tubercles lying beneath the endothelial lining, or more commonly to

the formation of thrombi consisting of fibrin or of endothelial leucocytes or of a varying combination of these two elements. In the fibrinous thrombus the tubercle bacilli may develop in great numbers and later, by softening and rupture of the thrombus, be discharged into the circulation (Figs. 9 and 10). Evidently fibrin under certain conditions is an excellent culture medium for this organism. Infection of the larger blood vessels from the intimal side is rare but possible; miliary tubercles have been found even on the inner surface of the aorta.

Tuberculous lesions of the arteries and aorta have, in rare instances, caused weakening of the wall and aneurismal formation.

The tuberculous lesions of blood vessels may be summed up in a few words. They are very common in capillaries and lead to complete occlusion of them. They occur fairly frequently in the small veins and arteries especially in certain parts of the body, such as the lungs for instance, and are dangerous because the tubercle bacilli may multiply in great numbers and by escaping into the circulation give rise to acute generalized miliary tuberculosis. They rarely lead to the formation of an aneurism in arteries or the aorta, from which again large numbers of bacilli may be discharged into the blood.

The leprosy bacillus is a very mild infectious agent. It does not cause much more of an inflammatory reaction than so much inhaled carbon; that is, it acts almost mechanically, giving little or no evidence of the production of a toxin to destroy either itself or the cells in which it lives. It has, however, the deadly gift of multiplying almost indefinitely so long as the supply of nutrition is abundant.

The leprosy bacilli occur chiefly in endothelial leucocytes which represent the inflammatory reaction to the organisms. They also invade some of the fixed tissue cells. Thus they occasionally grow into the epithelial cells of the epidermis and of the hair follicles, gradually spreading from one cell to another. They occur more frequently in the epithelium lining the coil glands of the skin and occasionally free in masses within the lumina. From these sources by desquamation and perspiration they may be set free from the body. In none of these situations do they cause any inflammatory reaction. Occasionally they invade fibroblasts and fat cells, and a few apparently unquestionably occur free between the cells and

fibrils of the tissues. The chief damage produced is done by the endothelial leucocytes which often contain the bacilli in large numbers, dozens to hundreds. The leucocytes crowd the tissues everywhere and utilize much of the nutrition brought to the part. They invade the nerves, carrying the bacilli with them, and gradually lead to atrophy and disappearance of the nerve fibers and consequent anesthesia.

It is difficult to determine how much injury and destruction of the fixed cells occur in leprosy and how it is produced, whether by the direct action of the bacilli or as the result of pressure from the presence of so many endothelial leucocytes, because the cell changes are so exceedingly slow and slight. Nerve fibers disappear and fat cells undergo necrosis, leading to the formation of giant cells around the fat set free. The connective tissue gradually increases in amount as the result apparently of regeneration following injury of some sort or other.

The changes in the blood vessels are not prominent. Bacilli are very often present in small to large numbers in the lining endothelium of capillaries, veins and arteries. They attract no leucocytes as tubercle bacilli would do and produce no visible effect of any sort. They do not even seem to invade the adjoining tissue. Another type of lesion is due to the presence of endothelial leucocytes filled with bacilli in the vessel wall which may in consequence be considerably thickened. The bacilli sometimes invade the fibroblasts near them. Such vessels may in time show much thickening of their walls with narrowing of their lumina and disappearance of the smooth muscle cells. The atrophy of leprosy nodules and scar tissue formation may perhaps be dependent in part at least on sclerosis of blood vessels.

The lesions of syphilis are the most difficult of all the infectious processes to obtain a clear and positive understanding of, for two reasons. Material for histological study is hard to obtain and it is practically impossible at present to show the infectious agent, the *treponema pallidum*, in the same preparations with the inflammatory reaction. The organism must be demonstrated in a parallel series of sections in which the cell changes often show but poorly. Moreover, the Levaditi method often fails to stain the spirochetes, especially in perfectly fresh tissue, and antisyphilitic treatment may have caused the disappearance of the organisms before the tissue

used for study was obtained. I can only present the views I have arrived at as a result of the study of such material as has been available.

Evidently the *treponema pallidum* is an organism of slight virulence. It produces a very mild toxin which is locally diffusible and is absorbed along the lymph spaces and vessels. The primary direct injury caused by it must be exceedingly slight. The organism has to be present, certainly as a rule, in large numbers to produce any visible injury. The lesions it causes develop so slowly that regeneration is usually a marked feature and may be more prominent than the inflammatory exudation. On the other hand, injury of secondary origin due to obstruction of blood vessels is usually a marked feature of the later manifestation of the disease.

The *treponema pallidum* may invade any tissue in any number. It occurs often in the epidermis, but is found especially in connective tissue wherever present, in organs and tissues in general and in the walls of blood vessels. In connective tissue it lies in the minute spaces between the cells and especially between the collagen fibrils, where great numbers of the organisms often accumulate.

The inflammatory reaction on the part of the body is not easy to determine with certainty. The organisms may be fairly numerous in the epidermis with no reaction around them. Then polymorphonuclear or endothelial leucocytes or both make their appearance between the epithelial cells. As they increase in number the *treponemata* are likely to disappear, although sometimes they increase in number. Evidently the epithelium is slowly injured in some way or other because ulceration often occurs.

In connective tissue in like manner the organisms are often present in enormous numbers with little or no inflammatory reaction around them. As a rule, however, the tissue is infiltrated with varying numbers of endothelial leucocytes and lymphocytes; many of the latter occur in the form known as plasma cells. Sometimes polymorphonuclear leucocytes are also added to the exudation, although they are rarely numerous.

In the primary lesion or chancre the injury and reaction, except for surface ulceration, do not, under ordinary conditions, go beyond this stage. The inflammatory infiltration with leucocytes and lymphocytes does not represent, however, all that has occurred in the lesion. There has also been a con-

siderable proliferation of fibroblasts, regenerative in character, evidently the result of injury produced slowly and gradually by the mild toxin derived from the spirochetes. Some of the fibroblasts have undergone necrosis and others have proliferated in order to replace them. The regeneration as usual has been in excess of the actual number of cells destroyed, so that an increased amount of fibrous tissue has resulted.

After a certain fairly definite period of time the primary lesion undergoes repair, apparently as the result of acquired local immunity. It does not tend to spread indefinitely as a tuberculous lesion, for example, would do. The treponemata die out probably as the result of the production of effective antibodies either by the leucocytes in the circulation or more probably by those attracted into the lesion. The leucocytes gradually disappear from the lesion, the ulceration heals, and the connective tissue contracts, leaving in the end a scar.

In the later lesions of syphilis the same kind of cell reaction is repeated, but it is often complicated by evident and frequently extensive necrosis forming the so-called gummata. Much if not all of this necrosis follows as the result of occlusion of blood vessels and cutting off of the blood supply. In syphilis of the liver, for instance, it is often possible to find both types of lesions present; extensive areas of necrosis and a diffuse inflammatory process showing more or less occasionally marked infiltration with polymorphonuclear or endothelial leucocytes. In addition there is always increase in the amount of connective tissue of regenerative origin. Apparently there is no essential difference in the actual injury and reaction caused by the treponema in the primary and later lesions which it produces. On the other hand it is exceedingly difficult to determine whether the leucocytes are attracted by the organism, its toxin, or the products of the destroyed cells.

The actual tissue lesion in congenital syphilis differs from that in the acquired disease apparently only in degree. The treponemata are usually much more widely distributed, and are present in relatively much larger numbers; but they produce as a rule less inflammatory reaction and rarely lead to obstruction of blood vessels and consequent necrosis. On the other hand, the proliferation of fibrous tissue is usually abundant and ordinarily the most marked feature of the process.

Syphilitic lesions of the blood vessels are of frequent occurrence and of great importance. The treponemata are present

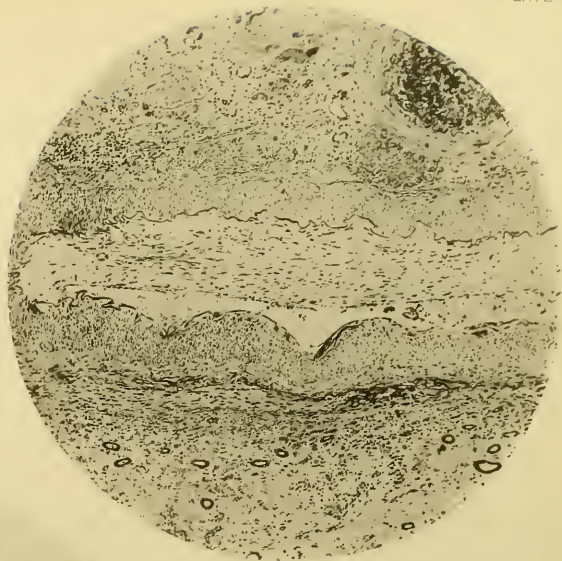
more often in the adventitia than in the intima, but both locations are often infected at the same time. The media may thus be involved from either or from both sides. The intima on one side or all around may rapidly thicken up and cause narrowing or complete occlusion of the lumen. The thickening is due to an infiltration of endothelial leucocytes often combined with lymphocytes and occasionally with polymorphonuclear leucocytes. In addition the fibroblasts proliferate. (Fig. 13.) The cell changes correspond with those produced elsewhere by the treponemata. As soon as the blood supply is cut off completely, necrosis occurs and more or less fibrin is formed.

In the adventitia much the same reaction takes place (Figs. 11 and 12). As soon as necrosis occurs, probably as the result of occlusion of blood vessels, numerous endothelial or polymorphonuclear leucocytes or both are attracted by the products or the disintegrating cells. Occasionally some of the endothelial leucocytes fuse around substances hard to dissolve, such as elastic fibrils, masses of fibrin, or fat and its products, to form foreign body giant cells.

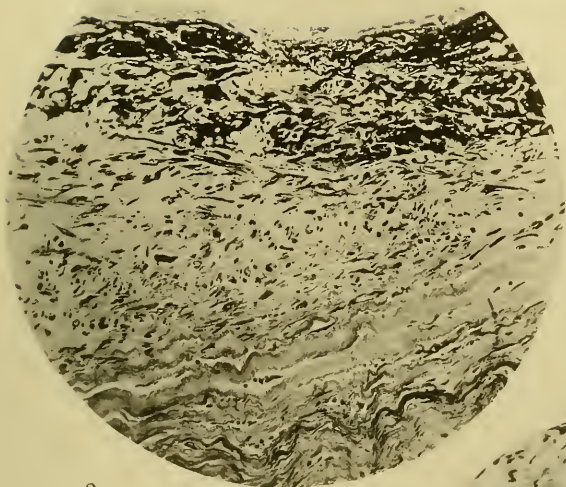
Syphilitic lesions of the aorta have always attracted much attention and excited a great deal of discussion, but the demonstration of treponemata in them, often in large numbers, has decided in favor of their actual occurrence. The organisms may invade the aorta directly from without or through the nutrient vessels of the wall, but certainly in many instances they infect the vessel from the intimal side. The lesions (Figs. 14 and 15) often extend deeply into the underlying tissue, causing necrosis and frequently softening with subsequent repair and scar formation or yielding of the wall in the form of aneurisms. Fibrin often forms in abundance and later may undergo more or less extensive organization.

As already stated, necrosis occurs in tuberculous lesions usually owing to complete infiltration of the tissues with endothelial leucocytes, which block all the smaller vessels, causing necrosis and disappearance of the tissue cells before they themselves undergo necrosis. Consequently all the landmarks have been obliterated. In syphilis, on the contrary, the necrosis results largely or entirely from the obliteration of blood vessels, and the tissue which undergoes necrosis may show only moderate inflammatory infiltration and proliferation of fibroblasts or none at all.

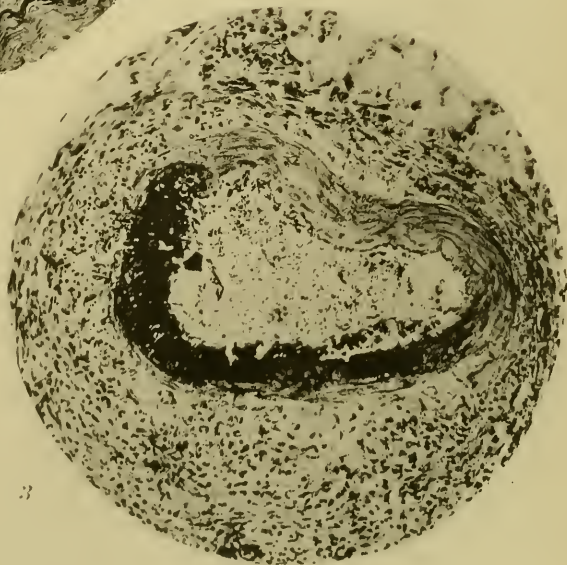
NOTE.—The lecture was illustrated by fifty-nine lantern slides made from photomicrographs, of which fifteen are reproduced here.

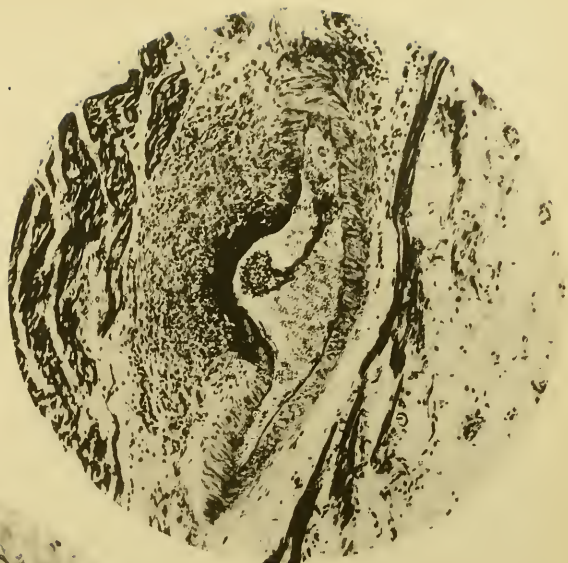


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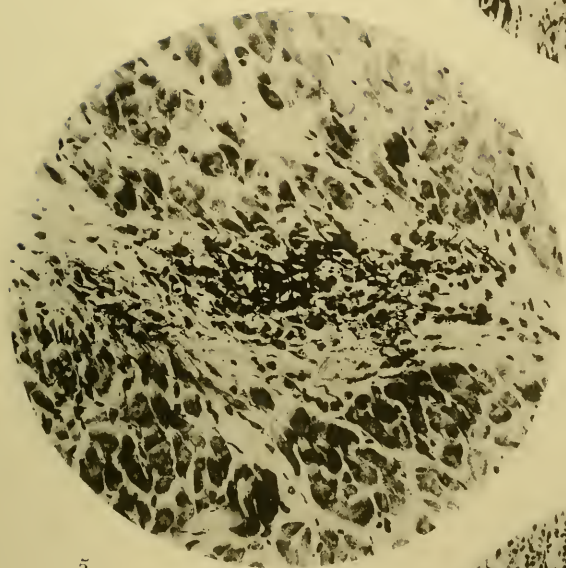


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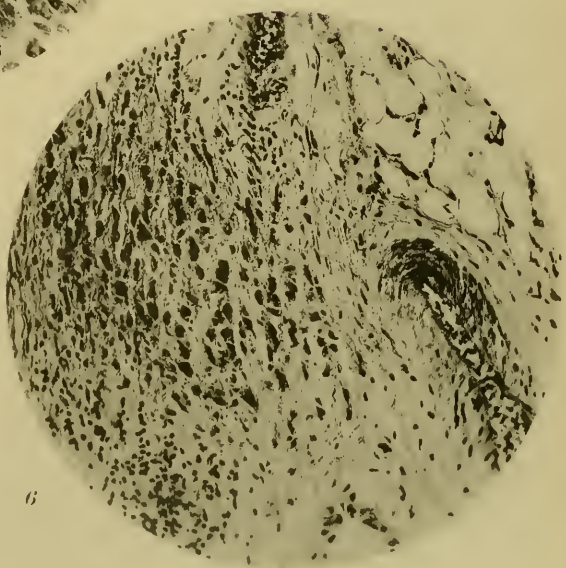




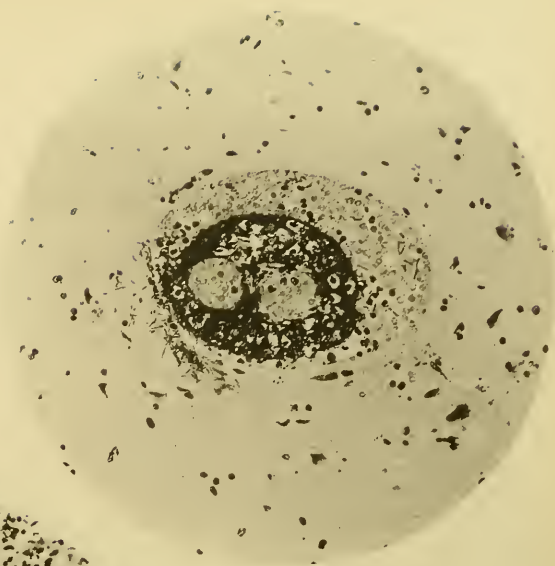
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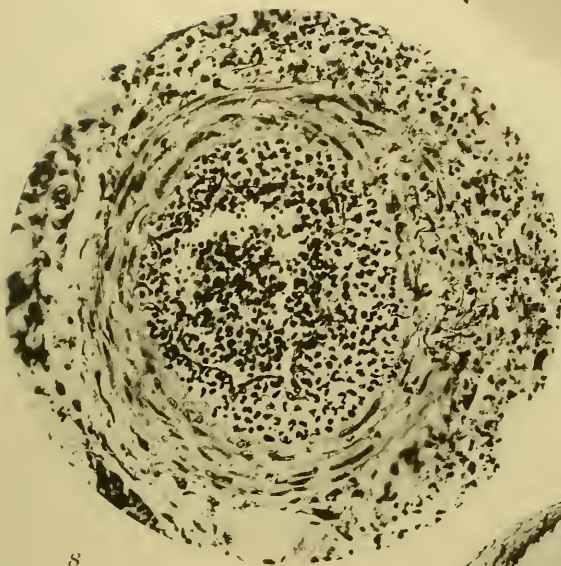
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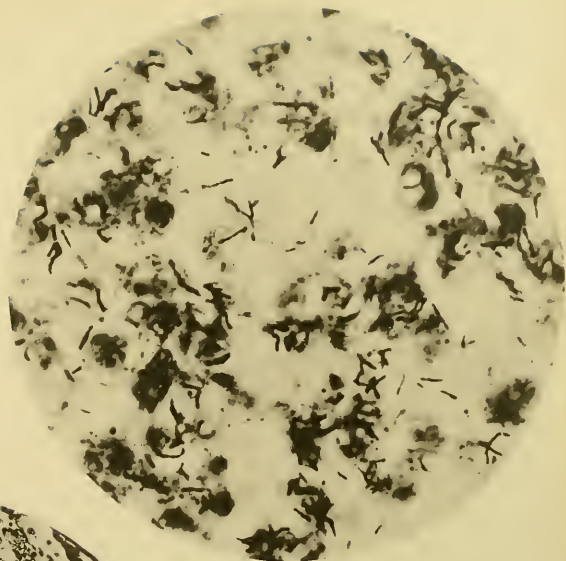
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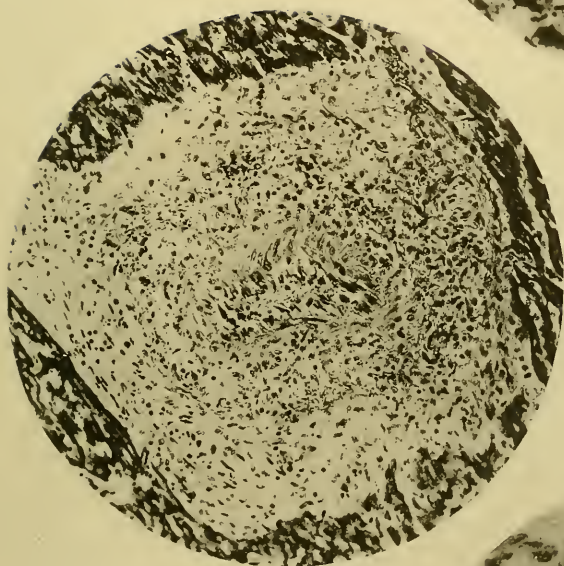
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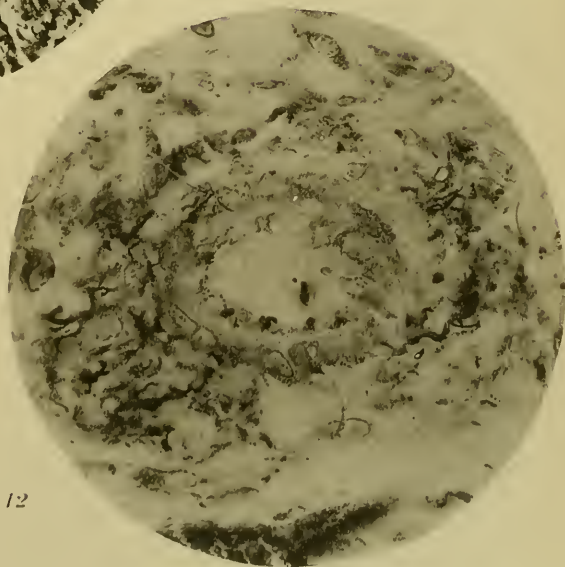
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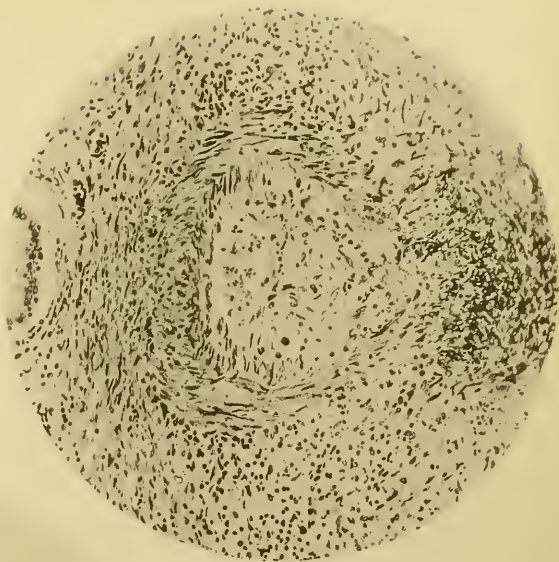
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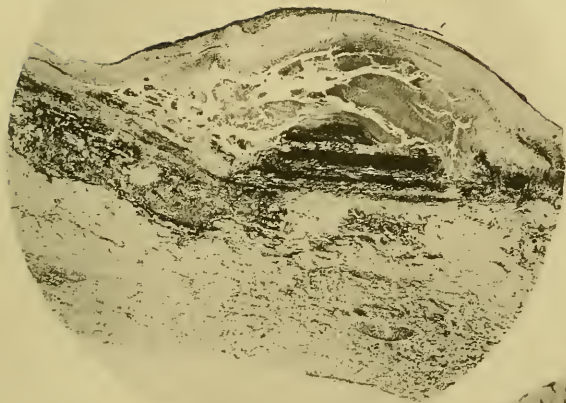
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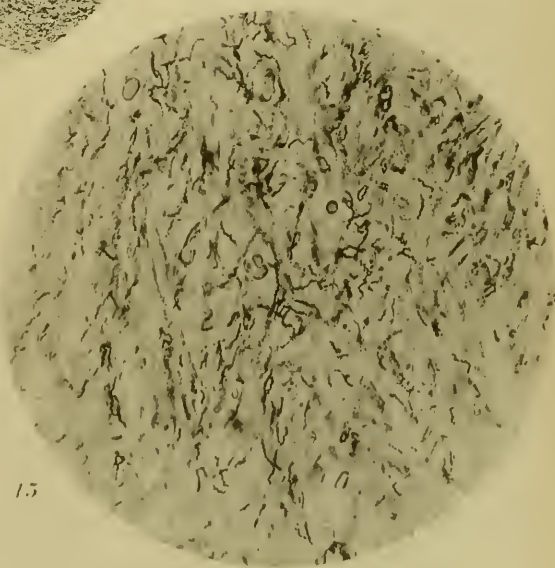
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DESCRIPTION OF PLATES.

FIG. 1.—Organized thrombus in an artery in the kidney, showing replacement of the fibrin by fibroblasts.

FIG. 2.—Organizing thrombus of aorta. The fibrin is stained black. The light spaces in it are fibroblasts which are gradually replacing it.

FIG. 3.—Acute infectious lesion in wall of artery in heart from a girl eight years old, dying from acute purulent arthritis, due to the streptococcus pyogenes and secondary to scarlet fever and diphtheria.

FIG. 4.—Acute infectious lesion in wall of artery of heart from same case as Fig. 3. The wall is yielding, forming an infectious aneurism.

FIG. 5.—Lesion in heart from a man nineteen years old, who died from acute articular rheumatism. The lesion shows fibrin and endothelial leucocytes.

FIG. 6.—A later lesion from the same case as Fig. 5, showing replacement of muscle fibers in part of wall of artery by scar tissue and a focal lesion in the neighborhood, consisting of endothelial leucocytes and fibroblasts with a few lymphocytes at the periphery.

FIG. 7.—Cross section of two branches of an artery in the cerebrum. The wall is infiltrated with numerous anthrax bacilli which are extending into the surrounding tissue. The vessel is surrounded by a zone of hemorrhage.

FIG. 8.—From a case of glanders. Cross section of artery in lung, showing numerous polymorphonuclear leucocytes collected beneath the lining endothelium and at one point where the muscle cells seem to be destroyed, extending through into the surrounding tissue.

FIG. 9.—Cross section of artery of lung, showing a softened adherent tuberculous thrombus filled with polymorphonuclear leucocytes.

FIG. 10.—High power field from Fig 9, showing the numerous tubercle bacilli present in the softened thrombus.

FIG. 11.—Cross section of artery in the heart from a case of congenital syphilis, showing marked inflammatory infiltration around the vessel.

FIG. 12.—From the same case of congenital syphilis of the heart as Fig. 11, stained by Levaditi's method to show the numerous spirochætes present.

FIG. 13.—From a case of acquired syphilis in an adult. The figure shows a cross section of an artery in the liver. The lumen is nearly occluded by inflammatory tissue in which is one distinct mitotic figure.

FIG. 14.—Syphilitic endoarteritis due to acquired syphilis in an adult; elastic tissue stain. The section shows marked thickening of the intima with necrosis extending deeply into the underlying muscle coat.

FIG. 15.—From the same case as Fig. 14 to show the numerous treponemata pallida present. (From a case which has been reported by Dr. J. H. Wright of the Massachusetts General Hospital.)

XIX.

THE LUETIN TEST.

BY W. P. BOARDMAN, M. D., AND L. W. GORHAM, M. D.

The skin reaction for syphilis introduced by Noguchi as a result of his successful cultivation of the *treponema pallidum* has been applied in a small series of cases at the Boston City Hospital in conjunction with the Wassermann test. The patients were obtained through the courtesy and cooperation of the First Medical Service, the Skin and the Nerve Services.

Fifty-two persons were inoculated, of which number thirty-five were syphilitic or parasyphilitic and seventeen were suffering from some other disease. The luetin was sent to us by Noguchi from the Rockefeller Institute. It consists of a suspension of several strains of *treponema pallidum*, grown according to Noguchi's method in ascitic fluid agar under anaerobic conditions, and killed by heating for thirty minutes at 60° C. This emulsion when placed under the dark field microscope reveals many dead pallida. Cultures made from it are sterile and the testes of rabbits when inoculated do not show lesions of syphilis.

The technique of applying the test is simple. For the purpose of control some of the culture medium, free from pallida, is injected into the skin of the upper right arm, while the test proper is given on the left arm; 0.07 cc., diluted one half with normal saline solution, is injected intradermically in each case, the skin having been previously sterilized.

The types of the skin reaction as given by Noguchi and confirmed by our experience are as follows:

1. *Negative Reaction.*—A normal or nonsyphilitic person when injected with luetin and the control will show in the great majority of cases after twenty-four hours a slight area of redness about the point where the needle entered the skin. There is no induration. A tiny papule of two to four mm. may be felt in some cases which, however, begins to subside after two to three days, leaving no induration behind.

2. *Positive Reaction.*— This may be of two kinds, (*a*) papular or (*b*) pustular. In (*a*) a large, red, indurated papule 7 mm. to 10 mm. in diameter usually appears in twenty-four to forty-eight hours. The size of the papule gradually increases during four to five days and then begins to recede. Noguchi has found a persisting induration in cases of secondary syphilis under regular mercurial treatment. In (*b*), the pustular form of reaction, the course of events is similar, except that the inflammatory process proceeds further and instead of a beginning subsidence on or about the fifth day pustulation takes place. The pustules break down, their contents escape, a scab forms and induration remains for some weeks or longer.

A "torpid form" of reaction occurs in rare instances. After a period of ten days or more the sites of apparently negative reactions may suddenly flare up and produce pustules.

No marked constitutional effect following the injections have been noted. Noguchi reports a slight rise of temperature in most positive cases lasting for a day. In several tertiary cases there was noted by him general malaise, loss of appetite and diarrhoea. We have seen no serious disturbances in any of the cases tested.

There is one apparent difficulty occasionally met with in making the test. The skin of certain persons having tertiary syphilis is noted for being very susceptible to injury. This fact, well known to dermatologists, has been designated as "Umstimmung" by Neisser. Among three hundred and fifteen cases of syphilis Noguchi found that the control emulsion as well as the luetin caused an intense reaction in fifteen. Twelve of these were tertiary cases. These control reactions were usually less intense and the induration more transient. We have observed Umstimmung in six cases, all of which were tertiary. In one instance the control site was decidedly more indurated than that of the luetin. It seems reasonable at present to call these reactions positive, as they have occurred only in syphilitics thus far.

TABLE OF CASES.

	Number of Cases.		Luetin.	Wassermann.
Primary syphilis.....				
Secondary syphilis.....	11	{ Positive reaction.....	1	11
		{ Negative reaction.....	10	
Tertiary syphilis.....	14	{ Positive reaction.....	11	7
		{ Negative reaction.....	3	7
Latent syphilis.....	4	{ Positive reaction.....	3	2
		{ Negative reaction.....	1	2
Parasyphilis.....	6	{ Positive reaction.....	4	3
		{ Negative reaction.....	2	3
	35			
Diseases other than syphilis.....	17	{ Positive reaction.....	* 1	
		{ Negative reaction.....	16	17

* Negro, diagnosis, psychasthenia. Syphilis could not be absolutely excluded.

No cases of primary syphilis were injected.

Eleven cases of secondary syphilis, all showing symptoms, were tested. Of these only two had been under treatment for more than a month. These two cases had been well treated with mercury and salvarsan. The Wassermann was positive in all eleven cases. The luetin test was positive in only one instance. These results agree with Noguchi's report of two positive tests in twenty-seven secondary cases slightly treated with mercury.

The results in tertiary and latent syphilis show a strikingly high percentage of positive reactions in favor of the luetin as against the Wassermann, but do not present as high a percentage as do Noguchi's cases where ninety-four out of ninety-eight tertiary cases gave positive luetin tests.

In the parasyphilitic group, including aortic disease due to syphilis, four positive reactions out of six were obtained. The results are not so remarkable in this field.

The series of seventeen cases of diseases other than syphilis all gave negative reactions, except in one instance where the reaction was faintly positive in a negro. He gave no definite history, but syphilis could not be absolutely excluded.

Three cases in the series may be cited as examples: A patient with a tertiary skin lesion had received three doses of salvarsan, his Wassermann becoming negative. The luetin then gave a

strong pustular reaction. A second patient, the mother of a syphilitic child, showed a negative Wassermann. Luetin was definitely positive. Mercury relieved the headache of which she complained. Here the test served as a guide for treatment when the Wassermann was negative. A third patient had a tertiary lesion of the soft palate with a negative Wassermann. The luetin test was positive with pustule formation.

The above series is too small to permit of drawing conclusions of value. In a general way Noguchi's claims can be supported, although the results obtained in tertiary and latent syphilis are less striking than his were. The skin reaction apparently supplements the Wassermann reaction at this late period of the disease. The test must still be regarded as in the experimental stage and as requiring more extended application and study. As an index of a cure in syphilis it may possibly prove of great value in prognosis.

XX.

THE ORIGIN OF THE GIANT CELL IN TUBERCULOUS LESIONS.*

BY ALEX. M. BURGESS, M. D.

This communication reports the results of an experimental study of the origin of the giant cells which form around the fat-like substance produced by tubercle bacilli. The fatty material was injected subcutaneously into guinea pigs and the resulting lesions were studied microscopically at various time intervals. In addition, for the sake of comparison, various other substances such as calcium salts, fat, fatty acids and cholesterol were injected in a similar manner and the lesions produced examined in parallel series of sections. The results obtained are similar in character but differ in detail. They all indicate strongly that these foreign body giant cells originate in only one way, by fusion of endothelial leucocytes.

The following is a brief outline of the methods employed: Half-grown guinea pigs were selected, the hair over a small area (usually just behind the right shoulder) was clipped close with scissors and the skin painted with tincture of iodine diluted one-half with alcohol. The substance to be injected was then taken up in a sterile needle of fairly large caliber and injected subcutaneously after passing the needle forward beneath the skin to the region of the axilla. When using the fat of tubercle bacilli the needle was filled by packing in the substance at the pointed end with the aid of a wire which exactly fitted the needle, and then emptied into the subcutaneous tissues by introducing the wire at the opposite end, and with it expelling the substance. For injecting the other substances a hypodermic syringe was used. With the exception of the olive oil, they were ordinarily taken up in

* Reprinted from "The Journal of Medical Research," Vol. XXVII., No. 2 (New Series, Vol. XXII., No. 2), pp. 125-131, November, 1912.

sterile normal saline solution. Often more than one injection was made into the same guinea pig. The animals were killed at varying periods after the injections, as, for instance, one day, two days, three days, four days, seven days, eleven days, seventeen days, and twenty-two days. The substances used were as follows:

1. Calcium phosphate.
2. Calcium carbonate.
3. Cholesterin.
4. Stearic acid.
5. Palmitic acid.
6. Olive oil.
7. Fat-like substance extracted from the bodies of tubercle bacilli.

The histological reaction to the various injected materials may be summarized briefly as follows:

Calcium Salts.—In the case of both calcium phosphate and calcium carbonate there is first seen a reaction to the mechanical injury. The reaction is evidenced by polymorphonuclear leucocytes and serum surrounding and infiltrating the injected material. At the end of twenty-four hours a few fibroblasts in the neighborhood of the mass can be found in mitosis. Proliferation of the endothelium of nearby capillaries and lymph vessels begins at about the same time, and by the third day mitoses in endothelial cells are fairly numerous. In some instances mitotic figures can be found in endothelial cells which are still a part of the vessel endothelium. A cellular zone consisting of fibroblasts and endothelial leucocytes is gradually formed around the injected mass. Mitotic figures in the fibroblasts and endothelial cells of this surrounding zone are fairly numerous. The majority of the endothelial leucocytes of this zone have doubtless appeared as the result of emigration from the blood and lymph vessels. Such leucocytes are normally present in the circulating blood and to a slight degree in lymph. The presence of mitotic figures, however, in the cells of the endothelium of nearby capillaries and lymph vessels is evidence that a local production of endothelial leucocytes is also taking place. Outside the cellular zone around the injected mass endothelial leucocytes containing fat droplets occur in small numbers. They undergo mitosis and sometimes cells with two nuclei are thus formed; but never the larger, multinucleated cells.

Before the end of the first week practically all of the polymorphonuclear leucocytes have disappeared from the injected material apparently by necrosis. In the zone surrounding the injected mass it can be seen as early as the third day that endothelial leucocytes have begun to fuse around small areas of granular material—presumably outlying masses of the calcium salt. In this way small giant cells are formed. It is possible to find, grouped about such small particles of injected material, endothelial leucocytes between some of which the cell outlines are still visible, while between others of the group fusion has apparently taken place. After fusion the nuclei often gather more or less at one side of the giant cell away from the granular material around which they have fused.

If the giant cell only partially surrounds a mass of calcium salts its cytoplasm may be spread out in the form of a thin layer or network for a short distance over the surface of the mass. Thus the large masses soon have many giant cells in contact with them. At the end of the first week giant cells are very numerous. Mitoses in the giant cells were never observed.

After the first week the process is apparently simply a gradual penetration of the mass of calcium salts by endothelial leucocytes and fibroblasts with fusion of the former about the larger masses of the salts to form giant cells. New-formed capillaries also penetrate the mass. We have, then, regeneration of capillaries and fibrous tissue from the capillaries and fibroblasts of the tissues adjoining the injected material. The whole process may be considered simply organization of the mass plus giant cell formation after the first week.

Cholesterin.—The reaction to cholesterin injections is similar to that just described. Penetration of the mass by endothelial leucocytes and fibroblasts is apparently much more rapid and a mass of closely packed giant cells is formed. These are separated by fibroblasts and new-formed capillaries. Some of the giant cells are large syncytial masses surrounding many crystals of cholesterin and containing several hundred nuclei.

Stearic and Palmitic Acids.—Injections of these substances also lead to histological changes, all the stages of which are similar to those described in case of the calcium salts.

Olive Oil.—Injected olive oil remains for a long time in dilated spaces in the tissues. Some of these spaces are appar-

ently lymphatics. The initial reaction to injury is slight, apparently because the olive oil is fluid, diffuses somewhat through the tissues, and causes relatively little mechanical injury. Endothelial leucocytes slowly gather about the dilated spaces and take up the fat. There is no marked fibroblastic proliferation. After ten days one giant cell containing fat and showing six nuclei was found. The specimen taken after seventeen days shows the dilated spaces to be lined with fat-laden endothelial leucocytes. Several small giant cells containing fat are also present.

*Fat-like Substances Extracted from the Bodies of Tubercle Bacilli.**—The reaction to injected masses of this substance differs from that which occurs in case of the calcium salts principally in this respect, that the exudation of polymorphonuclear leucocytes persists and the formation of giant cells is delayed. The inoculated material is surrounded and invaded by an acute inflammatory exudate consisting of polymorphonuclear leucocytes and serum. Endothelial leucocytes penetrate this mass and ingest many of the polymorphonuclears. There is however, relatively little regeneration of fibroblasts and capillaries in the tissues about this mass of injected material and leucocytes. The specimen removed on the fifth day shows, near the injected material, a number of pieces of hair which were accidentally introduced. Around these hairs giant cells are forming, as in the case of calcium salts, cholesterol, etc. In the same section, however, around the fat-like injected substance, there is no hint of giant cell formation. By the fifteenth day a well-marked fibroblastic capsule has formed about the injected material and a few small giant cells are present. The twenty-five day specimen shows fairly numerous giant cells. The mass of inoculated substance is still surrounded and infiltrated with polymorphonuclear leucocytes and some phagocytic endothelial leucocytes. The cellular zone about this mass consists of fibroblasts and capillaries, endothelial leucocytes, and giant cells. Polymorphonuclear leucocytes infiltrate this zone in large numbers. Many of the endothelial leucocytes contain globules of hemosiderin and others have ingested polymorphonuclear leucocytes. Some of the giant cells contain polymorphonuclear leucocytes, and rarely endothelial leucocytes filled with

* I am indebted for this material to Dr. P. A. Levene, from whom it was originally obtained by Dr. F. B. Mallory.

hemosiderin. Mitoses of endothelial leucocytes and fibroblasts are rather rare in this cellular zone.

The longest period after which examination of tissues at the site of the injection was made is three months and ten days. This specimen shows a much widened cellular zone about the mass of injected material and leucocytes. The leucocytes in this mass, as in the earlier specimens, are principally polymorphonuclear, but phagocytic endothelial leucocytes are also very numerous. The cellular zone resembles that seen in the twenty-five day sections except that it is much wider and contains many more giant cells. Polymorphonuclear leucocytes are still very numerous in this zone. There is very little hemosiderin in the endothelial leucocytes. Apparently the process of organization of the area occupied by the injected material is slowly taking place. Concomitantly, giant cells are being formed about the larger particles of the material. The reaction in this series of injections is apparently analogous to that which takes place in case of the calcium salt injections. The difference lies in the persistence of the polymorphonuclear leucocytes and the delay of organization and giant cell formation. It seems probable that while calcium salts, cholesterin, etc., are bland substances which act merely as foreign bodies, the fat-like substance from the tubercle bacilli acts as a chemical irritant and continuously attracts polymorphonuclear leucocytes. The process of giant cell formation is apparently analogous in the two series. Morphologically these giant cells do not differ from those found about any foreign body.

It is also true that the giant cells found about particles of the injected fatty substance from tubercle bacilli do not differ morphologically, in location, or in distribution, from those found in the lesions of tuberculosis. The preponderance of polymorphonuclear leucocytes in the exudate in the experimental lesions cannot be regarded as in any way weakening the analogy between these lesions and those of tuberculosis, when it is remembered that in lesions in which tubercle bacilli are present in very large numbers the exudate may consist principally of polymorphonuclear leucocytes. In such lesions it is probable that large quantities of the fat-like substance are present.

SUMMARY AND CONCLUSIONS.

1. Foreign body giant cells are formed about masses of calcium phosphate, calcium carbonate, cholesterin, stearic or

palmitic acid when injected subcutaneously into guinea pigs. They arise by the fusion of endothelial leucocytes about the injected material, as in the case of other foreign bodies. The process is identical with that observed by Forbes * in the formation of giant cells about injected masses of agar, and about cornified epithelium in epidermoid carcinomata.

2. Injections of a bland fat (olive oil) which is fluid at body temperature, are taken up gradually by endothelial leucocytes, a few of which occasionally form small giant cells, probably by fusion.

3. The formation of giant cells about the fat-like substance extracted from the bodies of tubercle bacilli is by the same process of fusion.

4. It is very probable that the giant cells which occur in the lesions of tuberculosis are also foreign body giant cells formed in the same way about particles of the same fat-like substance produced by the bacilli in the lesion.

* "Journal of Medical Research," 1909, Vol. XX., pp. 45-53.

XXI.

DISEASE OF THE MYOCARDIUM, WITH ILLUSTRATIVE CASES.

BY HENRY JACKSON, M. D.

Heart disease is a very comprehensive term and is the name applied to disease in several parts of the heart. Except that new terms are always objectionable unless absolutely required to describe a new disease, the word cardiopathy as used by Dr. Lewellys Barker might be urged as desirable. Dr. Barker uses the word cardiopathy as he does nephropathy. He criticises the word nephritis in that most types of renal disease do not represent an inflammation either acute or chronic of the kidney, but often a degenerative process which may be the end result of some pre-existent inflammation. The same criticism applies even more to disease of the heart; chronic endocarditis does not imply the existence of a chronic inflammatory disease of the valves of the heart, but a deformity of the valves dependent upon a pre-existing acute inflammation or a slow degenerative process which has extended to the valves from the aorta. Leaving endocarditis out of the question, the term myocarditis is still less justified. Acute inflammation of the myocardium occurs, though rarely, and even then usually as the local manifestation of a general septic process. It can hardly be spoken of as one of the types of heart disease. On the other hand, disease of the myocardium represents a very large class, and it is, by far, the most important of all forms of heart disease.

The importance of myocardial disease is still more emphasized when we consider the relation of the heart muscle to valvular disease. When the valves are diseased the heart muscle is called upon for extra work to overcome the failure which would otherwise result. As long as the heart muscle can and does respond to the extra work called for we have the stage of "compensation" and the individual does not suffer. In "decompensation" the muscle fails to respond to the demands

of the economy and the individual then begins to suffer from his valvular heart trouble. This dependence of the heart upon the integrity of the heart muscle gives rise to the dictum, "Valvular heart disease becomes of importance to the individual only when, and in so far as, the heart muscle is involved."

The only form of valvular heart disease in which the condition of the valves is the prime factor to be considered is acute endocarditis of the type spoken of as ulcerative or verrucous endocarditis according to the character of the lesion on the valves. In this type of lesion the danger to the individual comes not from the condition of the valves, but rather is dependent upon the septic process causative of the valvular lesion or upon the embolic lesions secondary to the acute valvular endocarditis.

The first consideration of the importance of other organs than the valves in heart disease came with "fatty heart." We were warned to differentiate carefully between fatty "infiltration" and fatty "degeneration." This was wise, as the first condition (the overgrowth of fat about the heart and the extension of fat into divisions of the heart) has but little practical importance; it represents one of the types of general excessive adiposity, while the latter, though it is found only rarely (that is true fatty degeneration of the heart muscle), drew the attention of the medical world to the large and very important group of diseases of the heart which are dependent upon some disturbance of the myocardium.

Fatty degeneration of the heart is an old clinical form of nomenclature which covers many pathologic conditions of the myocardium; practically some condition which has caused an enlargement of the heart with a dilatation of the cavities. Microscopically we find degeneration of the muscular fibers and a fibrous degeneration. The heart muscle is thinned and can no longer beat with the force necessary to carry on the work of the heart.

The etiologic factors are numerous, first, within the heart itself, as in disease of the coronary arteries. In this instance fibrous and calcareous degeneration of the coronary arteries leads to malnutrition of the muscle with subsequent degeneration of the muscle or replacement of the muscle by fibrous tissue.

Second, and of far more import, causes outside of the heart. First comes fibrous degeneration of the arteries of the body as a

whole; this leads to disturbance of the heart as a result of the constant overwork brought upon the heart. Such disturbance arises not from calcareous degeneration of the larger arteries, but from a fibrous degeneration of the minute vessels, the so-called arterio-capillary fibrosis. This is the most common cause of disease and is the main factor in that large class of diseases called clinically "cardio-renal" diseases, in which it may be most difficult to determine the relative importance of the heart and the kidney in the causation of the signs and symptoms of which the patient complains.

Chronic nephritis may by itself give rise to similar conditions in the heart without the occurrence of a general widespread fibrous disease of the arteries.

Chronic alcoholic excess has in some of my hospital cases been the direct cause of degeneration of the heart without the pathologic evidence of a primary renal or arterial disease, as instanced in Case 2.

Excessively hard and long continued physical labor is another factor to be considered, as in the so-called "soldier's heart."

The presence or absence of a murmur is not diagnostic of the type of heart disease in the individual case; a murmur is often heard in cases of disease of the myocardium due to dilatation of the cavities causing a relative insufficiency of the valves. The ring to which the valves are attached becomes enlarged and the opening so made may be so large that the valve curtains are no longer able to close it. Therefore, in deciding whether the main disturbance is to be sought for in a given case of heart disease in the valves or in some disturbance of the myocardium, other factors than the presence or absence of a murmur are to be considered.

In forming our decision as to the presence or absence of heart disease, and the effect of such disease upon the individual, the factors of chief importance to be considered are, first, the pathologic condition of the heart as determined by percussion, by X-ray and by auscultation; second, the evidence of secondary defects in other organs, as congestion with enlargement or other disturbance in the liver, lungs, spleen and kidneys; and third, and finally, the ability of the heart in each individual case to do the physiologic work required to carry on the circulation.

In spite of all the work that has been done to make plain the importance of the myocardium in disease of the heart, too much reliance is still placed on the consideration of the murmurs

which may be present. A murmur which is the result of some deformity of the valve may persist throughout a long life without giving rise to any disturbance of the integrity of the heart physiologically or pathologically.

By observation of clinical cases we have long known that certain disturbances of the heart were not inimical to a long life and the proper action of the heart in so far as it was apparently capable of carrying on the circulation. I refer especially to cases in which the heart occasionally was intermittent or even irregular in rate. Such disturbances of the heart action may pass entirely unnoticed by the patient or he may be conscious that there is some transient interference with the heart's action. Such irregularities have been observed by me in two classes of subjects, in young boys who have grown fast, and in elderly people with the absence of any and all signs of failure of the heart's action and all signs of change in the heart musculature. I have felt warranted in giving in the young a good prognosis. This favorable prognosis has been substantiated in such cases as have been for a large number of years under my observation. In elderly persons most of us can agree that such irregularities of the heart's action are not of serious import to the individual in the absence of other signs of heart disturbance.

In recent years I feel that the causes of such irregularities have been explained by studies as to the cause of the heart beat and the method of the transmission of the stimulus to the contraction of the ventricle passed from the auricle to the ventricle. Only in recent years have we become cognizant of the important role of the nerves regulating the heart action in the production of regular heart beats.

The stimulus to contraction of the ventricle passes from the auricle in which the stimulus arises by the bundle of His to the ventricle. By examination with the electro-cardiogram evidence may be produced that many types of irregular heart action and intermittency of the beats are due to the faulty transmission of the stimulus from the auricle to the ventricle. Such changes may be entirely independent of any disease in the valves or of serious involvement of the integrity of the heart muscle,—hence may be present without causing symptoms and signs of heart disease. Such methods of study are as yet new, so that we must not place too much confidence in the interpretation of the phenomena presented by a study of

electro-cardiograms, but the method appears to offer an explanation of clinical phenomena which have been long recognized.

Again, the polygraphic tracings are of great value as shown by the first case which I describe later in this paper. I am indebted to Dr. F. W. Palfrey for the tracings which appear in connection with the next article. In the first case such a tracing was the only means in my power accurately to determine the action of the heart. The man entered the hospital with excessively rapid heart action, while the pulse beat was very hard to determine and not nearly as rapid as the heart beat. The polygraphic tracing showed that each ventricular systole was transmitted to the radial pulse.

This first case is most remarkable in that the heart action was very rapid and because of the absence of symptoms of distress noticed by the patient. Examination of the heart showed enormous dilatation, and at no time either while the heart was dilated or after the heart was within normal limits was there evidence of valvular lesion. The etiology of the heart condition was obscure. The past history gave only the account of some fever in the Boer war, and as the patient had not suffered from any apparent weakness until recent date, it seems hardly probable that the fever could have been an etiologic feature. The recent history elicited only very hard work as a stoker on a vessel and excessive use of alcohol. Clinically, the case represents marked dilatation of the heart, with excessive rapidity, probably due to interference with the nervous mechanism of the transmission of the contraction wave from auricle to ventricle.

Disease of Myocardium: Alcoholism.

Case 1.—P. C., 40, single. Ireland. Stoker. October 17, 1912.

Previous History.—Five years ago was in the Boston City Hospital with a broken leg. About ten years ago was in hospital two weeks with fever. Has been troubled with fever at night, especially after hard work, about once in every six months. Measles at twelve. Pneumonia at time of broken leg, five years ago. Occasional sore throats. Bridgewater Hospital, swollen legs; frozen; there five months, November, 1911.

Habits: Tea, 2; coffee, 1; tobacco, 0; beer, 2-3 *i. d.*; whiskey, 1 before breakfast almost every day. Specific history negative. Sleeps poorly. Is afraid of being killed.

Present Illness.—Steady work as coal heaver till within two days of entrance. For two days has had great weakness, shortness of breath and palpitation. (Is too sick to give detailed history.)

Physical Examination.— Well developed and nourished; conscious and rational. Young man, lying comfortably in bed without complaint. Not dyspnoic or cyanotic. Somewhat prostrated. Eyes: Pupils equal and react. Conjunctivæ clear. Mouth, tongue clean; teeth fair; throat not remarkable. Glands not generally enlarged. Chest, symmetrical; expansion equal. Lungs clear throughout.

Heart: 6 cm. to right of mid-sternal line, left border anterior axillary line. Apex impulse sixth space outside nipple. Action very rapid, approaching 300, regular. No murmurs appreciated. Radial pulses barely perceptible, intermittent.

Abdomen: Level, soft, tympanitic. Liver and spleen not palpable. No fluid, masses, or tenderness.

Extremities: No œdema. Knee jerks present and equal.

Absolute quiet. Morphia, $\frac{1}{8}$ grain every four hours.

October 21. Morning after entrance pulse rate about 200 at apex. Apparently regular. Fair quality. Radial pulse 100. Notable that patient feels perfectly well. Pulse has persisted very rapid in rate, this a. m. slow and slightly irregular. Apex about 110 at 9 a. m. At 10 a. m. again very rapid, about 200. Temperature normal.

October 23. Tr. Opii Deod. min. x. *t. i. d.*

October 25. Heart action continues very rapid, regular. Patient lies quietly in bed. Says he feels perfectly well. Seen by Dr. Palfrey, who finds apex and radial pulses by polygraph correspond. Pulsation in neck one-half other rates. Also finds occasional sudden slowing, lasting few minutes.

October 29. Condition unchanged. Heart still very rapid. Radial pulse very irregular and of very small volume. Feels perfectly well.

November 1. Heart sounds faint, counted fifty-four to the minute with occasional added beat. Pulse rates approximately the same. Feels perfectly well. The slow heart was only for a short time. Digitalis min. v. *t. i. d.*

November 5. Heart rate rapid, about 180 when examined. Probably "slow" times undiscovered. Feels well. Sleeps well. No symptoms.

November 9. Heart rate somewhat slower. Feels well. No change in physical condition.

November 13. Pulse rate has fallen rapidly and steadily past two days without apparent ill effect. Doing well.

November 17. Patient says that he does not feel so well since heart has been slow. Digitalis omitted.

November 21. Heart remains slow and beats reach wrist. Slightly irregular still. Sounds of better quality. General condition improved. Up in chair and blankets for a short time without ill effects.

November 25. Continued improvement. Up in chair daily. Allowed clothes to-day and permitted to walk to toilet. Pulse, good volume and tension.

November 26. Patient up to-day for short time, but talks strangely as if mildly irrational. Seems to have some difficulty with articulation. Says he does not feel quite well. Put back to bed. Forbidden to go to toilet.

November 30. Condition slightly better. Heart action still irregular and sounds very faint, but patient feels well and seems mentally clearer. Up in chair for short time.

December 13. Up with clothes since last note. Was about to be discharged, on his own request, but seemed too irrational and irresponsible to go out with heart in such bad shape, so was held over a day. Next morning he became cyanotic and nearly fell out of chair and seemed mentally confused. Put back to bed.

December 21. Up with clothes since last note. Gaining in strength. Heart shows no enlargement and otherwise as last note. Patient was seen by Dr. Thomas, who advised commitment, but now patient seems more rational and mental state hardly warrants commitment, in Dr. Thomas' opinion.

January 13. Up and about ward since last note, doing light work without ill effects. Is moderately cyanotic while standing up. Heart: Normal area, action nearly regular, sounds faint. Pulse fair. Demands discharge.

The second case is one of decompensation of the heart as shown by the general œdema, the enlargement of the liver and the disturbance of the kidney function. The man entered the hospital with marked dilatation of the heart, and on entrance there was a systolic murmur in the mitral area with feeble heart sounds. The absence of increased blood pressure and the disappearance of the albumin after rest made it very improbable that the condition of the heart was due to disease of the kidney. The arteries were not sclerotic.

As an etiologic factor we have the very excessive abuse of alcohol over a long period.

Disease of Myocardium.

Case 2.—J. G., 31, single. September 3, 1912.

Previous History.—Typhoid fever, January, 1912; Bridgewater Hospital, three months.

Habits: Tea, 2 *i. d.*; coffee, 0; beer, 20 *i. d.*; whiskey, 5-6 *i. d.*, two before breakfast for last week. None for two months before this. Denies venereal.

Present Illness.—Came to town eight days ago for a spree and has been drinking hard ever since. Drunk continuously. Legs began to swell about one week ago; worse at night; would go down by morning. Shortness of breath on exertion for last month, not worse lately.

Two days ago began to cough with little sputum, white, thick, no blood. No pain. Cough worse at night. Uses two pillows.

Nocturia three times for last year; no pain; clear; large quantity at night, scanty in day time. Has gained weight and lost strength lately, especially last week. Legs began to pain him especially while walking around and swelling increased. Became frightened, stopped drinking and came to Relief Station to-day, where he was given card to Out-Patient Department. Chief complaint, swollen and painful legs and shortness of breath.

Physical Examination.— Well developed and nourished man, lying comfortably in bed, not dyspnoëic, very cyanotic, with no complaint. Conscious and rational.

Eyes: pupils equal and react to light. Conjunctivæ clear. Nose and ears, no discharge. Mouth, lips blue; tongue clean, moist, protruded, straight in median line. Teeth very poor and badly cared for. Throat reddened. Neck, not rigid or retracted. Chest symmetrical. Expansion equal. Lungs, resonant throughout fronts but impaired in backs, especially at tops. At both bases from lowest angle of scapula is marked dulness which extends around into axillæ. Breathing normal throughout lungs except for occasional medium moist râles. At both bases breathing diminished to absent. A few crackles can be heard more marked at left base.

Heart: 9 by 13 cm. Left border, 5 cm., outside nipple line. Apex, fifth interspace; 1 cm. outside nipple, not forceful. Very rapid and regular. Sounds, tick-tack rhythm, of poor quality. Systolic murmur heard in region of apex not transmitted to axillæ. Sounds of poor quality. Pulses, equal, regular, poor volume and tension. Abdomen, tense, level, not painful, no masses made out. Dull in both flanks, which become resonant on change of position. No fluid wave made out. Liver; edge felt, 4 cm. below costal margin in nipple line, firm, non-tender, not fluctuating. Spleen not felt. Genitals negative. Extremities, knee jerks slight, equal. Firm œdema of legs to mid thigh, pitting on pressure.

September 3. Blood pressure, 120.

September 7. Temperature practically normal. Pulse, good volume and tension, not rapid. Doing well.

September 11. Temperature, pulse and respiration continue normal. No complaints. Heart, 4 by 13 cm. No complications.

September 15. Temperature, pulse and respiration normal. Still quiet in bed. Doing well. Heart, 4 by 12 cm. Pulses, good volume and tension. Urine, that of slight nephritis.

September 18. Blood pressure, 110.

September 23. Still quiet in bed. Heart still enlarged. Sounds, weak. Action, very irregular.

October 1. Slight improvement. Left border of cardiac dulness, about 1 cm. outside nipple line. Action still very irregular, almost tumultuous.

October 5. Continued improvement in area of cardiac dulness. Action unchanged.

October 9. Left border cardiac dulness, nipple line. Heart action continues very irregular. Patient feels well. Patient allowed up on extra pillows daily, apparently without ill effect.

November 18. Up with clothes daily. Slow, steady gain in strength. Heart still somewhat irregular. Sounds of fairly good quality. Some slight œdema of ankles every night.

December 14. Does light work about ward daily, without dyspnoea or ill effects. Slight gain in strength from week to week. Heart still irregular but not rapid. Area slightly larger than normal; sounds of fair quality, no murmurs. Slight œdema of ankles each night. Discharged, relieved.

XXII.

PAROXYSMAL TACHYCARDIA CONFINED TO THE
VENTRICLES OR TO THE AURICLES,
WITH ILLUSTRATIVE CASES.

BY FRANCIS W. PALFREY, M. D.

The first case reported by Dr. Jackson in the last article is one of paroxysmal tachycardia apparently of a type hitherto not described in man, with the exception of the case recently reported by Hart.* The occurrence of a condition apparently analogous has been observed in experimental animals by Lewis,† but the rarity of the phenomenon as a clinical disorder is shown by the fact that this close student of the subject of paroxysmal tachycardia has not reported the type here presented in human cases.

Paroxysmal tachycardia is a disorder with regard to which there has been much discussion in connection with the revelations of polygraphic and electro-cardiographic studies of recent years. Through these studies it has been conclusively shown to be essentially distinct from simple rapidity of heart action due to the various familiar causes of increased heart rate. In consequence of exertion, of excitement, of surgical shock, of fever, and of certain intoxications, as well as in Graves' disease, marked acceleration of the heart beat occurs. But in these conditions the action of the heart is not changed except by its acceleration which occurs chiefly by the shortening of diastole. The acceleration begins and ends gradually, and the rate seldom exceeds 160 beats per minute. In paroxysmal tachycardia on the other hand the rate may even reach 300 beats per minute. The acceleration appears instantaneously in the course of a single beat, after which the contractions occur most commonly at approximately twice the previous rate until, after a variable period, the normal rate is resumed as suddenly as it was lost. Moreover, in most instances the

* Hart, T. S. "Heart," Vol. IV., No. 2.

† Lewis, T. "Heart," Vol. I., p. 98.

normal relation between the contractions of the auricles and the contractions of the ventricles is disturbed. In one of the types into which the cases are divided, it is true, an auricular beat precedes each ventricular beat as in normal heart action, but in a more common type the auricles and the ventricles contract simultaneously. It is therefore apparently a disorder primary in the mechanism of the heart.

Its pathological physiology is probably the occurrence of rapidly repeated stimuli to contraction arising in the heart at some point other than the normal origin of impulses, the so-called sino-auricular node, near the mouth of the superior vena cava. There is reason to believe that such impulses may arise in any portion of the heart, whether in the auricle, in the ventricle or in the muscular connection between the auricles and the ventricles, the auriculo-ventricular node and bundle. Each single stimulus is probably much the same as those which produce the premature beat or extrasystole, but in their rapidly rhythmic repetition Lewis* shows evidence from observation of the phenomenon in exposed animal hearts that the muscle is in a state which borders upon that of fibrillation. The abnormal stimuli which originate in the auricle are transmitted to the ventricle. Those which arise in the junctional tissues are transmitted both to auricle and to ventricle. Those originating in the ventricle may be transmitted to the auricle, but it is to be particularly noted in connection with the case here reported that, according to Lewis,* the auriculo-ventricular bundle conducts stimuli in the reverse direction, from ventricle to auricle, less readily than in the normal direction, from auricle to ventricle. Anatomically, no constant changes have been demonstrated, but some form of organic heart disease is commonly present.

Clinically, the paroxysms of tachycardia may occur at intervals for years without serious symptoms and without other evidence of disease of the heart. With the onset of the attack the patient is conscious of a fluttering sensation in the region of the heart or of definite palpitation. In some cases the distress and anxiety are severe, but in others the symptoms are made light of. Dyspnoea, as a rule, is not prominent, but in the more serious cases cardiac insufficiency with dyspnoea, cyanosis and œdema may appear rapidly and death may follow. As a rule, however, after a variable duration of the attack, the

* Lewis, T. "Heart," Vol. I., p. 98.

heart rate suddenly drops to normal and the patient is at once completely relieved. Many patients discover manœuvres, such as stretching or taking long breaths, which often terminate their attacks, but no one of these is always efficacious. The ultimate prognosis is grave. The treatment is confined to guarding against circumstances which may induce attacks, and to rest and digitalis in the attacks.

On physical examination nothing abnormal may be found except for the extremely rapid action of the heart with short diastolic pauses, a rapid embryocardia. The heart is commonly not enlarged. The venous pulse may not be visibly abnormal, and in the cases where the abnormal stimuli are believed to originate in the auricle, tracings from the jugular pulse are not distinctly abnormal. In cases where the source of the stimulus production is believed to be in the auriculo-ventricular junctional structures, however, the jugular pulsations are conspicuously large, and are shown by tracings to accompany systole of the ventricles instead of preceding it as they should do if produced by normally timed contractions of the auricles. It is inferred from this fact that the large waves in the jugular pulse are produced by contractions of the auricles simultaneous with those of the ventricles, and that their great volume is due to the fact that the auricle is contracting against a closed tricuspid valve. Wenckebach* has argued that the simultaneous contraction of auricles and of ventricles is due not to an abnormal source of stimulus production but to a delay in the auriculo-ventricular conduction, causing each contraction of the ventricle to occur at the same time as the contraction of the auricle which is to excite the next ventricular contraction. The evidence in support of this view, however, is not convincing. The fact that many cases show extrasystoles between paroxysms and not disturbance of auriculo-ventricular conduction favors rather the theory of ectopic stimuli.

In the case which furnishes the basis for the present study the history and the general clinical features have been adequately described by Dr. Jackson. The observation which first called to attention the fact that this case differed from reported types of paroxysmal tachycardia was the jugular pulse, in which there were clearly visible pulsations not as in cases previously described corresponding in rate to the contractions of the ventricles, but in regular cycles of approximately

* Wenckebach, *Deutsch. Arch. für Klin. Med.*, Vol. CI., p. 402.

half the rate of the apex beat. Simultaneous tracings were therefore taken of the jugular pulse, the apex beat and the radial pulse. Certain of these are here reproduced, showing the fact observed on inspection, namely, that the largest waves in the jugular pulse occurred only with every second beat of the apex. In tracings taken with the paper moving at a slow speed (Fig. 1) it was suggested that the higher waves in the jugular curve corresponded with alternate more forcible beats of the apex, or the so-called *heart alternans*. But tracings taken with the paper moving more rapidly (Fig. 2), so that time relations could be more exactly determined, gave evidence that this alone was not the true condition. It was seen in these more rapid tracings that the jugular pulse showed waves

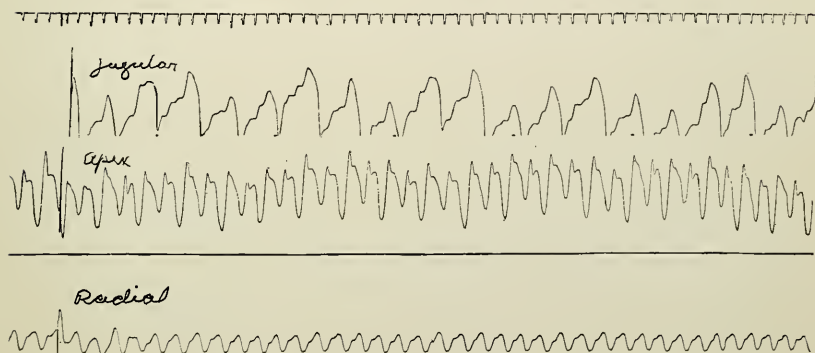


FIG. 1.—Tracing taken during tachycardia with paper at low speed. The radial pulse is hyperdirotic; the deepest depressions represent the dirotic notch.

bearing a definite relation to all apex beats, but that the certain waves at longer intervals did not occur in any definite time relation to the ventricular contractions. It therefore seemed probable that these last were produced by contractions of the auricles at a rate independent of that of the ventricle.

The steps by which this conclusion was reached may be followed by examination of Tracing 2. In the venous pulse waves accompanying or slightly following the beginning of the apex impulse are commonly known as "e-waves." In the tracing therefore the first step was to mark each wave so timed with reference to the apex beat as "e." But when this was done it was obvious that these waves did not produce the longer periodic rises in the curve, but that these last were due rather to other waves which were labeled "a." It then became plain

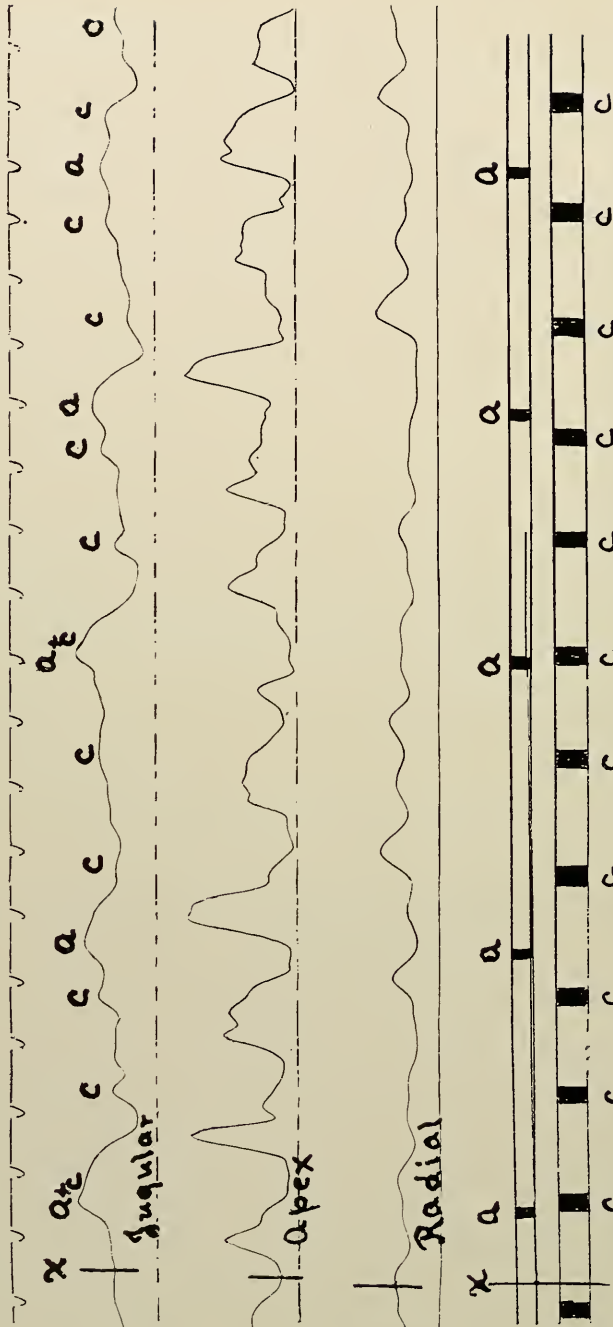


FIG. 2.—Tracing taken during tachycardia with paper moving at high speed. The diagram shows the timing of the waves as interpreted.

that these "a-waves" occurred at definite intervals, and that if deficiencies in their sequence were made up by the supposition that an "a-wave" had coincided with a "c-wave" and was therefore obscured, an assumption readily justified on study of the tracing, two independent sets of rhythmic waves could be distinguished. Under this assumption certain prominent waves occurring at times which fit in with either series have been labeled "a + c." The results of this interpretation have been represented by marks placed in parallel lines in Figure 2. The marks represent the beginnings of waves, those in the upper row being the "a-waves," those in the lower row the "c-waves."

The cause of the waves marked "a" can hardly be laid to but one factor. These waves are obviously independent of the contractions of the ventricles as represented by the apex beat, and of the respiration which was at the rate of twenty to the minute, whereas the waves in question occurred at about eighty to the minute. It is difficult to explain them in any way except as the result of contractions of the auricles at a rate independent of and slower than that of the ventricles.

In the author's belief, therefore, we have here a case of paroxysmal tachycardia in which abnormal impulses originating at some point in the ventricles have set up a tachycardia of the ventricles, but in which there is failure of conduction of these impulses to the auricles, which continue to beat at a normal rate and presumably in response to normal stimuli.

Further support for this view was obtained from tracings taken in the intervals between the periods of rapid heart action. As shown in Figure 3 the normal beats are here interrupted by ventricular extrasystoles which do not interrupt the sequence of the auricular waves.

In connection with this case of tachycardia affecting only the ventricles it may be of interest to report briefly another case in which, according to strong evidence, there was a period of tachycardia affecting only the auricles.

W. G., 49 years of age, a janitor, with chronic aortic and mitral endocarditis, hypertrophy and dilatation, and for the second time badly broken compensation, entered the service of Dr. Withington on the 26th of February, 1912. At entrance his pulse was recorded as 140 per minute, but by the next morning it had dropped to 80, and continued at about the same rate on succeeding days. The apex beat was regular

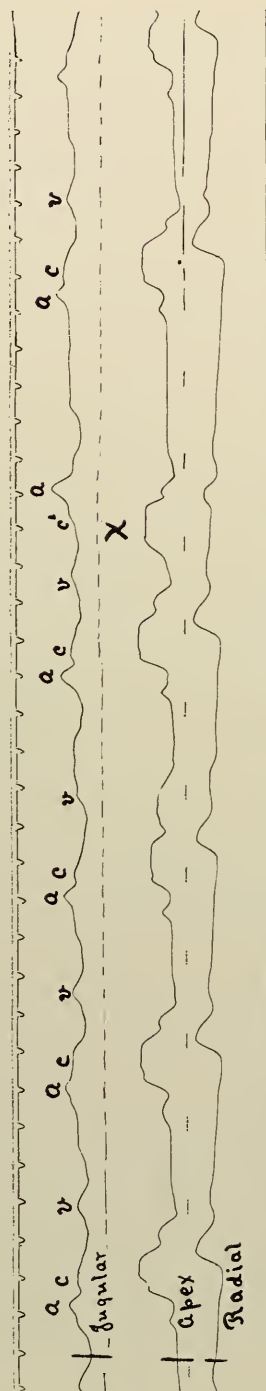


FIG. 3.—Tracing taken in an interval between periods of tachycardia. A ventricular extrasystole is shown at X; the sequence of auricular waves as indicated by "a-waves" is not interrupted.

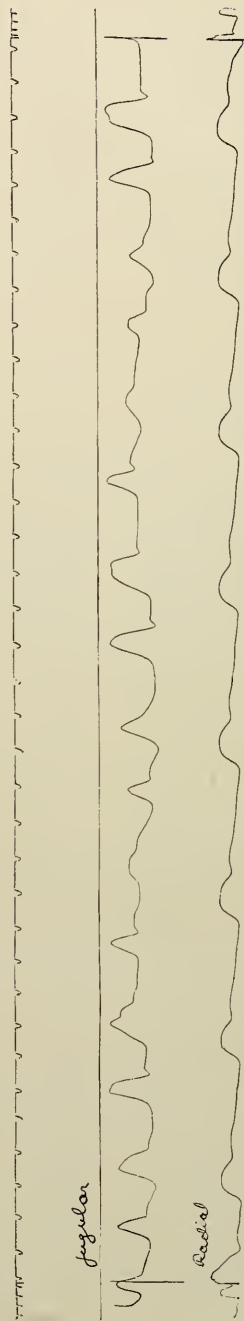


FIG. 4.—Tracing from second case showing two jugular pulsations to each beat of the radial pulse. The time marker as in the other tracings records fifths of a second.

and corresponded entirely with the radial pulse. The astonishing feature of the case, however, was the presence after the diminution in rate of the apex beat and radial pulse of an extremely large and conspicuous venous pulse in the neck, of a rate double that of the apex beat. So large was this venous pulse that tracings could be taken only with a very small receiver, so that all traces of more delicate waves that may have been present were obliterated. The tracing here reproduced (Fig. 4) is for this reason apparently a crude one. It serves to show, however, that every second one of the large venous waves precedes a beat of the radial pulse by three-tenths of a second as an auricular wave should precede a radial pulse, but that the intervening waves are not followed after the same interval by radial pulsations. Since on auscultation no heart sounds were heard except those in normal relation to the radial pulse no ventricular contractions in relation to these waves can have occurred. Furthermore, these waves are too late in time to be the result of tricuspid regurgitation in ventricular systole. The only plausible conclusion is that abnormally rapid contractions of the auricles were responsible for the production of these waves, and that every second one of these auricular contractions failed to produce a ventricular contraction, through a partial auriculo-ventricular heart block.

XXIII.

TRAUMATIC FACIAL PARALYSIS.

ANASTOMOSIS OF THE SPINAL ACCESSORY TO THE FACIAL
NERVE AND OF THE DESCENDENS HYPOGLOSSI TO THE
PERIPHERAL END OF THE SPINAL ACCESSORY.
(GRANT'S OPERATION.*)

BY L. R. G. CRANDON, M. D.

Nellie M., 28, single, in April, 1911, during the course of an operation for acute mastoiditis, suffered complete section of the right facial nerve, which resulted in complete right facial paralysis. When first seen by me, July 1, 1911, the right face was entirely paralyzed and showed no response in either nerve or muscles to faradic electrical stimuli. Right side of face was without expression; patient unable to draw up right angle of mouth, to close right eye or to wrinkle right side of forehead. Galvanism was used three times a week up to July 4.

After consultation with Dr. I. H. Coriat, operation was advised. July 6, 1911 (two and one-half months after the injury), operation was done, with the assistance of Dr. Ehrenfried.

Following the admirable method of Dr. Grant, the operation was performed as follows:

Operation.—Incision from tip of mastoid down neck in front of sternomastoid three and one-half inches, crescentic incision from upper end of wound below the lobe of ear to end in front of middle of tragus. By blunt dissection the posterior border of the parotid gland was brought to view, lifted and pushed forward, and in the narrow space between the mastoid and the ramus of the jaw the facial nerve was exposed where it enters the gland. The nerve was hard and gray instead of soft and white as is usual. The nerve was now cleared back to

* W. W. Grant: "Journal American Medical Association," October 22, 1910, Vol. LV., p. 1438.

where it issues from the stylomastoid foramen and was not cut but held up by a silk loop.

The spinal accessory was found posterior to the sternomastoid and followed down to where it enters that muscle just below a line from the lower edge of the maxilla. A loop was put round this nerve. The next procedure was to expose the hypoglossal nerve. To do this the posterior belly of the digastric muscle was cut at about its middle and the ends turned aside. Under the muscle lies the hypoglossal nerve resting

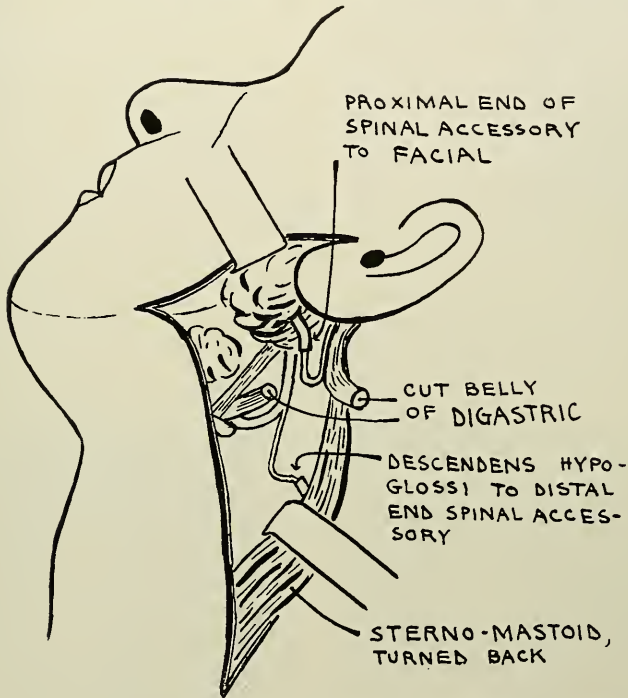


FIG. 1.—Diagram of spino-facial anastomosis and descendens-spinal compensation.

upon the hypoglossus muscle. Underneath the point where the digastric was divided was found the descendens hypoglossi branching from the hypoglossal. This descending branch was dissected free down along the carotid sheath for about one inch and then held up by a loop.

The facial nerve was now cut at the stylomastoid foramen and the distal stump pulled outwards. The eleventh nerve was next cut about one-fourth inch from its point of entry into the muscle and its proximal stump was united to the

distal stump of the facial by three finest Pagenstecher stitches, the first one going through and through the nerves to give strength to the union, the other two through neurilemma of both nerves but in a plane at right angles to that of the first stitch. The dissection had been so free that even with the head turned far to the left there was no tension on the line of suture.

By a similar technique the proximal end of the descendens hypoglossi was united to the distal end of the spinal accessory. Cargile membrane was not used. There was almost no bleeding. The deep fascia was sewed with No. 1 chromic catgut and the skin with intracuticular silkworm gut; rubber dam drainage for twenty-four hours. Simple dry dressing and bandage was applied but the head was fixed from turning for the first four days by sand-bags.

The convalescence was uneventful. The patient declared she could control liquid in the affected cheek within twenty-four hours but, except for that, practically no change was seen till nearly the end of four months. In the meantime she had been having the galvanic current and massage applied to the region three times a week. After the *first month* the faradic current was used part of the time. At that time slight motion of right face; no lachrymation of right eye; no reaction of right side of face to strong F. (Faradism); to G. (Galvanism) very slow reaction; polar inversion complete (anode cathode); complete reaction of degeneration. At the end of four months the girl could hold her mouth straight for an instant but always associated with a shoulder movement. She could partly close the affected eye.

January 1, 1912. (*Six months after operation.*) Almost perfect motion right side of face, can close right eye and draw angle of mouth to right. Unable to wrinkle right side of forehead.

January 21, 1912, right side of face reacts only to strong F.; to G. slow reaction, AnCC > CaCC. (Complete R. D.) No atrophy of tongue. Able to wrinkle slightly right side forehead and also can pull voluntarily angle of mouth to right, but all these movements are weak. At rest, right naso-labial fold is prominent. Very slight weakness of right shoulder. Able to close eye almost completely. No shoulder drop.

March 10, 1912. (*Nine months after operation.*) Able to wrinkle slightly right side forehead, can close right eye com-



FIG. 2.—Before operation: right eye staring; on smiling only the left side of face moves.



FIG. 3.—Before operation: right eye cannot close.



FIG. 4.—After operation: both eyes open equally; both sides of face move in smiling.



FIG. 5.—After operation: face symmetrical; right eye closes as well as left.

pletely, but the muscular power is weak. Can draw right angle mouth upwards with fair strength.

July 3, 1912. (*One year after operation.*) Can close right eye completely and wrinkle side of forehead to a certain extent. Nearly all movements of mouth muscles. Muscles react to moderate strength F. To G. quick reaction, AnCC < Cacc (disappearance of R. D.).

January 6, 1913. (*Eighteen months after operation.*) There remains only a look about the face suggestive of asymmetry, but the functions of the eyelid, the cheek and the muscles about the mouth seem to be practically perfect. The shoulder and the neck movements are normal. No treatment since October, 1912. At rest, the right naso-labial fold is less prominent than the left, but the fold is present. Very slight movement right side of forehead. Can close right eye almost completely, but the movement against resistance is weaker than on the left. Mouth movement normal, but weaker on right side than left. No shoulder drop. Movements tongue normal. No atrophy. On drawing angle of mouth to right, there results a slight shrug of the right shoulder (incomplete dissociation of muscular movements). Sense of taste normal and no subjective dryness of mucous membranes on right. The muscles supplied by the facial nerve on the right react to a moderate Faradic current with almost as active a reaction as the normal side to the same current, but somewhat more sluggishly. The flatness of the right side of the face is due to an over-action of the strong muscles on the left over the weaker muscles on the right.

This case seems to corroborate the opinion of Ballance, quoted by Grant, when he says that "perfect symmetrical movements of the facial muscles from emotional stimuli can only be obtained by devoting the whole nerve, either spinal accessory or hypoglossal, to the cure of facial palsy."

Grant's comments on his own case are as follows:

"I believe the conclusion justifiable that the sooner a nerve is reunited after division or the destruction of its function by disease, the more certain, prompt and satisfactory will be the union and the restoration of function. In facial palsy the spinal accessory is to be preferred, if for no other reason than the fact that the peripheral end can, without unusual difficulty, be stitched to the descendens hypoglossi, and with practically no additional dissection than is necessary in spino-facial anastomosis. The descendens is a little smaller than the spinal, but that is not an important objection. The spinal is a little smaller than the hypoglossal, but

that is no advantage in facial anastomosis. Complete section of both nerves and end-to-end anastomosis is to be preferred. Splitting is objectionable, because axis cylinder end-to-end apposition is necessary to regeneration, and is uncertain in splitting.

“Implantation of one end through a slit in another is unscientific.

“Transverse division of half the diameter of a nerve and then splitting the proximal end for anastomosis with a peripheral nerve, end to end, may be justifiable in some cases, as was done by Ballance in one case with the spinal and peripheral hypoglossal. His statement that symmetrical and perfect facial expression is more certain with complete division of the nerves is worthy of the highest consideration. The best technique for exposure of the facial nerve is along the lines followed in the subjects of this paper. It should not be approached through the body of the parotid gland, for that would needlessly endanger the integrity of the nerve which, soon after entering the gland on the under surface posteriorly, bifurcates and gives off other smaller but important branches. Besides, there would be the danger of annoying hæmorrhage.”

As to the selection of the spinal accessory rather than the hypoglossal, I believe we are warranted in concluding:

1. Cutting of hypoglossal causes hemiatrophy of the tongue.
2. During the period of dissociated movements it is very distressing for the patient to have tongue movements dissociated rather than the sternomastoid and trapezius.

3. The dissociation ought to disappear more quickly in the sternomastoid and trapezius than in the tongue, because the latter is a muscle-group of very delicate and highly organized coordination. Furthermore, the conclusions of Kennedy's* detailed and careful work are properly to be added:

- “4. In any case of facial paralysis due to division or compression of the facial nerve, the best procedure, should spontaneous recovery fail or be deemed impossible, is to attempt restoration of the damaged nerve.

- “5. Should efficient restoration of the nerve be impossible, or be deemed impossible, anastomosis with the spinal accessory or hypoglossal holds out most favorable prospects of recovery, given that the facial muscles are still recoverable from the point of view of duration of complete severance from the nutritive influence of the central nervous system.

- “6. Of the two substitutes, spinal accessory and hypoglossal, when the latter is used the restoration appears to commence sooner, but there does not seem to be a great difference in the ultimate result of the two substitutions, as far as the recovery of the face is concerned.

- “7. Of the new paralysis produced as a result of cutting the substitute nerve, that which is produced when the spinal accessory is cut is much less objectionable than that produced when the hypoglossal is cut, and when the paralysis is to be left as a permanent defect, namely, when the peripheral segment of the substitute nerve is to be left unattached, the hypoglossal paralysis is not justifiable.

* Phil. Trans. Royal Soc. London, Vol. CCII., p. 93, 1911.

"8. When in consequence of the anastomosis association movements are present in addition to voluntary coordinated and dissociated movements, these associated movements give no trouble, and are not noticeable with ordinary movements when the spinal accessory has been used, but if present may be most objectionable and noticeable with ordinary movements when the hypoglossal has been used.

"9. As regards the interval during which the paralysis has lasted before anastomosis has been performed, there appears to be no difference in the date of commencing recovery and the ultimate result, whether anastomosis immediately follows section of the facial, or whether one month's interval at least is allowed to elapse before the anastomosis is performed after the facial has been cut.

"10. The only way to make an efficient union between two nerves is completely to cut across all the nerve fibers in both nerves; methods such as Manasse's, designed to maintain the integrity of the nerve fibers, give inefficient unions.

"11. In the course of recovery of independent voluntary coordinated movements, the orbicularis palpebrarum is first to exhibit recovery, and usually is the muscle which recovers best, and in no case has a perfect recovery in the movements of the face been proved to take place.

"12. Reunion of the facial nerve is to be preferred to restoration by means of anastomosis, as the latter involves interference with the distribution of another nerve and association movements are sometimes troublesome."



TABLE OF CASES.

CASE.	Patient.	Service.	Date.	Etiology.	Examination.	Diagnosis.	Treatment.	Course and Complications.	Result.	Remarks.
1.	P. C., 11.	Dr. Gavin.	April 20, 1899.	Leg caught between spokes of wheel.	Marked depression above patella. Prominence in popliteal space.	Simple separation of epiphysis.	Ether. Reduced with traction and flexion. Ham splint and light extension.		Recovery without incident.	
2.	M. M., 11.	Dr. Gavin.	May 22, 1899.	Leg caught between spokes of wheel.	Abnormal mobility above condyles. No deformity.	Simple separation.	Ham splint.		Discharged with good function at end of six weeks.	
3.	H. C., 7.	Dr. Cushing.	June 11, 1899.	Run over.	Usual deformity. Leg cold and pale. No pulsation in post. tibial and dorsalis pedis.	Simple separation.	Ether. Two attempts at reduction failed. Put up in double inclined splint. (See Plate I.)	Circulation of leg returned. Displacement persisted. Toe-drop.	September, 1899, Dr. Lund. Epiphysis is found impossible to reduce; resection. Two years later, much shortening.	Toe-drop persisted. Poor result.
4.	(7)	Dr. Munro.	1899 (?)	Leg caught between spokes.	Shock. Lacerated wound of popliteal space. Diaphysis projecting with vessels on stretch. No pulsation of leg vessels.	Compound separation.	Ether. Reduction difficult owing to hit of capsule between fragments, pulled out with hook. Plaster.	Three days later no circulation. Sixth day, amputation just above epiphyseal line.	Good recovery.	
5.	F. G., 15.	Dr. Thorndike.	Aug. 6, 1899.	Kick by horse on outer side of knee.	Lateral (external) displacement of leg on thigh. Abnormal lateral mobility.	Simple separation. (Lateral displacement.)	Ether. Separation of epiphysis confirmed. Position corrected. Ham splint.	September 9, good union.	Good, immediate result.	
6.	T. S., 19.	Dr. Mooks.	Nov. 30, 1899.	Caught foot between logs.	Lateral (internal) displacement. Deep sulcus above lateral condyle.	Simple separation (lateral).	Ether. Reduction (difficult) by flexion and manipulation. Ham splint.	January, 1900, shortening 1/2 inch.	Good, immediate.	
7.	J. Z., 14.	Dr. Blake.	June 15, 1904.	Run over.	Swelling and tenderness just above knee.	Simple separation. Locking without displacement.	Ham splint.	July 7, good union.	Good, immediate.	
8.	D. H., 8.	Dr. Monks.	Feb. 28, 1905.	Leg caught in wheel.	Ragged wound with diaphysis projecting in popliteal space.	Compound separation.	Ether. Cleaned. Reduced. Torn peritonsium sutured in place. Plaster in slight flexion.	April 20, union firm. Later, nerve freed from scar tissue by Dr. Lund.	May, 1905. Toe-drop marked. (Plate II. and III.)	Two-inch shortening of thigh, causing lateral curvature.
9.	J. K., 6.	Dr. Thorndike.	July 30, 1906.	Fell off fence.	Crepitus and abnormal mobility just above knee and at middle of thigh.	Simple separation (locking), and fracture of middle third.	Ether. Put up in extended position.	Uneventful.	Good, immediate.	
10.	J. B., 11.	Dr. Bolles.	Dec. 4, 1907.	Caught in spokes of wheel.	Abnormal lateral mobility and displacement outward and backward.	Simple separation.	Ether. Plaster.	December 19, good position.	Good, immediate.	
11.	A. S., 16.	Dr. Watson.	April 7, 1908.	Caught foot on shaft in lighting.	Forward and outward displacement.	Simple separation.	(Dr. Cotton) Ether. Reduction. Plaster.	Uneventful. May 4, union.	Good, immediate and final.	Seen January 31, 1913. Perfect result.
12.	E. B., 9.	Dr. Thorndike.	Aug. 23, 1909.	Struck by team.	Abnormal mobility just above joint. Forward displacement by X-ray.	Simple separation.	Ether. Incision on outer side of limb. Manipulation, reduction. Plaster in slight flexion.	Slight displacement required. Shown by X-ray. Corrected September 1.	Good, immediate.	
13.	H. L., 10.	Dr. Monks.	March 6, 1910.	Fall.	Shock. Pain and swelling in region of epiphysis. X-ray showed slight post. displacement.	Simple separation.	Plaster.	Uneventful.	Good, immediate.	
14.	J. B., 6.	Dr. Monks.	June 11, 1911.	Run over. (?)	Lacerated wound. Diaphysis projecting 3 inches. Injury of nerve and vein.	Compound separation.	Dr. Binney: Cleaning, reduction and fixation by wire nail in outer condyle. Plaster in slight flexion.	Superficial sepsis. Good union. Nail removed after seven weeks.	Partial toe-drop. Good, immediate.	
15.	W. B. G., 13.	Dr. Lund.	Sept. 26, 1911.	Struck by team.	Lacerated wound of popliteal space. Diaphysis projecting 4 inches.	Compound separation.	Ether. Cleaned. Epiphysis placed into position. Second attempt, Dr. Blake: immobility in flexion also failed.	Gas bacillus infection. Recurrence of displacement. Partial peroneal paralysis.	See Plates VII. and VIII. Fair result in presence of infection.	
16.	S. B., 10.	Dr. Monks.	Dec. 24, 1911.	Run over.	Swelling just above knee. Bony projection posteriorly.	Simple separation.	Ether. Reduction. Ham splint. Displacement recurred twice. Held by acute flexion, February 10, 1912.	Operated by Dr. Lotbrop, April 19. Ether. Full extension of knee.	See Plates IX. and X. Good, immediate.	
17.	H. X., 10.	Dr. Monks.	Dec. 30, 1911.	Caught in wheel.	Abnormal mobility just above knee. Bony projection posteriorly. One and one-half inch shortening.	Simple separation. (See Plate XI.)	Ether. Flexion and manipulation. Ham splint.	Uneventful.	Good.	January 28, 1913. No shortening. Flexion not quite complete.
18.	J. C., 14.	Dr. Thorndike.	April 11, 1912.	Caught in wheel.	Wound over internal condyle, diaphysis projecting.	Compound separation.	Ether. (Dr. Peablow.) Reduced by manipulation.	May 25, union firm. Good position.	Good, immediate.	

XXIV.

REPORT OF EIGHTEEN CASES OF SEPARATION OF
THE LOWER FEMORAL EPIPHYSIS AT THE
BOSTON CITY HOSPITAL.

BY HORACE BINNEY, M. D., AND FRED B. LUND, M. D.

Until the recognition of this lesion, thanks to the X-ray, had become generally possible, and the necessity understood for reduction by flexion, as well as immobilization in flexion in some cases, the results of the injury made it one of the gravest nature, and the early statistical reports made a melancholy chapter. The past decade has seen a marked change in the results obtained by the more enlightened treatment, and the injury, while of great importance, is happily not so much to be dreaded as formerly. Such a record as is mentioned by Monsehr, twenty-two cases with four deaths and fourteen amputations, undoubtedly belongs to a by-gone day. The striking contrast between the ease of handling and good results obtained in some cases, and the difficulties attending treatment that occasionally appear in others, has led the writers to a study of this group of cases, occurring at the hospital in the past fourteen years.

Etiology.—The usual description given by recent writers, notably Scudder, Stimson and Cotton, is found to obtain in this series,—hyperextension being the usual form of violence. In this series the leg was caught between the spokes of a moving wheel in seven cases (1, 2, 4, 8, 10, 17 and 18). In one case (Case 7) the force apparently was applied to the femur above the epiphysis, the wheel passing over the thigh just above the knee. In two cases (5 and 6) the force was a lateral one, being a kick by a horse on the outer side of the knee in one; in the other, the leg was caught between two logs, and the patient, falling towards the same side, sustained an inward displacement of lower leg on the thigh. In the remaining cases the nature of the injury was not determined.

Pathology.—While many cases of this lesion are of simple displacement without serious injury to soft parts, a considerable proportion of compound injuries occur, Scudder stating it to be 50 per cent. In this series but five were compound cases (4, 8, 14, 15, 18). The injury may be a simple loosening of the epiphysis, the conjugal cartilage usually adhering to the epiphysis, and there being but slight displacement forward or laterally of the fragment with relation to the shaft of the femur;

PLATE I.



CASE 3.—Showing union of displaced epiphysis with shaft, 3 months after injury. Result: Resection and wiring of tibia to femur.

or there may be great displacement of the fragment, which may ride forwards and upwards in front of the lower end of the shaft, the articular surface being behind patella and quadriceps tendon. In such cases the periosteum is likely to be extensively torn and stripped up from the diaphysis. It is in these cases that there is always more or less pressure on the popliteal vessels and nerves, owing to the projection of the diaphysis backwards and downwards. In extreme cases this

has produced rupture of the vessels, requiring immediate amputation; again, the vessels may be drawn tightly over the end of the diaphysis like the strings over the bridge of a violin, as in the case of Coural (Kirmisson). If not promptly relieved, the resulting arterial thrombosis may produce gangrene, or if in the vein, death from pulmonary embolism (Desmarest). The nerve injury is usually to the external popliteal, a number of cases being followed by some degree of toe-drop. In this series, the injury to popliteal vessels was rarely serious; only in one case did gangrene threaten as result of the injury, demanding amputation (Case 4). There was peroneal paralysis in three cases (Cases 8, 14 and 15). Considering the severity of the trauma, it is not surprising that in many cases there was shock and a variety of other lesions, although in only one case was the femur fractured in addition to the epiphyseal injury (Case 9). In the compound cases the force was apparently so great as to drive the sharp posterior edge of the diaphysis against the skin covering the popliteal space, rupturing it to a varying extent. As a rule the edge of the diaphysis presents in the wound, or as in one case, the lower end of the diaphysis may actually project for three or four inches. There were five cases only where the injury was compound (4, 8, 14, 15, 18).

Mechanical Factors Affecting Displacement.—In the usual type of injury, where the epiphysis rides forward in front of the diaphysis, the former, being attached to the patella and upper end of the tibia by the strong ligaments of the knee joint, is drawn upward by the pull of the quadriceps. The extent of this displacement and its tendency to recur after reduction is apparently affected by the attachment of the gastrocnemius and the popliteus muscles. The gastrocnemius is attached to the posterior surface of the femur just above the condyles, partly above and partly below the epiphyseal line. The popliteus is attached to the outer aspect of the external condyle below the epiphyseal line. If, in a mild degree of separation, there is little or no detachment of these muscles, they will simply be put on the stretch and will evidently tend to prevent, after reduction, a tendency for the fragment to slip forward again, as they will antagonize the pull of the quadriceps; in other cases, however, the injury is likely to be severe enough to have caused detachment of the gastrocnemius and popliteus from the epiphyseal fragment; thus, the quadriceps

pull is not antagonized, and the recurrence of the forward dislocation easily takes place. In some cases, especially compound separations, the difficulty of reduction appears to be due to a strip of torn capsule or fascia, which is interposed between epiphysis and lower end of diaphysis. The extended position of the lower leg will, of course, tend to put such a band on the stretch, and traction alone on the leg may fail to remove this

PLATE II.



CASE 8 (1).— Showing lower end of femur 6 years after injury.

mechanical obstacle. By flexion of the knee joint this band will become relaxed, and may by proper manipulation be worked out of its position of interference with reduction.

Symptoms and Diagnosis.— Any case of injury to the knee in a patient below twenty (the age of ossification of the epiphysis) is suggestive of epiphyseal separation. In the classical case the appearance is that of a fracture of the lower end of the femur with certain distinctive features; namely, the marked

PLATE III.



CASE 8 (2).— Deformity and shortening due to epiphyseal separation 8 years after injury.

prominence in the region of the patella with a transverse depression across the thigh just above the patella, the second pathognomonic sign being the bony prominence in the popliteal space, caused by the backward projection of the lower end of the diaphysis. Mobility just above the knee joint and a soft crepitus, if present, are suggestive. While in the milder cases with little or no displacement there is no evidence of pressure on popliteal vessels, this condition should be borne in

PLATE IV.



CASE 10.—Showing slight forward displacement of epiphysis before final reduction.

mind, and should always be looked for. In cases with much anterior displacement of the epiphyseal fragment, pulsation in the vessels of the leg may be wanting, and, if this has persisted long enough, there will be coldness, pallor, or cyanosis, and swelling of the extremity. In the slightest cases pain and swelling in the epiphyseal line only may be present. With any considerable amount of displacement, there will be shortening of the limb. In some cases the separation of cartilage from

diaphysis is not clean cut, and a spicule of bone may be found to go with the epiphysis, resulting in possible sensation of bony crepitus, and adding to difficulties of reduction.

The diagnosis from dislocations of the knee is usually easy, the difference in the deformity being usually marked. A posterior displacement of the epiphysis, which is extremely rare, might resemble a posterior dislocation of the tibia, and therefore require X-rays for determination. In fractures of the lower end of the femur, the bony crepitus and character of the deformity should afford evidence by which we can differentiate between the two conditions. In the slighter cases, practically without symptoms or deformity, the X-ray alone may answer the question, and in any case where feasible an X-ray plate is of the greatest value both for diagnosis and treatment.

Importance of Repeated X-Rays.—There is no fracture which, after reduction, possesses a greater tendency to recurrence of the displacement or some malposition of the fragments than this lesion. The literature contains many cases apparently reduced, and put up in fixation apparatus, only to show after a few weeks that the displacement has recurred with union of epiphysis in a wrong position, or of development of vessel or nerve injury from pressure. In this series of cases failure of the epiphyseal fragment to remain in place was not uncommon. In Case 4, where reduction apparently was accomplished, obstruction of the circulation developed on the day following, and it is to be assumed that the displacement had recurred, although no X-rays were available. In Case 15 displacement recurred after the operative reduction, the gas-bacillus infection making it impossible to maintain the most effective apparatus. In Case 16 a good result was obtained only by repeated X-rays in that the displacement recurred after two separate attempts, and success only followed immobilization in acute flexion. With the danger that exists in every epiphyseal injury of subsequent faulty development of the involved bone, a prompt and exact replacement of the epiphysis is of the greatest importance, and the repeated supervision by means of X-rays during the first fortnight, until the union of the epiphysis has begun, is necessary.

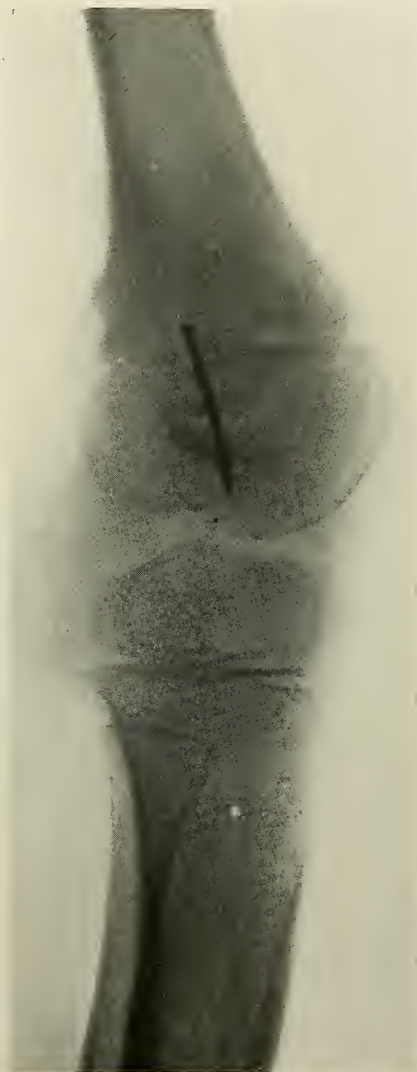
Effect of Epiphyseal Injury on Subsequent Growth.—The danger of some degree of arrest in growth in these cases is well recognized, and must be always considered in the prog-

PLATE V.



CASE 14 (1).— Ant.-Post. view, showing epiphysis reduced and held by wire nail.

PLATE VI.



CASE 14 (2).— Lateral view, showing nail holding epiphysis in position.

nosis. References in the literature to such unfortunate results of this accident are not rare. Broca found a shortening of four cm. four years after operative reduction in a patient nine years old. The injury may affect one side more than the other, resulting in lateral deformity, as in the case of Reboul, the patient showing a genu valgum two years after the accident. In this case operation and wiring of the epiphyseal fragment was performed. Any foreign body such as a nail,

PLATE VII.



CASE 15 (1).—Showing displacement of epiphysis on entrance to hospital. (Compound separation.)

screw or wire penetrating the epiphysis undoubtedly increases the danger of disturbance of growth, and this fact must therefore be borne in mind in deciding upon a method of fixation in operative cases.

Treatment.—The treatment of this fracture presents many problems of peculiar interest. The first and most important of these is the fact that it is invariably associated with injury to the epiphyseal cartilage, so that no matter how simple

PLATE VIII.



CASE 15 (2).—Showing resulting malposition 3 months after gas-bacillus infection of wound, and after two attempts at reduction.

and successful the reduction, there is always a possibility that the cartilage has been so injured as to interfere more or less with subsequent growth. Immediate reduction and the consequent placing of the divided cartilage in position and under favorable conditions for growth is, therefore, a matter of considerable importance. The treatment is also complicated by the concomitant injuries which have been enumerated above and which so frequently happen. Paralysis from pressure of the

PLATE IX.



CASE 16 (1).—Showing recurrence of displacement 2 days after reduction and immobilization on ham splint.

sharp posterior edge of the upper fragment has been produced as enumerated in several of these cases and injuries of the arteries have resulted in gangrene with consequent amputation.

Simple Separation.— In simple cases of milder type in which there is simply loosening of the epiphysis without extensive detachment of periosteum or muscles and therefore little or no deformity, fixation in the extended or slightly flexed position will suffice. As a rule plaster of paris is preferable to the ham splint, as more positive fixation is obtained. Where slight

PLATE X.



CASE 16 (2).—Showing successful result after second reduction and immobilization in acute flexion.

forward displacement has occurred, and is likely to recur, fixation in semi-flexion is often effective. In this series extension or moderate flexion was used at the first application in all but Cases 14 and 16; but in five cases, or one-third of the total, deformity recurred, requiring further reduction and a change of method in the fixation. In two of these cases the result was so serious as to require amputation (Case 4) and resection (Case 3). In the majority of cases a careful and thorough reduction can be obtained only by use of an anæsthetic. In this series only three cases were reduced without ether (Cases 3, 7, 13). The more serious cases with marked deformity may be attended with considerable difficulty in reduction and subsequent treatment. Under full anæsthesia the deformity, if a lateral one only, can be corrected by traction of the lower leg and manipulation of the epiphysis. With the more difficult anterior displacement of the epiphysis, traction and extension often fail to correct the displacement. As was emphasized by Hutchinson, flexion usually furnishes the key to the situation. With the thigh elevated and knee flexed, traction on the lower leg will tend to draw the epiphysis down into its normal position. Manipulation of the epiphysis in front, and pressure forward in the popliteal space on the lower end of the diaphysis by an assistant, will facilitate the reduction. The problem then becomes one of preventing recurrence of displacement. Maintenance of the right angle position by means of plaster of paris is usually a safe procedure. Great care, however, must be exercised to prevent pressure on the popliteal vessels and nerves. An X-ray must be taken during the first few days to insure maintenance of the epiphysis in the correct position. If the epiphysis cannot be held by this method, the question of immobilization in acute flexion or of operation and fixation of the epiphysis by nail, screw, or bone-plate arises. Likewise, if the reduction cannot be accomplished, immediate operation should be done and it may then be found that, as in Case 4, interposition of the torn capsule is the reason which prevents reduction. Although Stimson and others are opposed to fixation in acute flexion on account of the irksome attitude, this has been employed successfully in a number of cases, and in this series was resorted to successfully in Case 16. With evidence of vascular injury, however, one should hesitate to employ acute flexion for fear of increasing obstruction to the circulation. In the average case

it would seem more desirable in view of the quickness and certainty of good reduction to resort to operation, and after open reduction, inasmuch as there is always more or less of a tendency to a recurrence of the deformity, the writers would advocate the use of a nail through the outer condyle as was performed in Case 14 by one of the writers (Dr. Binney).

Compound Separation.—After thorough cleansing of the wound, which may have to be enlarged, and after removal of hindrances to reduction such as bands of fascia or capsule or a projecting spicule of bone, the displacement having been reduced, fixation of the fragment must be obtained. The technique of the method used by one of the writers may best be described by citing one case in detail:

Case 14.—The patient, a boy of 6, sustained a compound separation of the lower epiphysis of the right femur by being run over. At the Relief Station a lacerated wound of popliteal space found with projection of lower three inches of the diaphysis through the skin wound. Soft parts much lacerated but artery intact. For cleansing as well as reduction operation performed by Dr. Binney. Wound thoroughly douched; on flexion and manipulation deformity was corrected, the epiphysis coming into place without difficulty, but could be displaced forward very easily. As the wound extended on to outer aspect of knee, the outer part of epiphyseal junction easily exposed. To prevent possible recurrence of the displacement, with the epiphysis held in place by flexion and pressure in front of the knee, a wire nail, $1\frac{1}{8}$ inches long, which the resident, Dr. Brickley, had provided, was driven through the outer edge of the diaphysis obliquely inward and slightly backward, into the epiphyseal fragment. The wound was then closed with drainage and a plaster of paris spica bandage was applied, with the knee slightly flexed. At the operation no serious injury to the external popliteal nerve was noted, although it was laid bare for the distance of two or three inches.

Except for superficial sepsis of the wound, he made a good recovery, and union was solid at the end of a month. Slight toe-drop noted. *Removal of nail:* To prevent possible interference with growth at the epiphysis, seven weeks after injury the boy was etherized, a longitudinal incision two inches long made over external condyle, carried down to bone. Owing to considerable periosteal thickening head of nail hard to find, but on being disclosed it was easily grasped with artery forceps and withdrawn. Wound closed. Ham splint applied. Wound healed promptly. At end of eight and one-half weeks boy was discharged on crutches to Out-Patient Department, there being considerable degree of toe-drop. (See Plates V. and VI.)

A somewhat similar instance was reported by Desmarest, in which, the attempt to reduce displacement failing, he operated on the eighth day and by means of a lever behind the diaphysis,

pressure on the epiphysis, and flexion, was able to reduce it. He used lateral incisions. The epiphysis was then secured by plates over both condyles, which were removed on the fortieth day. Nine months after injury there was no shortening, and the X-ray showed perfect position. He cites six other cases

PLATE XI.



CASE 17 (1).—Showing position of epiphysis on entrance to hospital.

from the literature in which screws, nails, silver wire, or bone-plates were used with good immediate result, but the late result was not known, except in Reboul's case, which showed a genu valgum at the end of two years.

The presence of the wire or other foreign material *for a limited period* does not seem to damage the epiphysis sufficiently to

interfere with the growth of the bone. It seems wise, however, to remove fixation materials, such as nail, wire, or bone-plate, as soon as their object is accomplished, namely, within two or three weeks. In Case 14 the delay in removing the nail was due to complicating sepsis of the popliteal wound. This, however, was superficial, and did not involve the epiphyseal injury.

Excision of the joint is probably never necessary. It was performed in Case 3 in this series, but that was a case in which

PLATE XII.



CASE 17 (2).—Showing epiphysis in good position after reduction under ether, and immobilization on ham splint; no tendency to recurrence. Good final result.

the deformity had been allowed to remain unreduced for a very long time, and at operation reduction seemed impossible. Excision will practically remove the lower epiphysis and will, as it did in this case, form a very serious impediment to growth so that very marked shortening will result.

Case 8, referred to above as having peroneal paralysis, is very interesting, as showing the amount of interference with

the growth of the epiphysis, which resulted from the compound separation. The epiphysis was reduced, remained in place and united. The injury occurred in 1905, when the boy was eight years old; subsequently, the toe-drop was treated by Dr. Lund, who freed the external popliteal nerve from the surrounding scar tissue. He returned for observation in 1911, having grown to his full height and showing about two inches of shortening. He walks on the ball of his foot, and has to have a high heel on the shoe on that side. The accompanying photograph (Plate III.) illustrates the amount of shortening and the smaller size of the limb.

The writers wish to express their thanks to their colleagues who have allowed them the use of their cases.

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XXV.

REMOTE METASTASES FOLLOWING CANCER
OF THE BREAST. *

BY J. C. HUBBARD, M. D.

Cancer of the breast is a favorite subject in medical literature. Much has been written about its diagnosis, the technic of its removal and the end results of operation, and of late years it is with cancer of the breast that scientists have worked to determine the cause of cancer in general. Scattered through this mass of material is a wealth of facts concerning the remote metastases following mammary cancer which I have brought more or less together in this short paper. The incentive to do so was furnished by my interest in several cases which recently came under my observation of secondary growths of mammary cancer remote from the breast.

Before going further it may be well for me to explain what here in this paper I mean by remote metastases. I choose to class under this heading those metastases which develop in parts of the body distant from the primary tumor. I therefore pay little attention to secondary growths in the axillary glands or on the chest wall. It is with those appearing in the bones and thoracic or abdominal organs that I am most concerned.

There is some difference of opinion by what route the cancer cells reach these distant organs. That they pass through the lymph stream is generally accepted. That they pass through the blood vessels and into the general circulation is believed by some men. Gladstone † is an exponent of this latter theory. He believes that the cancer cells enter the general circulation and pass by the arteries to the different viscera. To prove his claim he cites the metastases occurring in the vault of the

* Read before the Alumnae Association, Women's Hospital, New York, April 23, 1912. Reprinted from the "Boston Medical and Surgical Journal," Vol. CLXVII., No. 1, pp. 1-4, July 4, 1912.

† Middlesex Hospital Cancer Reports, Vol. III.

skull. It is distinctly stated that these secondary growths occur symmetrically and follow the branches of the middle meningeal artery. By injecting this artery with coloring matter, he determined that there is a free communication between the arterioles and venules without the intervention of small capillaries. He thought that this free communication of the arteries of the bone with irregular venous spaces doubtless favored the lodgment and growth of the secondary carcinoma cells. For it is in situations where the bone is especially vascular, and the veins large, that the deposits are most common. He felt the power of resistance of that particular part determined whether the cancer cells grew or not. In other words, the selection of a certain situation for a secondary growth depends, according to Gladstone, on the state of the circulation of the part, and the power of resistance of the tissues.

Handley,* on the other hand, believes that where the cancer cells do not get into the lymph circulation they travel along the fascia, and not through the arteries. He believes that the cancer spreads by continuity along the network of the pectoral fascia, which anastomoses freely with the fascia of the abdominal wall. In a later report (Vol. IV.) he shows by the microscope that there is a permeation along the fascia. A fibrosis occurs about the growth as it extends thus, and shuts off here and there areas of cancer cells, which by growing make these nodules which we see clinically.

As a clinical proof of the correctness of his theory, he cites thirty-seven cases where the bones were the site of secondary deposits as proved by examination or spontaneous fracture. He excludes cases where the growth was in the rib or sternum, because of their close proximity to the primary growth and the probability of simple extension of the original process. In these thirty-seven the femur was involved 4.2 per cent, spine 6.3 per cent, cranial bones 2.7 per cent. He states that the most common site for the growth in the femur is in the upper third, about two inches below the base of the trochanter; that the humerus is most often involved at the deltoid insertion. He reasons now that were the cancer cells carried by the blood stream, as the nutrient artery in the femur runs upward, the metastasis would occur at the epiphyseal line rather than below it, as is the fact. In the humerus the nutrient artery enters the bone below the deltoid insertion, and runs down-

* Middlesex Hospital Cancer Reports, Vol. III.

ward, away from the common situation of the metastasis. He argues also that were the cells carried by the blood stream, pulmonary metastases would be more common in those cases which have involvement than in those without secondary deposit in bone. This, however, he states cannot be proved by the figures. He believes that the bones are involved where they lie nearest to the deep fascial lymphatics, that is, where they come nearest to the surface, namely, at the base of the trochanter and the deltoid insertion, sites which correspond with the places clinically most commonly involved. As the weightiest argument of all against blood infection, he brings forward the fact that the tibia and fibula entirely escape from secondary growths. He argues that were the cells in the blood stream, these bones would be just as liable to embolism as the humerus or femur.

Ribbert, in his recent book on carcinoma (*Das Karcinom des Menschen*) demonstrates microscopically that cancer reaches the lumen of lymph vessels and the veins and arteries, and illustrates the passage of the tumor into the circulation by a breast cancer growing into the inside of a vein. He says that the cancer cells proliferate so rapidly that they lose their connection with the main growth and wander about until they lodge, and then continue to grow. They may go to pieces and act on the surrounding tissues as a foreign body.

He believes that, in breast cancer especially, the growth is certainly by continuity. He believes also that metastases by the blood stream do occur, though ordinarily less common by that than by the lymph stream. He thinks that the longer the primary growth is present the more liable it is to get into the blood circulation.

In going over the medical records at the City Hospital, I was very much surprised at the number of cases of internal cancer secondary to breast cancer. I had no idea that they were so common. Such cases evidently go to the physician rather than to the surgeon. It seemed while looking over these records that it would be possible to illustrate from them almost any kind of case desired.

The reports of the Middlesex Hospital are most trustworthy, as the diagnosis is made from microscopic sections on practically every case. I have culled most of the following figures from the various clinical reports of that hospital: In comparing the frequency of remote metastases in the cellular and

fibrous type of mammary cancer, it is of interest to note that Campiche, Lazarus and Barlow found* that these growths were widespread in both types, but that the fibrous type showed a greater tendency to infect important organs, while metastasis in the bone was found more commonly in the cellular type. Metastases are, of course, multiple in many cases. A metastasis in the other breast is not so very uncommon. In a series of 1,512 cases the opposite breast was involved in 9 per cent of cases. On the average, the secondary growth appeared three years after the primary. In another series of 412 cases collected by Beckton (Report VIII.) forty-six had a metastasis of the opposite breast. From the figures collected during 1910 and 1909, there were twenty-eight cases of cancer of the breast, with ten cases of secondary growth in the opposite breast. Combining these cases, there are 1,952 cases with a secondary growth in the opposite breast in a little over 9 per cent of the cases.

The thoracic organs, as one would naturally expect, are frequently involved. In the twenty-eight cases occurring in the years 1909 and 1910, there were twenty-two cases where the thoracic organs were affected.

When one comes to the abdominal organs, the liver is by far the one most frequently involved. Beckton collected from 1904 to 1908, 481 cases of cancer of the breast. In 96 of these cases there were metastases recognized postmortem. Of these 96, 51 had involvement of the liver, and of the 28 cases occurring in 1909 and 1910, there were 10 cases in which there was liver involvement.

The kidney, however, is one of the organs least frequently involved. In Beckton's series of 96 cases with metastases recognized postmortem, the kidney has a secondary cancer in only 8 cases. In the 1909 14 cases, there was but one case of kidney cancer, and in 1910 there was not a case of kidney involvement in the 14 cases. This, therefore, makes the case which I report later quite uncommon.

The relative frequency of the involvement of the different organs is often quite unreliable when determined clinically. The figures made from autopsy findings should alone be accepted. The following statistics demonstrate this clearly. Campiche, Lazarus and Barlow collected from 1858 to 1903,

* Middlesex Hospital Cancer Research Report IV.

1,110 cases in which no autopsy was made. From these cases there was said to be a metastasis of the liver recognized during life in nine cases, and of the kidney in but one. In a series of 410 with a postmortem examination, the liver was involved in 202 cases, and the kidney in one—a vastly higher percentage. The same difficulty occurs when one tries to consider the figures of secondary growth in the skeleton. The skeleton is scarcely ever examined unless there are clinical evidences drawing particular attention to a definite bone. In these same 1,110 cases, the vertebræ were involved but three times, the femur but nine times clinically, while in the 470 cases examined by the microscope the vertebræ were involved thirty-two times and the femur twenty-eight.

Sprengel, quoted by Snow,* examined carefully the bones in twelve cases of mammary cancer; nine of these showed on microscopic examination scirrhus carcinoma, although in not one had there been during life anything like a tumor or a spontaneous fracture to call attention to the bone.

Ribbert states that bone metastases in females most commonly follow cancer of the breast, while in the male they are secondary to the prostate, and, as has already been said, the cellular type more often involves the bone secondarily than the scirrhus form. Ribbert states that the bone metastasis may be the only one present in the body, the other organs being free. With a bone metastasis, spontaneous fracture is of course liable to occur, and is often the first symptom of any trouble.

No matter how metastases reach the bone, statistics show that secondary cancer of the bone beyond the elbow and knee is exceedingly rare. In a large series of autopsies of cases of cancer in the Middlesex Hospital Report, cancer of the tibia is mentioned only once, and it is explained in this case as having reached the tibia by continuity from the femur, the knee-joint being ankylosed. The femur is said to be involved 4.2 per cent, spine 3.6 per cent, cranial bones 2.7 per cent.

Ribbert speaks of metastases in the brain, including the membranes, as occurring most commonly after breast cancer. He puts them down as occurring in 15 per cent of the cases.

I have been able to find no mention of a secondary growth in the cord itself.

* "British Medical Journal," March 12, 1892.

The following case is of interest because at the time of the breast operation the prognosis seemed most favorable. The recurrences were fairly rapid, however, occurring in organs which are not often involved.

Mrs. J. C. S., 44 years, was operated upon in June, 1910, for a tumor in the right breast of the size of a large almond, which had been discovered accidentally about seven weeks previously. No glands were felt in the axilla or about the clavicle. At the operation both pectoral muscles were removed, and the axilla dissected. Dr. Whitney was present at the operation, and reported that the tumor was carcinoma and that a few small glands found in the axillary fat contained no metastases. An examination made by him later gave the same result. The final diagnosis was medullary cancer with nothing abnormal in the axillary glands. The patient was not seen again until January, 1912. She had been perfectly well until six months before this date. Then she began to have pains in her back. Treatment by a regular doctor and by an osteopath gave no relief. The pain became very severe. It was painful to lie down or sit up. Walking about seemed to ease the pain. Finally a mass was found in the abdomen coming down under the left ribs. An X-ray picture taken by Dr. Brown showed the kidneys of normal size, and a degenerated spot in the transverse process of the fifth lumbar vertebra. At times her whole spine seemed rigid, and at times much less so. Being a very nervous patient, it was hard to determine the exact amount of rigidity. A catheter specimen of urine contained no albumin. I think that I never saw a patient who appeared to suffer such pain as this woman. She was constantly found walking the floor, holding on to her side. On the nineteenth of January, an abdominal operation was done to determine the site of the tumor. It was found then to be the kidney. The patient was turned over, and the kidney removed. It contained a tumor about the size of the thumb, growing out under the capsule. On examination Dr. Whitney pronounced it to be of the same type of cancer as that in the breast. The patient's pain was greatly relieved; it might be fair to say, entirely so. She had some difficulty in passing urine in the bedpan, and so even the first day after the operation was allowed to get up and use the cabinet. Retention of urine then appeared, partial at first, but gradually increasing, until by January 31 a catheter was always necessary. By this time she was not able to stand on her feet, although the evening following the operation she had been able to do so. She gradually lost the use of her legs, and was unable to move them. The surgical convalescence meantime went along rather exceptionally well. She was seen by Dr. Thomas in consultation. His notes of the case he kindly loaned to me. The diagnosis made by him, and later agreed to by Dr. Walton, was a metastasis in the cord itself in the region of the dorsal vertebræ. Physical examination showed a very complete paralysis of both legs, the only movement being enough flexion of the legs on the thighs to start them swinging, and a very slight flexion of the thighs on the trunk. The muscles of the legs were relaxed, there being no spasticity, but there was no atrophy. Knee-jerks were present and equal on the two sides. There was slight ankle clonus

and Babinski sign, and Oppenheim's reflex on both sides. Sensation for touch and pain in both legs was markedly diminished and on the trunk, front and back, the upper level on the back being at the level of the third lumbar spine and on the front to one and one-half inches above the umbilicus on the left, and three inches above on the right. The abdomen was full, slightly distended, but not tender. The abdominal and epigastric reflexes were absent on both sides. The muscles of the thighs and legs reacted well to the faradic current. The arms were normal in every way. The pupils were equal and normal, and there was no disturbance of the ocular muscles, such as diplopia or nystagmus. Retention of urine.

The condition remained much the same, except that bedsores developed, and the patient died early in March. The degenerated place in the transverse process of the lumbar vertebra clinically caused no symptoms.

A. McN., 53 years, single. Entered the Boston City Hospital on October 18, 1911, with the following history:

One year ago the left breast was amputated for cancer at another hospital in the city. For about one year the patient has had more or less trouble with the left knee. It began with sudden pain and slight swelling. It has bothered her off and on until four weeks ago, when the knee became swollen, painful and stiff. There is no history of an injury. There has been no cough, no chills, no vomiting or loss of weight.

Physical Examination.—A well-developed, rather fat woman, pupils equal, regular, and react to light and distance. Throat negative, tongue protrudes straight, clean and moist. Neck negative. A scar for the removal of the left breast. Heart not enlarged. No murmurs, occasional râles at the base of lungs. Abdomen fat, otherwise negative. Temperature, 98.9°; pulse, 85.

There was no evidence of any local recurrence of the breast cancer. The left leg was greatly swollen from the mid-thigh to the ankle, and motion was slightly painful. The X-ray plate showed a great loss of density in the head of the tibia. There were many expressions of opinion given by the surgeons who saw the case as to the diagnosis. Finally I cut out a bit of the tissue for examination. Dr. Mallory reported it to be carcinoma of the type similar to mammary cancer.

Because of the great rarity of cancer of the tibia previously mentioned, this case is of considerable interest.

G., 42 years old, entered the Boston City Hospital on December 3, 1910. She gave the following history:

January, 1909, she noticed a small lump in the right breast near the sternum. Amputation of the breast was done in the same year at a hospital in the city. In September, 1909, had an attack of rheumatism which has been continuous up to the present time. In December, 1909, had a recurrence of the breast tumor in the operation scar. Went back to the hospital for rheumatism in May. Discharged unrelieved in two weeks. Breast has been getting rapidly worse, but not painful. Has been attended since by district nurse. Three months ago began to have a tender and painful lump on the right jaw, which is increasing in size. Has had considerable pain in both knees and the left hip. Three days ago, while the nurse was attending to the patient, she lifted the right leg by the foot. The patient felt a snap, the nurse put the leg down and then lifted it again;

then came a louder snap, and a large lump appeared on the front of the hip. She was brought to the hospital, unable to move, and in much pain.

Physical Examination.—Thin, emaciated woman. Mucous membranes pale. Pupils equal and react. Teeth poor. Tongue rather dry and brown-coated. Right ramus of the jaw presents a firm, rounded swelling from about one inch in front of the angle to an inch from the symphysis, closely adherent to the bone. Not tender. Enlarged glands beneath both rami. Supraclavicular glands enlarged. Chest examination unsatisfactory because patient unable to sit up. Lungs in front normally resonant. Heart not enlarged, sounds of good quality. No murmurs. Left border in nipple line. Pulses equal, regular, synchronous. Artery wall not palpable. Right chest shows scar of breast amputation, and dissection of axilla. Nearly in the median line a hard, nodular, heaped-up growth, about the size of half an orange, firmly adherent to the chest wall. Ulceration, slight amount of discharge. Tumor not tender or painful. Axillary and inguinal glands not enlarged. Liver dulness from sixth rib to costal border. Edge not felt. Abdomen tympanitic and soft. Visible peristalsis. Just below the iliac crest on the left and behind the anterior superior spine is a non-tender, non-painful mass about one and one-half inches in diameter, and two inches long, closely adherent to the bone. Femoral glands enlarged. The right femur presents an oblique fracture at the mid-shaft, with crepitus, mobility and localized tenderness. One inch shortening.

Patient was put in an ordinary apparatus for a fractured thigh, and, without getting any great amount of union, remained in the hospital until the hot weather in July, when she quietly died.

The case is of interest because of the spontaneous fracture, evidently due to a metastasis in the femur. The tumors of the jaw and ilium were evidently also bony metastases.

Mrs. D. Entered the Boston City Hospital in June, 1911. She gave the following history:

She was operated on for a tumor of the vagina. Then a second operation for repair of the perineum, etc. Then came a vaginal hysterectomy for a tender uterus. Then an appendix operation. The right breast was then removed for cancer. Then the left breast was removed for cancer. Then a laparotomy was done, both ovaries were taken out, being cancerous. Then came an operation on a tumor of the jaw, which proved to be cancer, and a dissection of the glands on the opposite side. When she entered the hospital, she was thin, emaciated and had much difficulty in swallowing, being able to take liquids only.

On X-ray examination of the chest there was a mass in the mediastinum which probably pressed upon her esophagus. A gastrostomy was done. Stomach was found very much contracted, and numerous small nodules scattered through the retroperitoneal region.

She lived for several days quite comfortably, and then without any apparent reason quietly died.

This case is of interest because of the many operations she had had, and the metastases of a breast cancer occurring in the other breast, in the ovaries, and in the jaw itself.

XXVI.

ACUTE ANGULATION OF THE TERMINAL ILEUM
AS A CAUSE OF INTESTINAL OBSTRUCTION
IN CERTAIN CASES OF ACUTE
APPENDICITIS.

BY DAVID CHEEVER, M. D.*

No more frequent and fatal complication of acute appendicitis exists than that comprising the various types of post-operative intestinal stasis. These may be assigned roughly to two main groups: First, those due to failure of peristalsis, resulting in intestinal paresis, distention, and stasis of the fecal current; and second, those due to mechanical obstruction resulting usually from kinks, twists, adhesions or bands. The most familiar examples of the first group are the cases of paralysis associated with peritonitis causing a toxæmia acting either after absorption or locally on the neuromuscular mechanism of the intestine; the paralysis due to trauma, seen in the course of long abdominal operations involving manipulation and exposure; and that due to mesenteric thrombosis. Many of these cases are relieved spontaneously or by appropriate non-operative measures, but not a few require interference, by enterostomy, as an emergency measure to provide drainage until peristalsis may be restored, and no more anxious and difficult decision confronts the surgeon than when to interfere. The cases of mechanical obstruction forming the second group are sharply demarked etiologically, but if they occur early they are unfortunately difficult to separate from the paralytic cases. This does not refer to the late secondary cases of ileus occurring weeks, months or years after the operation. Inasmuch as mechanical obstruction, once established, is rarely relieved except by operation, and since the mortality of such secondary interference, high enough anyway, is vastly increased by delay, it becomes imperative to make the diagnosis and proceed to the relief of these cases at the earliest possible moment.

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Since in appendicitis the area immediately adjacent represents the usual region of peritonitis with resulting possibilities of adhesions, it is natural that the terminal ileum should be the most frequent seat of mechanical obstruction due to this cause. This is recognized by most surgeons and is mentioned by many writers on the subject of the post-operative sequelæ of appendicitis. There is a small subdivision of this group of cases which seems to the writer to present a fairly clean-cut clinical picture, and therefore to offer possibilities of early diagnosis and successful interference justifying its brief presentation.

Three cases called attention to this condition:

Case 1.— Esther C., 7 years of age, entered the City Hospital December 8, 1906, with a story of abdominal pain and vomiting for two days. She presented the clinical picture of a spreading peritonitis of the lower abdomen and pelvis, probably due to appendicitis. Incision behind the right rectus showed free pus in the right iliac and hypogastric regions and pelvis. The appendix was found acutely inflamed, hanging over the pelvic brim, and adherent to the lateral wall of the pelvis; the tip of the appendix was perforated and reached to the pelvic floor. The appendix was removed, the pus was wiped away and cigarette drains were carried to the right iliac fossa and pelvis. The case progressed favorably for three days, but on the fourth day distention, constipation and vomiting began. Readjustment of the wicks failing to relieve, the wound was explored hastily and fruitlessly, owing to the patient's condition, and an ileostomy was made through a small incision in the left linea semilunaris. This artificial anus tided over the crisis and, on January 1, 1907, a loop of terminal ileum adherent in the pelvis and containing in its proximal portion the artificial opening, was excised and the bowel repaired by end-to-end anastomosis. The patient made a satisfactory recovery.

Case 2. Hugh McC., 24 years of age, entered March 6, 1907, with a history of abdominal symptoms for three weeks, becoming acute during the last two days. The abdomen was tender, dull to percussion and spastic in the right iliac and hypogastric regions. Incision showed free turbid fluid and a gangrenous appendix lying in the pelvis. It was removed and the infected area drained. The patient showed marked toxæmia but rallied and did well for three days, when vomiting and distention appeared, with failure to procure relief by enemata. Time was wasted by these measures and a final ileostomy did not avert a fatal result. Examination through the wound showed the terminal ileum adherent and sharply angulated in the pelvis.

Case 3.— Edith D., 18 years, single, entered June 30, 1911, with a history of acute abdominal symptoms for four days. The whole lower abdomen was spastic and tender, especially on the right where a mass was palpable. On opening the abdomen through the right rectus a free turbid exudate was found with an incompletely walled-off abscess occupying the right half of the pelvis and right iliac fossa. The appendix was semi-necrotic, perforated, and adherent to the wall of the pelvis and its tip to

the pelvic floor. It was removed and the infected area drained in the usual way. Although very ill, the patient began a rapid convalescence with soft abdomen, good bowel movements and diminishing pulse rate. On the sixth day, elevation of the pulse and temperature with other symptoms suggested a residual abscess whose presence was not confirmed by digital examination. Distention began to appear but enemata gave some results. Time was wasted in the adjustment and withdrawal of drains and by palliative measures. On the eighth day vomiting began and the abdomen was reopened. Precious moments were lost in exploring and controlling the distended bowel which threatened fatal evisceration. The condition as to peritonitis was satisfactory, but the terminal ileum was found adherent along the tract formerly occupied by the appendix, and acutely angulated at the floor of the pelvis. The adhesions were separated, the ileum freed and additional drainage of the bowel established by a tube in the proximal limb. The patient left the table exhausted and died in twelve hours. The first misfortune was the failure to establish the diagnosis of obstruction earlier; the second was the choice of an exploration rather than ileostomy to relieve it.

Each of these cases presented at the time of primary operation a degree of peritonitis sufficient to warrant a grave prognosis, but in each case it was arrested and the toxæmia controlled, promising recovery until the obstruction introduced a new element, fatal in two cases, fortunately relieved in one.

The mechanism of this complication is apparently clear. Studies on the cadaver and of bismuth radiographs indicate that in the majority of cases the terminal coils of the ileum occupy the pelvis, sharing its cavity with the pelvic colon. In many cases, especially if the colon and other pelvic viscera are distended, the ileum is largely forced out of the pelvis, but probably it is the rule that if traced backward from the cæum it will be found to run downward against the right aspect of the pelvic wall to its floor, if the length of the mesentery permits; it then partially fills the pelvis or is pushed upward by the other pelvic viscera, thus presenting a potential kink at its lowest excursion. If an acutely inflamed appendix lying in a mass of inflammatory exudate along the pelvic wall is removed, there remains a bed of adhesive plastic exudate against which lies this terminal limb of ileum. Evidently the conditions are ideal for the formation of prompt and firm adhesions, especially if the usual post-operative paresis of the intestines is marked and prolonged, as in the case of a diffuse peritonitis. Probably in the majority of cases no definite harm results, or nothing worse than some degree of chronic ileostasis, but more rarely, owing perhaps to the crowding out of

the pelvis of the rest of the ileum, an acute angulation occurs at the lowest fixed point, which, with condensation of the inflammatory adhesions, affords obstruction to the passage of gas; then ensues dilatation, which in turn results in more kinking and a valve-like obstruction which becomes fixed by the agglutination of congested serous surfaces.

It is not clear what means may be employed to prevent the occurrence of this series of events. It may be wise to encourage a knuckle of pelvic colon to lie against the bed of the appendix, or to place there a coil of ileum somewhat distant from the cæcum to prevent the rigid angulation described above. The corner of a very long omentum might be adjusted there, probably at some risk of the formation of dangerous bands. It is probable that a drain covered with or composed solely of rubber tissue and flattened rather than rounded, adjusted over the appendix bed so that it intervenes between the pelvic wall and the ileum, may prove effective, since the exudative reaction occurring beneath it is less likely, after its withdrawal, to cause adhesions. Since the occurrence of the last case noted above, the writer has carried out this manœuvre in a number of cases, approximately twelve, in which the conditions at the primary operation corresponded closely with those above described, and he has not observed an instance of post-operative obstruction of this character. This evidence is, however, too limited to be of much value.

The therapeutic suggestion gained by a consideration of these cases is not new, but affords a clean-cut plan of procedure in a limited group of very grave cases. It may be summarized as follows: In acute pelvic appendicitis, where the inflamed or gangrenous appendix has been torn from its bed on the lateral pelvic wall, from brim to floor, the occurrence of the earliest symptoms of acute intestinal stasis, especially if appearing after an interval of a few days of normal convalescence, should lead to the assumption that there exists an acute angulation of the terminal ileum at the pelvic floor. After the elimination of ill-placed drains as a factor, at the earliest justifiable moment, the attack should be directed at that point by a secondary operation. If the patient's condition does not justify this, a better than forlorn hope is offered by ileostomy.

XXVII.

TRANSFUSION IN THE TREATMENT OF RUPTURED
TUBAL PREGNANCY.*

BY ROBERT M. GREEN, M. D.

The direct transfusion of human blood, conceived in theory several centuries ago, and subsequently attempted from time to time without success, was first made a practicable surgical possibility in 1906 by the scientific genius of Crile. Since then, improvements in the technic of the operation have been made by Elsberg, Vincent, and others; and to-day direct blood transfusion stands as a recognized therapeutic procedure of great beneficence and value.

The field of indications for transfusion has been steadily widened until it includes a large variety of conditions characterized by diminution in the quantity or change in the quality and constituents of the circulating blood. In some of these conditions the benefit of transfusion is transient or doubtful. In none is it more strikingly definite, curative, and life-saving than in the acute anemia of traumatic hæmorrhage, from any cause, and in that imperfectly understood group of diseases collectively classified under the name *hæmorrhagica neonatorum*.

Of the conditions giving rise to acute internal concealed hæmorrhage, the rupture of a tubal pregnancy affords one of the most dramatic and serious pictures of surgical emergency. Though not frequent, it is unhappily not rare, and occurs with a considerable percentage of regularity in the clinical experience of general as well as of special practitioners. Though not often immediately fatal, it generally becomes so if not promptly treated by surgery; and though nature may occasionally effect a cure by the organization of a pelvic hæmatocele, rarely by the continuance of abdominal pregnancy and formation of a lithopedion, the after-results of these terminations are likely to be inconvenient, serious, or lethal. Even

* Reprinted from "Boston Medical and Surgical Journal," Vol. CLXVIII., No. 8, p. 270, February 20, 1913.

prompt surgical treatment is by no means always effectual in saving life; for the shock of laparotomy, superadded to that of hæmorrhage, often constitutes the *coup de grâce* to a patient already *in extremis*. For these reasons, any procedure which shall minimize the shock of operation and restore, in whole or in part, the volume of blood lost, is urgently to be desired in the effort to reduce the mortality of this grave abdominal emergency.

The employment of direct blood transfusion in the treatment of ruptured tubal pregnancy immediately suggests itself to anyone familiar with the conditions. As a matter of fact, I have been able to find very little reference in the literature to the use of transfusion in the immediate treatment of ruptured tubal pregnancy.

Anderson,¹ in the discussion of a paper by Wilkinson, mentions having examined the blood of a patient with secondary anemia following a ruptured ectopic pregnancy, in whom "transfusion was followed by very happy results."

Soresi,² in an article on "Clinical Indications for Direct Transfusion of Blood," mentions two ruptured ectopic pregnancies in a list of twenty-five cases in which he has performed transfusions, but gives no further details, other than to state that both patients were helped by the transfusion and recovered.

Doubtless the procedure has been much more extensively employed in ruptured tubal pregnancy than these references would seem to indicate, but the cases have not happened to come to my notice, or have not been reported. Obviously, Anderson's case was one of late transfusion, and hardly comes within the field of our consideration. Soresi's cases were probably fairly early and acute, though he does not state whether the transfusion was done at the time of original operation or later.

It was therefore my desire to test the procedure in actual practice and to determine whether immediate transfusion might not be a valuable adjunct to the surgical treatment of ruptured tubal pregnancy.

Opportunity to do this has arisen twice during the past five months in the Gynecologic House Clinic at the Boston City Hospital. For the privilege of operating upon and reporting these two cases, I wish to express my most courteous and appreciative gratitude to the Visiting Surgeon, and to my senior colleagues on the staff. I wish also to extend my cordial

and sincere thanks to all the house officers and nurses who assisted in the operation and care of these patients, for the cheerful and efficient fidelity, zeal and intelligence of their cooperation.

Case 1.—M. A. R., 25, married one year. No previous pregnancies. Last catamenia May 26, 1912. Entered Boston City Hospital (Gyn. 181-209) at 1 a. m. on August 8, 1912, with a history that twenty-four hours ago she had a sensation of scalding, followed by severe pain in the lower part of the abdomen. She has grown progressively weaker and has been very thirsty all day. Some vomiting; no headache or fever. Physical examination shows a well developed and nourished woman with an anxious expression, restless, and with marked pallor of skin and mucous membranes. Pulse, 136, of fair quality, and regular. Temperature, 98°. Heart and lungs normal. Abdomen moderately distended, with slight tenderness and spasm throughout, most marked in the left lower quadrant. There is shifting dullness in both flanks. By vagina the cervix is felt to be soft and velvety, the external os patulous, the internal os closed. There is a slightly blood-tinged discharge. Uterus somewhat enlarged and globular. In the left vault there is a bulging, doughy, tender resistance. White count, 18,000. Hgb. 35 per cent.

The diagnosis of ruptured left tubal pregnancy seemed clear, and immediate operation was advised and accepted.

On opening the peritoneum, the abdomen was found full of dark fluid blood and clots, to the estimated amount of about three pints. The left tube was found to be the site of a ruptured ectopic pregnancy, and was accordingly tied off and removed. The right appendages were normal. The appendix was thickened and showed a few old adhesions, and was therefore also removed. The patient's pulse was by this time 160 and of very poor quality. In view of her precarious condition, transfusion had previously been suggested, and the husband, who had volunteered as donor, had meantime been prepared. While the abdomen was being closed in layers by the senior assistant, the donor's left radial artery was exposed under $\frac{1}{2}$ per cent cocaine local anæsthesia. The patient's left median cephalic vein was also exposed, and transfusion performed by the usual technic, employing an Elsberg canula in making the anastomosis. Good pulsation was obtained in the recipient's vein, and the blood was allowed to flow for twenty-five minutes, delivering an amount estimated at one and one-half pints. During this period the patient's color and general appearance improved notably and her pulse fell to 132. By this time the donor was becoming pale, and sighed several times, though his pulse had risen from 70 only to 90. The transfusion was therefore intermitted, the vessels tied off, and the wounds closed with horsehair stitches.

The patient made an uninterrupted convalescence. For several days she had a slight pyrexia, as is common in these cases from absorption of fibrin and from peritoneal insult; but her pulse never again rose above 132, and dropped steadily to a level of about 90. She was discharged well on the fourteenth day after the operation, with both wounds healed by first intention, hemoglobin of 75 per cent, the uterus well involuted, and the pelvis free from exudate. The donor's wound also healed by first

intention, and after a few days he felt none the worse for his experience, and has had no unpleasant after-effects, either from his loss of blood or from the sacrifice of his radial artery.

Case 2.—S. F. H., 36, married for six years. No previous pregnancies. Last catamenia October 12, 1912. Entered Boston City Hospital (Gyn. 186-353) on December 20, 1912, with history that two weeks before entrance she began to have cramp-like pain in the lower abdomen, which has continued ever since and for the past week has been accompanied by moderate flowing, no vomiting, chills, or fever; no history of previous similar attacks of pain.

Physical examination showed a well developed slender woman, with moderate pallor of skin and mucous membranes. Heart and lungs normal. Pulse, 128, regular, fair quality. Temperature, 98.8°. White count, 7,800. The lower half of the abdomen was tender, with moderate fulness and spasm, especially on the right. No shifting dullness was made out in the flanks. Vaginal examination showed the cervix small and soft, the uterus of apparently normal size and displaced forward and to the left by a tender, rounded, semifluctuant mass, about the size of a large orange, occupying the right vault and extending into the posterior cul-de-sac. The left vault was free. There was no flowing.

The patient's history suggested an ectopic pregnancy, with primary rupture two weeks before, followed by encysting of blood clot and the formation of a pelvic hematocele. Pelvic abscess was also considered as a diagnosis, but was considered unlikely in the absence of fever and leukocytosis. As the patient's condition seemed in no way critical, she was put to bed and kept under observation.

On December 21 her condition was essentially the same. That night she had a considerable exacerbation of pain in the lower abdomen, but no flowing, and her pulse began to rise. When seen at 9.30 a. m. on December 22, her clinical picture had distinctly changed. She was markedly pale and restless, had a thready pulse of 140, and there was a notable increase of general abdominal spasm and tenderness, though no free fluid was made out. In view of these developments, the diagnosis was made of secondary rupture of an encysted ectopic pregnancy, and immediate laparotomy was advised and accepted. The patient's husband consented to act as donor, if transfusion should be deemed necessary.

On opening the abdomen, a considerable amount of dark, clotted blood was found free in the peritoneal cavity, and floating among the clots was a two-months' embryo. The right tube was ruptured, and connected with it was a cavity of adhesions, evidently representing the result of the first rupture two weeks previously. The right tube and the small sclerotic appendix were removed. It was then discovered that the fluctuant mass previously felt by vagina in the posterior cul-de-sac was a parovarian cyst originating from the left broad ligament, but prolapsed and adherent behind the uterus. This cyst was removed intact, and the uterus suspended. The patient's pulse was now 160, irregular, and her condition evidently grave. Therefore while the senior assistant was closing the abdomen in layers, the donor's left radial artery was prepared, by the usual technic, and transfusion performed into the patient's right median basilic vein, an Elsborg canula being employed in making the anastomosis. Good pulsa-

tion was obtained in the recipient's vein; but as the donor's artery was small, and his pulse-volume not as great as in the preceding case, the flow was allowed to continue forty minutes. During this time the patient's color and general appearance improved markedly, and her pulse dropped to 120. At the end of this period the donor, whose condition had apparently remained unchanged during the transfusion, turned suddenly pale and sighed profoundly. The vessels were therefore tied off, and the wounds closed with horsehair stitches, a continuous subcuticular stitch being used in the case of the donor.

The patient's pulse later rose again to 140, but dropped to normal in a few days, and she made an uninterrupted convalescence, except for the moderate, characteristic pyrexia of the first week, as above described. She was discharged on the seventeenth day after operation, with both wounds healed by first intention, and hemoglobin of 70 per cent. The donor recovered promptly and completely.

Several points of technic deserve comment in connection with this case. In the previous transfusion considerable difficulty was occasioned by the bleeding from small radicles on the posterior surface of the radial artery, which were cut in raising it from its bed. In the present case, therefore, the artery was exposed, but was mobilized only at the point of applying the canula. The remainder of the artery was mobilized only at the moment of making the anastomosis, and the bleeding was much less than when the radicles were cut before the flow of blood into the vein was established.

At a recent unsuccessful attempt at transfusion in a case of profound sepsis, failure seemed in part attributable to spasmodic arterial contraction from the trauma of the Crile clamp applied above the anastomosis. Accordingly in the present instance no clamp was employed, the compression of the canula alone being relied on to hold the blood current in check, and proving entirely efficacious. At first no ligature was applied about the canula at the point of anastomosis; but after a while there began a slight leakage, which was, however, easily controlled by a ligature, passed without interrupting the transfusion.

These two cases are of course far too few to warrant any positive or generalized conclusions. Both patients might well have recovered without transfusion; but it is my belief, from such experience as I have had, that their prognosis without transfusion was fairly grave, and that the transfusion at least did no harm, minimized shock, and expedited convalescence, even if it did not actually save life. These two cases, in my opinion, seem to indicate that direct blood transfusion may be a procedure of definite value in the treatment of ruptured tubal pregnancy. It would certainly be unwise and unnecessary to advocate its employment as a routine measure, but in properly selected, grave cases it seems justifiable. It can do no harm, and may do much good. The ideal method would be to

have one operator begin the preparation of the donor's artery at the same time that another operator opens the recipient's abdomen, in order that the transfusion may be made immediately after the hæmorrhage is checked; but if this be impracticable, the method above described is satisfactory. In any event, I believe that transfusion at the time of laparotomy is much preferable to transfusion at a later period, since it supplies the blood when it is most needed, combats the shock of the primary operation without involving additional shock, and by enabling the operator to take advantage of the recipient's original anæsthesia, obviates the necessity and disadvantage of a second anæsthesia, without which the transfusion can hardly be performed with success and convenience. It is to be hoped that further reported experience, from different sources, in the employment of this procedure, may contribute sufficient clinical data to determine definitely its value, indications and limitations in the treatment of ruptured tubal pregnancy.

SUMMARY.

1. Direct blood transfusion is a surgical procedure of beneficence and value in the immediate treatment of ruptured tubal pregnancy associated with excessive hæmorrhage, and may to advantage be employed in such cases as soon as possible after the hæmorrhage is checked, and under the original anæsthesia.

2. Even if the patient's life is not in imminent danger, such transfusion, in serious cases, at least does no harm, minimizes shock, and expedites convalescence.

3. In the technic of transfusion, if the Elsberg canula be employed, it seems advisable not to apply a clamp proximally to the donor's artery unless the compression of the canula proves insufficient to control the flow of blood. It seems also advisable not to mobilize the donor's artery completely until the moment when the anastomosis is made, since by this method troublesome hæmorrhage from minute arterial radicles may be avoided.

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XXVIII.

A REPORT OF TWO CASES OF MALIGNANT DISEASE
OF THE VULVA.

BY NATHANIEL R. MASON, M. D.

In practically every case of carcinoma of the vulva, leukoplakic vulvitis has existed beforehand. We are ignorant of the cause of this disease, but we know that it is preceded by the single symptom of intolerable pruritus. In leukoplakia the surface of the vulva is of a dull white color owing to the thickening of the epithelium.

The inguinal glands on both sides are early affected in carcinoma of the vulva. Leukoplakic vulvitis and carcinoma of the vulva are usually met with in elderly women. It is absolutely necessary that the patches of leukoplakia be completely removed in order to guard against the subsequent development of carcinoma.

The ultimate results of operations for carcinoma of the vulva are unsatisfactory because local recurrence and recurrence in the inguinal and iliac glands frequently result. The unsatisfactory results are due to incomplete operations for the disease, or because they are employed when the disease is far advanced. Better results would be obtained by the employment of a complete operation in the beginning of the disease.

The following reports are histories of two cases of carcinoma of the vulva.

Case 1. A. B., born in England, 33 years old and single, entered the hospital August 3, 1911. The history was that for ten years she had noticed a swelling of the vulva accompanied by a profuse foul discharge. She had never been pregnant. For the past year the vulva had increased markedly in size, and she had lost twenty pounds in weight.

Examination at entrance showed a well developed and fairly nourished woman. Enlarged glands were felt in both groins. Vaginal examination showed a cauliflower tumor extending from the pubis to the anus, and completely covering the vulva. The vulva bled readily on touch. Areas of necrosis over the tumor discharged thick yellow pus. The pelvis could not be reached by the examining finger, for it was hugged by

the œdematous vagina. A rectal examination showed the pelvis to be normal. No palpable lymph nodes were felt in the pelvis but in both groins there was a chain of them enlarged to the size of peas.

Operation.—After preparation of fifteen days she was operated on August 18. The glands in both groins were removed. The entire carcinomatous area which replaced the vulva was removed, accompanied by profuse bleeding.

A pathological examination of the mass removed from the vulva showed it to be epidermoid carcinoma. There was no evidence of malignancy in the lymph nodes.

The convalescence was long and stormy. The patient suffered extreme pain over the entire surface of the wound which suppurated and discharged pus freely. On her discharge to the Out-Patient Department October 9, on the fifty-second day after the operation, the following note was made: "Clean granulating area the size of the palm of the hand over the former site of the vulva."

The condition of the patient steadily improved. She was back at work in a few weeks and was making plans for her marriage.

Case 2. C. D., born in Italy, 59 years old, and a widow. Entered the hospital August 15, 1911. The history was that for seven months she had had pain and itching in the vulva. She had had two children.

Examination of the patient at entrance showed a well developed, but emaciated woman. Several tender glands could be felt in right groin varying in size from a pea to a plum. Inspection showed a hard, slightly sensitive tumor of the size of an olive attached to the right labium, just to the right of the clitoris. The clitoris was indurated and enlarged to the size of a finger.

Operation.—On August 21, six days after entrance, she was given ether for operation. The glands from both groins and the carcinomatous growth of the vulva were excised.

A pathological examination of the lymph nodes and the mass removed from the vulva showed epidermoid carcinoma in both.

A good convalescence was made, aside from slight infection about the silkworm gut stitches, which was produced by the patient's persistent efforts to remove the stitches with her finger nails.

She was discharged to the Out-Patient Department September 13, twenty-three days after the operation. A few weeks later both groins broke down and discharged pus, and the patient was reported to have failed rapidly. The ultimate results of the case are unknown to the writer.

XXIX.

THREE CASES OF SPINAL CORD SURGERY.

BY ISADOR H. CORIAT, M. D., AND L. R. G. CRANDON, M. D.

We wish to place on record three cases of spinal cord lesion, in which early surgical intervention was productive of excellent results. Spinal cord surgery is of interest to the neurologist and surgeon alike, as it furnishes the data for regional level diagnosis and the perfecting of operative or decompression technique. Our cases will be reported with a minimum of comment, as data referring to spinal cord injuries and tumors can be found in abundance in the various text-books on neurology and surgery and in the special monographs of Wagner and Stolper, of Krause, and of Kocher.

The first two cases were severe injuries of the spine with a crush of the spinal cord; the third case was one of spinal cord compression resulting from an osteomatous tumor growing into the spinal canal. Our cases demonstrated two important facts, viz:—the value of an exact regional diagnosis of the cord lesion, thus limiting in extent the laminectomy, and the excellent results which may be obtained in spinal cord surgery from early operation. The writers feel from their experience that early laminectomies alone offer the unfortunate victim of spinal cord lesion any hope of amelioration or cure.

The chief point of differential diagnosis in severe injuries of the spine, where neither fracture nor dislocation can be demonstrated, is in the so-called cases of spinal concussion. In spinal concussion not only are marked irritative root phenomena predominant, but also the sudden onset of weakness or paralysis of the muscles innervated by the particular segment involved. In most cases this paralysis disappears at the end of twenty-four to forty-eight hours, while the root symptoms may persist for a prolonged period of time. This persistence of definite root symptoms has been noted in several of our cases of spinal concussion. It could be clearly differentiated from a traumatic neurosis, since in the latter condition the

pains referable to the spine are indefinitely localized and no sensory disturbances involving definite spinal metameres can be demonstrated. In this group of cases we have found that absolute rest in bed, combined with immobilization of the spinal column in plaster, has within a few weeks led to a complete disappearance of the root pains and the disturbances of sensation. In so-called spinal concussion with marked symptoms pointing to posterior root irritation, it is extremely doubtful if even microscopic hæmorrhages take place within the spinal cord. In these cases we are probably dealing with a temporary suspension of function combined with a transitory œdema of the spinal cord, a process which has also been noted in experimental concussion of the brain. (Cannon, Scagliosi.)

The pressure resulting from this œdema may, according to the segment involved, produce a varying degree of transitory motor paralysis and root pains. This explains the mechanism far better than a hypothetical theory of microscopic "molecular changes." Scagliosi, however, found that spinal concussion in rabbits caused alterations of the nerve cells within twenty-four hours, followed by a rapid secondary degeneration. Actual compression of the spinal cord, as shown by Thomas in a case of meningeal tumor, may produce degeneration of the myelin sheaths of a systemic type and marked increase of neuroglia both above and below the point of compression.

Thus injuries of the cord may vary from simple concussion with œdema to actual destruction or complete disintegration of the cord, a type of traumatic myelitis, or a severe hæmatomyelia. The most severe damage is usually caused by fracture or fracture-dislocation of the vertebræ. The diagnosis and extent of the lesion and the important element of exact localization can only be determined by a thorough neurological examination, into the details of which it is not necessary to enter here. In injuries to the vertebræ, where an actual distortion or fracture cannot be demonstrated, it is well not to delay operation for more than forty-eight hours. If at the end of this time the paralysis or motor weakness has not disappeared or shown signs of improvement, then one may be fairly certain that the lesion is a destructive one (pressure, hæmorrhage, disintegration) and not a mere œdema or concussion of the spinal cord. Even in a persistent œdema, however, a decompressive laminectomy may be productive of

benefit, analogous to cerebral decompression for the relief of headache and choked disc in brain tumors or in serous meningitis. Of course, if an actual fracture or dislocation can be demonstrated, or if the symptoms due to œdema fail to clear up within a reasonable time, operation is advisable in order to attempt to restore the functions of the damaged spinal cord.

In actual damage of the spinal cord there is no regeneration of cells or fibers, and it has also been shown that prolonged œdema, pressure or hæmorrhage may likewise cause irreparable cell and fiber lesions within a few hours. In tumor cases the degeneration is slower, because of the slow growth of the tumor and gradual development of pressure.

It has been demonstrated by Ballance and Stewart and also by Schmaus that structural regeneration has never been observed in the central nervous system. In cases of experimental hemisection of the cord, where the cut fibers have been left in apposition on their appropriate tracts, regeneration did not take place. The result was degeneration and sclerosis. The explanation of this failure of central regeneration in contradistinction to regeneration in the peripheral nervous system (such as in nerve suture, facial-hypoglossal or facial-spinal-accessory anastomosis) is to be found in the absence of neurilemma cells in the central nervous system. In some cases of experimental section of the spinal cord, a few scanty regenerated fibers have been observed in the periphery of the cord, but these fibers were of the "peripheral type," possessing neurilemma cells. In compression myelitis or in tumors of the cord, the restoration of function after removal of the pressure by operation is due, not to regeneration, but to the fact that many fibers have escaped injury. Possibly the œdema resulting from pressure may have rendered the fibers temporarily functionless, without any actual destruction. Here again, however, recovery of function can take place only if the compression has not proceeded to the point of causing irreparable degeneration and the formation of sclerotic tissue.

Recently, however, Lewandowsky and Neuhof have been able to demonstrate in a case of complete transverse lesion of the spinal cord due to a bullet wound, and followed by a flaccid paralysis of the lower extremities and a disappearance

of the deep and superficial reflexes, that faradization of the paralyzed limbs may cause the reflexes temporarily to return.

Thus in injuries of the spinal column, the prognosis depends upon the extent and site of the lesion, upon the amount of damage sustained by the cord and finally upon the period elapsing between the time of the injury and the decompressive laminectomy. In spinal cord tumors the prognosis is largely dependent upon the nature and site of the tumor, the duration of the pressure symptoms and the accuracy of the level diagnosis. The outlook is more grave in tumors of the cervical than in those of the thoracic or lumbar regions, although successful results in the removal of cervical tumors have been reported. In suspicious cases of spinal cord tumor, with a negative Wasserman reaction and a negative cerebro-spinal fluid, an exploratory laminectomy seems justifiable. In the severe intramedullary tumors, particularly those showing a syringomyelic temperature dissociation, a decompressive laminectomy may cause a temporary amelioration of the paralysis and the irritative root pains. In analyzing the cases of spinal cord tumor from the literature, Oppenheim found recovery or improvement in 50 per cent of the cases, thus rendering the prognosis more hopeful than it appears to be at first glance.

Case 1.— J. S., age 38, carpenter, on August 12, 1911, fell from a staging a distance of about twenty-five feet and struck on the back in the mid-dorsal region. There followed the accident some tingling of the legs with almost an immediate paralysis of both legs. The paralysis was of the flaccid type and without muscular spasm. Respiration was normal, but there was a slight elevation of temperature. There followed rapidly on the accident priapism, retention of urine, and incontinence of feces. The patient was seen four days later in consultation with Dr. E. J. Powers.

The Physical Examination showed the following: Complete flaccid paralysis of both legs, abdominal muscles not involved, although the abdominal muscles on the right side seem less active than those on the left. Knee jerks, Achilles jerks, plantar reflex and cremasteric reflexes were absent. The left abdominal reflex was more brisk than the right. There was extreme tenderness, with deformity, over the twelfth dorsal spine: Hyperalgesia and hyperæsthesia over the left leg below the knee (the fourth lumbar and first and second sacral segments), hyperalgesia and hyperæsthesia over the right thigh and right calf, involving the same segments. Over the left thigh and the anterior portion of the right leg there was complete analgesia and anæsthesia. Thermoanæsthesia was well marked over the entire right thigh, the right calf and entire left leg. The sensory disturbances ceased abruptly at the level of the twelfth dorsal segment. (See Chart 1.)

The clinical diagnosis was fracture and dislocation of the lower dorsal vertebræ with hæmatomyelia.

Operation.—(Dr. Crandon.) Four days after injury, laminectomy of eleventh and twelfth dorsal and first lumbar vertebræ. The bodies of the vertebræ were found cracked and in some places broken into small fragments. The spinal cord was bent considerably to the right and anteriorly at an angle. The first lumbar roots were torn. The upper lumbar

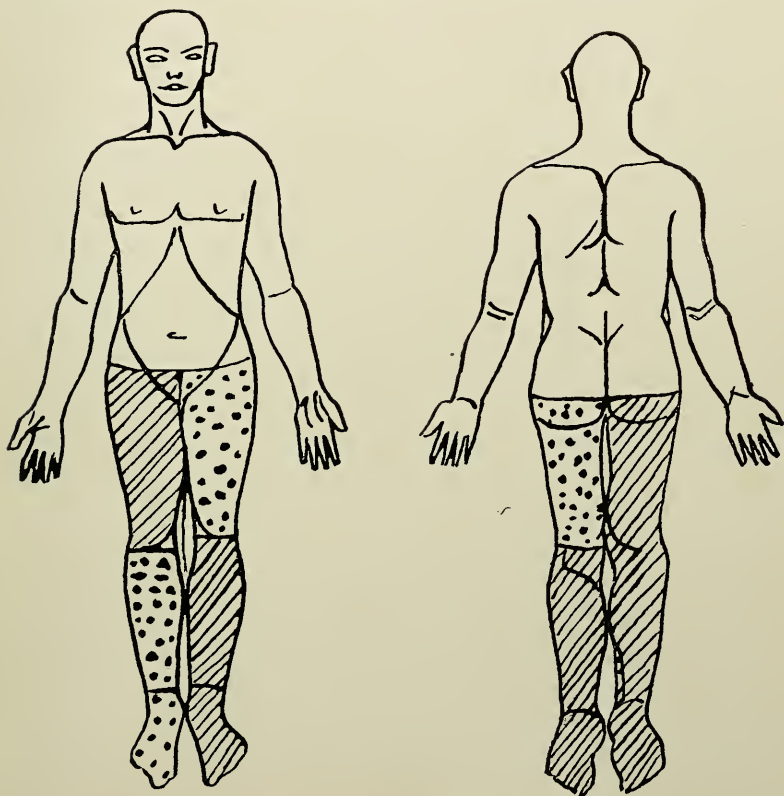


CHART 1.

Disturbances of Sensation in Case 1.—Hyperalgesia, hyperæsthesia and thermoanæsthesia are indicated by the oblique parallel lines; analgesia and anæsthesia by the dotted areas.

segment of the cord was crushed, the dura tense and filled with blood and debris of nerve tissue.

The patient slowly recovered and sixteen months after operation he writes that he is able to raise the left leg from the floor and that for two months some movements of the right leg have been possible, but he cannot move toes on either foot. There is occasional pain in the legs and some muscular twitching. It is impossible for him to retain the urine after the call for urination.

Case 2.—E. M., age 23, on January 18, 1912, was struck by a falling pile of lumber. There resulted a compound fracture of the right tibia and almost immediate paralysis of both legs. There was very little shock. On the day of the accident there was retention of urine, necessitating the use of a catheter, although there was a sensation of pain in the full bladder. Retention of fæces was also present. The temperature following the accident was 98°, but during the course of the day it arose to 101.6°. No priapism. Slight hiccough. There was swelling and tenderness in the region of the second and third lumbar vertebræ. He was able to slightly extend and rotate the legs and also slight movement of the toes was present, but there was complete inability to flex either the legs or the thighs.

The patient was seen on the day following the accident in consultation with Dr. George Fenwick.

Examination.—Distention of bladder, no dribbling of urine. Distinct knuckle and deformity, with tenderness, over second lumbar vertebra, also tenderness without deformity over fourth lumbar vertebra. Unable to move the toes. Very slight flexion of leg on thigh is possible, also slight movement of the quadriceps muscles, and slight ability in external rotation of both thighs. With the exception of these limited muscular movements there is complete flaccid paralysis of both legs. No fibrillary twitching of the paralyzed muscles and no spontaneous pain. Knee jerks present but quickly exhausted. Both Achilles jerks absent. No Oppenheim, Babinski, or ankle clonus. No plantar reflex. Right cremasteric very brisk, left sluggish. Abdominal reflexes brisk and equal. Hypoalgesia and hypoæsthesia of both legs comprising the fourth lumbar and first and second sacral segments. Analgesia over penis and testicles and over the buttocks, comprising the third and fourth sacral segments. Anæsthesia and analgesia of both feet below the ankles. No sensory disturbances to heat or cold. (See Chart 2.)

The clinical diagnosis was fracture of the lower lumbar vertebræ, and a lesion of the cord involving the lower sacral segments and the conus.

January 20. Beginning trophic skin disturbances over both buttocks.

Operation.—(Dr. Crandon) Laminectomy. Cord crushed. Forward dislocation involving cord in the lower lumbar region. Fracture of lamina of the third lumbar vertebra. Dura intact. No subdural hæmorrhage.

March 7. Cystitis with incontinence of urine. Sacral decubitus and healing decubitus on left heel. Weak, but almost normal movements of left leg are possible. Slight dulling of sensation over left foot. Voluntary movements of right quadriceps muscle.

April 8. Decubiti and cystitis improving. The open fracture of the left tibia is healing (delayed union due to trophic disturbances?). The patient is unable to move the toes of the left foot but can flex and extend the left leg at the hip and knee and also rotate the left thigh. Unable to move toes of the right foot but can voluntarily contract the right thigh muscles. Moderate incontinence of urine. Left knee jerk moderate; impossible to test the right knee jerk on account of the splint. Plantar reflexes absent. Abdominal and cremasteric reflexes brisk and equal. The sensory disturbances are as before but less marked.

July 17. The fracture is practically healed. All voluntary movements of both legs are possible, excepting the persistence of a double foot-drop. No spasticity. Reflexes unchanged.

One year after the injury, in response to an inquiry, the patient writes that he is able to move both legs with considerable freedom — likewise the toes — and can walk with help.

No dribbling of urine and no cystitis or bed sores. Tenotomy of both tendines Achillis was done to overcome the toe-drop.

Case 3.—J. C., age 56, was first seen in consultation with Dr. J. G. McPhail on April 4, 1912. Twenty years ago a loaded wheelbarrow had

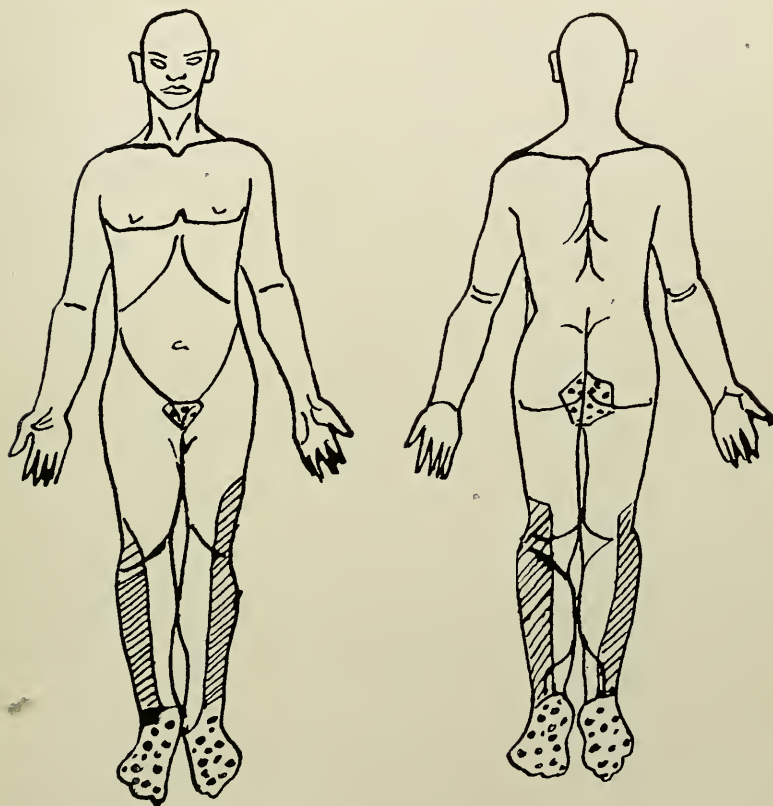


CHART 2.

Disturbances of Sensation in Case 2.—Hypoalgesia and hypoæsthesia are indicated by the oblique parallel lines. Analgesia and anæsthesia by the dotted areas.

tipped over on his lower dorsal region. He was laid up a few days only with contusion of back. Since November, 1911, he has suffered from gradually increasing shooting pains in both legs. About the beginning of February, 1912, pain in the lumbar region became intense and at about the same time he began to lose control of both legs. Finally the weakness and the numbness of the legs increased until about a week before the consultation when he became completely paraplegic. No incontinence of urine or fæces. No history of syphilis.

Examination.—Almost complete flaccid paralysis of left leg with the exception of slight movements of the toes. Right leg shows complete spastic paralysis. Speech and ocular movements normal. No nystagmus. Pupils equal and react promptly to light and accommodation. No tremor of hands. Tongue central and free from atrophy or tremor. Both knee jerks exaggerated. Double Babinski and double ankle clonus. No Oppenheim, Gordon or Mendel-Bechterew reflexes. Abdominal and

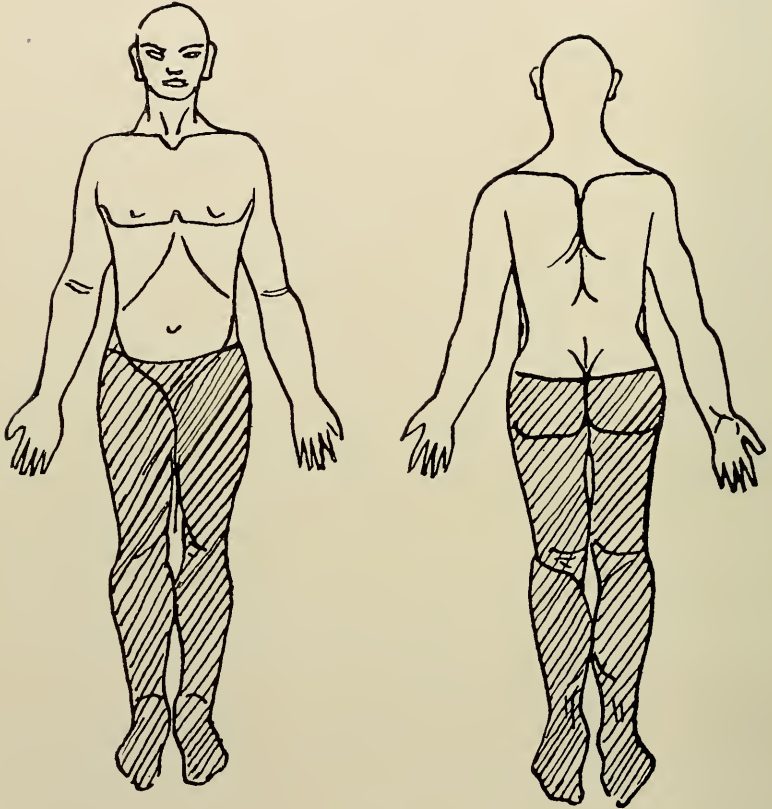


CHART 3.

Disturbances of Sensation in Case 3.—Hypoalgesia and hypoesthesia are indicated by the oblique parallel lines. The right leg also shows thermoanesthesia.

cremasteric reflexes absent. Quadriceps and calf muscles flabby but not atrophied. Subjective complaint of severe root pains radiating around the abdomen. Diminished sensation to touch or pain over both legs and abdomen up to about the lower level of the twelfth dorsal segment. Right leg weaker than left. Thermoanesthesia of the right leg, but not of the left. (See Chart 3.)

The clinical diagnosis was a tumor of the spinal cord, localized at about the level of the twelfth dorsal segment.

April 8.—*Operation* (Dr. Crandon) Laminectomy. During the process of etherization there developed a marked clonus of both legs, particularly on the right. On chiselling of the twelfth dorsal vertebra while the patient was under full anæsthesia the clonus again developed during the process of chiselling but ceased when the procedure was finished. The cord at this region was cyanotic and congested. At the twelfth dorsal segment there was a kink of the cord to the left corresponding to a bony outgrowth and prominence of the right side of the spinal canal. This outgrowth seemed to resemble an osteoma. Dura tense and thickened. Adhesions between the pia and dura. Careful probing up and down beneath the dura detected no obstruction. Dura sutured. No drainage.

April 13.— Voluntary movements began three days after the operation, the patient being able to flex and extend the toes, the ankle joint, the knees and the thighs, although these movements were rather weak and slow. Less subjective sensation of numbness. Diminished knee jerks. Babinski on right, none on left. No ankle clonus and no bladder disturbances. Abdominal reflexes absent. Cremasteric reflexes moderate. No thermo-anæsthesia of right leg. Sensation to touch and pain on right leg is normal; slight diminution of sensation of left leg.

Eight months after operation, in response to an inquiry, the patient writes that he is able to use both legs very well and for two months has walked with help of crutches or a cane, supported, also, by a stiff corset.

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XXX.

SPINAL ANÆSTHESIA. SOME SPECIAL INDICATIONS
FOR ITS USE AND TECHNIQUE.

BY F. L. RICHARDSON, M. D.

Spinal anæsthesia was first used within a short time of the discovery of the analgesic properties of cocaine. This early use of cocaine for the production of spinal anæsthesia was far from satisfactory, due to the great toxicity of the drug which sometimes gave rise to alarming symptoms, which were very distressing, if not actually dangerous. This method of producing anæsthesia would have fallen entirely into disrepute if it had not been for the later introduction of less toxic cocaine derivatives and substitutes which again revived the interest in this procedure. Among the more recent drugs stovaine and tropacocaine are by far the best. These drugs have the further advantage over cocaine that they can be easily rendered sterile without seriously injuring their anæsthetic properties. With the various combinations of stovaine (stovaine glucose, stovaine strychnia, etc.) I have had no experience. The solution I have used most is 5 per cent tropacocaine with adrenalin.

Quite recently, because of the publicity given to the ill-advised use of spinal anæsthesia, this method has received a great setback. One enthusiast has said that the time will come when spinal anæsthesia will be the anæsthesia of election in almost all cases. This is not the belief of most anæsthetists. On the other hand, there are a number of surgeons who believe that there is no use for spinal anæsthesia. As usual, the truth lies between these two extreme views. I believe that it is not justifiable to use spinal anæsthesia for operations above the costal margin because of the danger of respiratory paralysis with high anæsthesias, and I do not favor its use on children, because they are rarely in a condition that renders spinal anæsthesia less dangerous than inhalation anæsthesia.

There are certain classes of patients, however, for whom this method should be considered the method of election because it is less dangerous for them than any other method. Patients with lung conditions which make the inhalation of ether or chloroform a serious risk, especially where there also is arteriosclerosis, will frequently undergo an operation under spinal anæsthesia with remarkably little shock and without the lowering of resistance to infection which ordinarily is such a serious matter in these cases. Patients of this type may be operated upon for hernia, intestinal obstruction, or lesions of the lower extremities, without anywhere near the same amount of risk as where inhalation anæsthesia is used, and will recover remarkably well. Another class of cases that do particularly well under this form of anæsthesia are bladder and rectal cases. Many of the patients with enlarged prostates or stone in the bladder are past middle age, are in far from the best general condition and the shock which follows an operation even when rapidly and skilfully performed is very considerable. Under spinal anæsthesia there is little or no shock and the resistance has not been lowered, as is the case where ether has been used. (Case 1.)

Diabetics form still another class of cases in which this is the anæsthetic of election if the part to be operated on is below the diaphragm. These cases are notoriously poor risks with ether and are not much better with chloroform, but with spinal anæsthesia their chances are very much better. (Case 2.)

One advantage that spinal anæsthesia has over ether when the abdomen is not opened is that there is no necessity of withholding all food, and, in fact, it is a distinct disadvantage to do so. Withholding food for some hours before operation, and the inability of the patient to take any for some hours after, deprives the patient of all nourishment for a number of hours, which in some cases is a matter of considerable importance.

In selecting the cases best suited for spinal anæsthesia one should remember that patients who are very apprehensive do not behave as well as the phlegmatic type. They are more easily distressed by the talking and moving about of the surgeon and his assistants and their attention must be tactfully directed away from the field of operation. It is the duty of the anæsthetist to occupy the minds of the patients with thoughts that are quieting, and it has been my custom to give the patients some hot coffee while the operation is in progress, in part for

the stimulating effect of the coffee, in part for the quieting effect of having something hot in the stomach, but largely to keep the patient's mind occupied.

Technique.—The solution of tropacocaine with adrenalin comes already prepared and sterilized in ampoules. These ampoules should be washed and placed in 70 per cent alcohol for at least ten minutes. Any glass syringe made without packing on the plunger, or washers may be used. The syringe should fit the needle by a friction joint. The needle should be about 9 cm. long, not over 1.5 mm. in diameter and both the needle and the stylet should have a very short concave bevel. Both the syringe and the needle should at all times be kept free from alkali and of course no soda can be used in the water in which they are boiled. The patient should not be deprived of food on the morning of the operation unless the nature of the operation makes this desirable, otherwise the preparation is the same as for inhalation anæsthesia. It is desirable whenever possible to have the patient in the sitting position with the legs hanging over the edge of the table and with the back flexed as far as possible. The back is then scrubbed with soap and water followed by alcohol, being sure that all soap is washed off. An assistant will place a finger on the crest of the ilium on both sides. A line drawn connecting these will cross the spine between the third and fourth lumbar spinous processes. The puncture may be made at this level, but I believe that it is better to use the space between the second and third spinous processes. Having found the third process and marking it with the left forefinger, the tip of the needle is placed on the skin 1.5 cm. to the right of the median line and just above the tip of the spinous process. No anæsthetic is used on the skin as this part of the body is not very sensitive and puncturing the skin hurts no more than making a puncture for a hypodermic injection. When the skin has been punctured the patient will straighten up and the anæsthetist should wait until the patient is again quiet with the back well bent before pushing the needle further in. The direction of the needle should be inward at such an angle that the point will reach the median line at about the depth of 6 cm. and directed slightly upward. When the needle enters the spinal canal there is a distinct feeling of loss of resistance to the onward course of the needle. If the needle

is in the canal the spinal fluid will flow out through the needle freely and until the fluid does flow freely no attempt should be made to inject the tropacocaine. If the fluid flows freely, about 2 c.c. should be allowed to escape, the syringe, which has previously been filled with the proper dose of solution from the ampoules, should then be connected to the needle, a little more fluid drawn into the syringe and then the mixture of spinal fluid and tropacocaine injected. The height of the anæsthesia depends on the amount of fluid withdrawn and the force with which it is re-injected as well as on the position of the patient on the table. The needle should be allowed to remain in position for about half a minute after injection to prevent leakage of the fluid through the puncture hole. After removal of the needle the wound is covered with a sterile cocoon and the patient is allowed to lie down with the head slightly elevated. The dose of tropacocaine solution is about 1.7 c.c. for a patient in good condition, less for debilitated patients. At this time the patients will sometimes complain of a slight feeling of dizziness or faintness. Anæsthesia should begin in about three to five minutes and be complete in about eight to ten minutes. Occasionally patients feel nausea on the table and sometimes even vomit.

If at the end of twenty minutes there is not enough anæsthesia for the operation and the anæsthesia is not going higher a second injection should be made one space higher, using only a third or a half of the initial dose. Anæsthesia will almost invariably follow this injection in three or four minutes and will be complete. Under ordinary conditions the anæsthesia will last for about an hour, at times for two and a half hours and at times for as short a time as forty-five minutes. The anæsthesia begins at the toes and travels up toward the head and sensation is regained in the opposite direction. Some patients complain of slight headache or stiffness of the neck following the use of this method, but so far I have not had any cases in which that was a matter of any importance.

CASE 1. DIABETES, ENLARGED PROSTATE, CYSTITIS, ACUTE RETENTION.

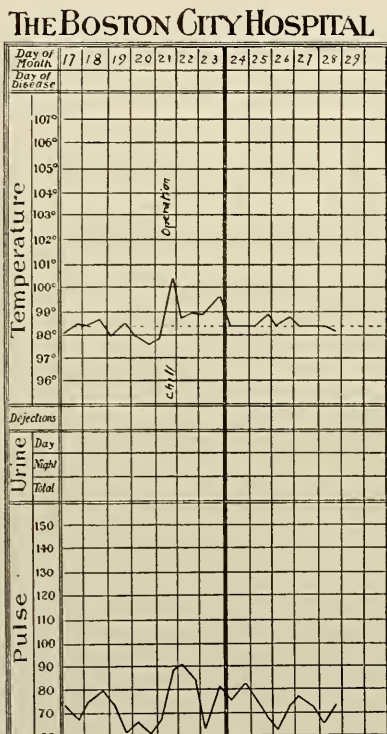
Obese male, 73 years old. Entered the hospital August 8 on the First Surgical Service with acute retention for the past twelve hours.

Physical examination showed the bladder distended almost to the umbilicus. Moderately enlarged, hard prostate. Catheterized with No. 16F. catheter and thirty-five ounces of urine withdrawn. Urine showed 1.81

per cent sugar. Cystoscopic examination showed slight chronic cystitis, enlarged prostate with the left lobe larger than the right or middle lobes.

The patient was put on a diabetic diet and on August 15 the urine showed 0.69 per cent sugar.

August 21. Perineal prostatectomy, Dr. Lund; time, twenty minutes; 1.6 c.c. tropacocaine solution injected between third and fourth lumbar vertebræ. There was no discomfort at the time of the operation except when strong traction was exerted. The patient could feel this pulling



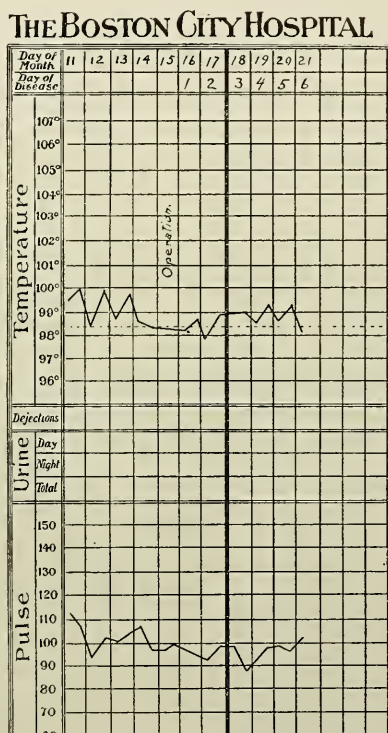
because the anæsthesia extended only to just below the level of the umbilicus and the traction was transmitted by viscera to a point above the highest point of anæsthesia.

After the patient returned to the ward he had a distinct chill, which is not uncommon in operations on the urinary tract, and I believe had nothing to do with the anæsthesia. Sensation returned in about two and one-half hours from the time of the operation, and the subsequent recovery of the case was entirely uneventful.

CASE 2. DIABETIC GANGRENE, MITRAL REGURGITATION, ALCOHOLISM.

Man aged 54 years, bartender. Entered the hospital February 19 on the First Surgical Service. History: Three days ago reddened, painful, swollen area appeared on the left great toe.

Physical examination negative, except for mitral regurgitation and condition of the foot. Examination of the urine showed 7.8 per cent sugar. Patient was put on a sugar free diet, in bed, with dry sterile dressing on the foot. The sugar could not be reduced below 6.0 per cent.



CASE 2.

March 15. Amputation above the knee, Dr. Blake; 1.3 c.c. of tropacocaine solution was given between the third and fourth spinous processes. The anæsthesia was complete for forty minutes, after which the patient could feel the prick of the needle in sewing up the skin, though it did not cause much discomfort. Return of sensation was complete in one and one-half hours. There were no symptoms following the operation which in any way could be due to the anæsthesia.

XXXI.

FRACTURES OF THE TUBEROSITY AND PROXIMAL
END OF THE FIFTH METATARSAL BONE.

BY FRANK H. LAHEY, M. D.

As nearly as I am able to ascertain through my search of the literature, fractures of the proximal end of the fifth metatarsal bone, as the result of indirect violence, were first described by Robert Jones in an article in the "Annals of Surgery" in 1902,* and his attention was directed to it by the occurrence of such a fracture in his own foot while dancing.

The literature on this seemingly typical fracture since that time in medical periodicals, surgical text-books and books upon fractures has been remarkably scarce.

Lillienfeld, writing in the "Archiv. für Klin. Chir.," † describes in a very excellent article fractures of the proximal end of the fifth metatarsal and also fractures and separation of the tuberosity of the fifth metatarsal, observing only five in six hundred fracture cases seen in a period of four and one-half years.

In Stimson's "Fractures and Dislocations" one finds also mention of this fracture, together with references to the literature upon the subject.

Under the transactions of the Philadelphia Academy of Surgery, ‡ one finds a verbal report of three cases by Wharton, all the result of twists with the weight upon the foot in supination.

In nearly all text-books of surgery or fractures one finds the bare statement that the fifth metatarsal, like the first, is particularly liable to fracture on account of its exposed position.

My attention was directed to this fracture in a way similar to Robert Jones', except for the occurrence of such a fracture in my dancing partner's foot instead of my own. Her foot

* Annals of Surgery, Vol. 35, p. 697.

† Arch. für Klin. Chir., Vol. 78, p. 929.

‡ Annals of Surgery, May, 1908, p. 824.

was in a position of plantar flexion, when, on account of a small obstruction to it, the weight was suddenly directed almost entirely upon the outer and anterior edge of her foot. Intense pain was complained of at once over the tuberosity of the fifth metatarsal, where there was also very definite tenderness, swelling and distinct crepitus. The skiagraph (Fig. 2) taken the next day confirmed the diagnosis beyond question.

Following the occurrence of this case, I was constantly on the lookout for this type of fracture in my service in the Surgical Out-Patient Department at the Boston City Hospital. Here the number of cases seen each day runs from one hundred to two hundred, of which cases a great majority are traumatic, including a large number of fractures.

That the fracture is not common is shown by the fact that only seven cases were seen during a period of about four months' search for them. It does occur often enough, however, so that it is not rare, and, if not treated, is the cause of at least partial disability and considerable discomfort over an unnecessarily long period of time.

In my list of cases and likewise in Lillienfeld's one finds three distinct types of fracture, a line of fracture through the proximal end of the metatarsal (Fig. 1), a line of fracture through the base of the tuberosity (Fig. 2), and a line of fracture through the tip of the tuberosity (Fig. 3). This is the type of case which I shall describe later as a separation of an epiphysis, and practically a duplicate skiagraph of this case may be seen in Lillienfeld's article.*

On first thought it would seem that the indirect violence was delivered through the tendon of the peroneus brevis, attached as it is to the tuberosity of the fifth metatarsal, and this is the mechanism suggested by Robert Jones in his article upon this subject. There are, I believe, however, other factors entering into this break, which is so constant in its three different lines of fracture.

In order to bring out these factors, I had made a skiagraph (Fig. 4) of my own foot in as much supination and plantar flexion as possible, hoping in this way to show as nearly as possible the relation of the proximal end of the metatarsal, the tuberosity and the cuboid at the time of fracture or under conditions as nearly similar to it as possible. It was impos-

* A single X-ray of each group has been selected for illustrative purposes, as the prints of each are so characteristic that others would be but repetition.

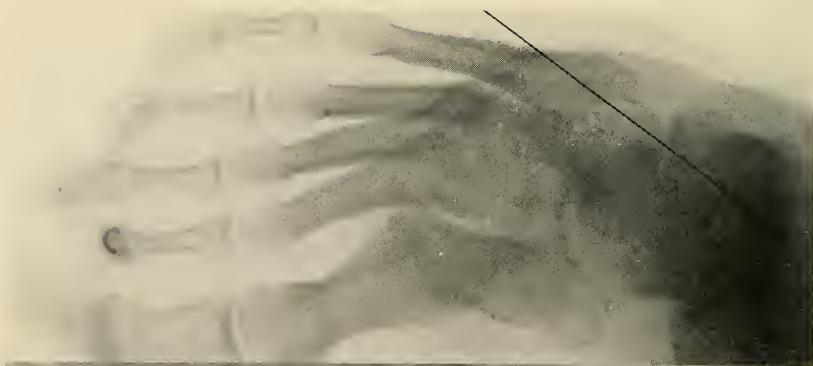


Fig. 4

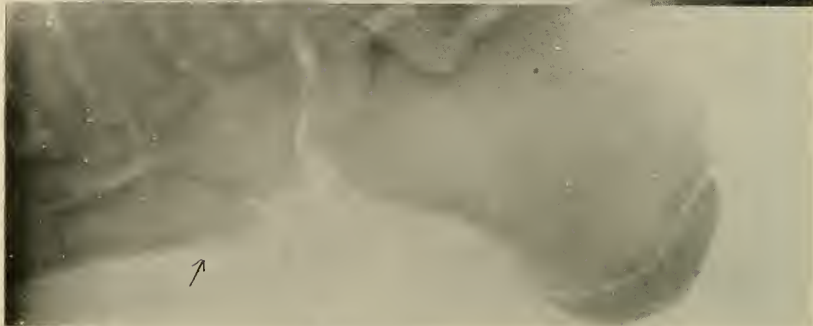


Fig. 3



Fig. 2



Fig. 1

sible to get the amount of weight and the amount of supination desired, as at the time the fracture occurs the weight and position are such that they could be maintained only for one instant. It is likely, then, that the relation of the head, tuberosity and cuboid are even more exaggerated than as they appear in Fig. 4. This skiagraph has been so taken, it is stated by Drs. Dodd and Holmes, that the relations shown in it, so far as the cuboid and fifth metatarsal are concerned, are in no way the result of distortion of the image.

We know that the proximal ends of the fifth metatarsal vary much in size, both as regards the whole end and the tuberosity. (See illustrations in Dwight's "Variations of the Bones of the Hand and Foot.") It seems probable that in the type of case such as Fig. 1 the fracture is the result of pressure from the cuboid directly upon the articular end of the metatarsal indicated by arrow, counter pressure being made at the part indicated by arrow, the situation of strong ligamentous bands running between the fifth and fourth metatarsal, and possibly in a slight measure the result of strong traction upon the tuberosity and proximal end from the pull of the peroneus brevis. If one notes the line in Fig. 4, it is evident that nearly all of the body weight is in this position directed through the cuboid. In this type just spoken of it seems wholly impossible that it can be the result of indirect violence, delivered only through the peroneus brevis tendon; for if one looks at Fig. 3, and notes the direction of the peroneus brevis pull, roughly in the long direction or long plane of the foot, it is obvious that a great part of its effort would be used in pulling the oblique articular surface of the metatarsal against the oblique surface of the cuboid, which in turn carries with it against the metatarsal a great part of the whole body weight. Therefore, it is my opinion that this type of fracture is the result of pressure rather than traction.

To what degree the factor of cuboid pressure enters in the second type of fracture (Fig. 2) it is impossible to say. Its part, I believe, in most of the cases of this type, is not the deliverer of the fracture force, but only the counter force at or near the fracture line and against the pull of the peroneus brevis.

It is in this type, in which the whole tuberosity is torn off, that one is so apt to see the prominent, tapering tuberosity. Here it seems probable that the fracture is brought about

mostly through the sudden, sharp pull of the peroneus brevis, plus the counter pressure in the cuboid, as one would hold a match in one hand, pull on a string tied to it, and break it at or above the place where it is held.

In the third type the fracture force is delivered alone through the peroneus brevis tendon and the fragment represented in this skiagram (Fig. 3) is really the pulling off of an epiphysis.

Before the appearance of this case it had been my impression that an occasional epiphysis must exist in the tuberosity of the fifth metatarsal, but a hasty search through the English text-books of embryology failed to reveal mention of any such epiphysis, until in Kreibal and Mall (*Human Embryology*) reference was found to the occasional appearance of an epiphysis here, upon the authority of Gruber. Gruber, who is also credited with the discovery and description of this epiphysis in Thomas Dwight's "*Variations of the Bones of the Hand and Foot*," and in Lillienfeld's article, states that this epiphysis appears in 4 per cent of cases between fifteen and eighteen years of age. He further states, but with less proof, that there is sometimes an epiphysis involving the whole proximal end of the bone.*

The diagnosis is so simple that it hardly merits mention. The history very often brings out the story of an audible snap and almost always, if one questions closely, the history of plantar flexion and supination at the time of fracture. There is intense pain and local swelling, together with very marked tenderness, over the site of fracture. The elicitation of crepitus will in a measure depend upon the type of fracture. In the type represented by Fig. 1, in which the fracture line is through the proximal end of the metatarsal, crepitus may not be brought out on account of the fracture line running through the situation of the attachment of the ligaments between the fifth and fourth metatarsal. In the other two types, crepitus should be elicited.

Some of these cases have had a long wooden plantar splint, some a short tin plantar splint, some only strapping, and some plaster of paris. I believe that either a plaster cast inclosing the whole foot, or such a plantar splint as to prevent use of the foot, are the best methods of treatment. It is difficult to obtain the consent of patients to apply such dressings, owing to the fact that after the subsidence of acute symptoms, a matter

*Gruber, Wenzel, *Archiv. f. Anatomie und Physiologie*, 1875. *Virchow's Archiv.*, 1885.

of a few days, it is possible to hobble about on the foot without too great pain. That complete rest in the first two and one-half weeks shortens the period of discomfort, I am sure.

Such is the position of these fractures that almost any effort at locomotion brings upon them a strain, particularly on plantar flexion, with the result that pains or discomfort at the site of fracture are complained of over a considerable period of time. Perfect union may be expected with no interference with function. In fractures treated some time after the injury, pain may be expected to persist over a much longer period of time, and a case of non-union has been reported.

In interpreting skiagraphs of the tuberosity of the fifth metatarsal, clinical findings and histories must be at hand, to confirm the Roentgenological findings, as one recalls the occasional appearance of the Vesalianum here.

Dwight describes this bone as similar to the one of the same name in the hand, and states that it is the proximal and external part of the tuberosity of the fifth metatarsal, appearing as a separate bone. "It is excessively rare and should not," he states, "be confounded with an occasional epiphysis appearing here, described by Gruber."*

*Variations of the Hand and Foot, Thomas Dwight, M. D., p. 10.

XXXII.

THE OUTDOOR TREATMENT OF PUERPERAL
INFECTION.*

BY ERNEST B. YOUNG, M. D., AND JOHN T. WILLIAMS, M. D.†

The importance of the outdoor treatment of puerperal infection has never been fully recognized. Although carried out in a desultory manner in different institutions, and by various obstetricians, it has been for the most part entirely overlooked or considered of minor importance.

Stone,¹ of New York, alone, has considered it of sufficient importance to make it the subject of a paper, while Watkins,² Lea³ and others refer briefly to the subject in general articles.

Stone claims that with this treatment restlessness and delirium are less frequent, the duration of fever shortened, the general condition better maintained and, finally, that many cases recover in which the prognosis appears hopeless. Stone, however, gives no statistics to support his views.

The Gynecological Service of the Boston City Hospital receives many severe cases of puerperal sepsis, and for the past five years the outdoor treatment has been the routine.

It is the intention of the writers to show the benefits of such treatment, when supplementing that previously employed, other factors in both series being essentially the same.

From July 1, 1896, to July, 1906, one hundred and fifty-seven severe puerperal infections were admitted to the service, of whom seventy (44.6 per cent) died.

Since July 1, 1906, the outdoor treatment has been faithfully carried out in addition to the treatment previously employed, with the result that in one hundred and thirty-three cases the mortality has fallen to 24 per cent.

In both series no mild infections are included and the temperature in all has been at least 102° or the pulse 130. Such

* Reprinted from the "Boston Medical and Surgical Journal," Vol. CLXVI., No. 11, pp. 405-409, March 14, 1912.

† Former House Surgeon in Gynecological Department.

patients as died within forty-eight hours after admission are excluded, as they may reasonably be assumed to have been beyond the reach of any form of treatment.

It is also fair to state that these women, with a few exceptions, were delivered outside the hospital and admitted after the sepsis was well advanced — sometimes after weeks of treatment in their homes.

The writers regret that it has not been always possible to obtain cultures from the uterus and blood stream, but an analysis of the cases in which such cultures were taken gives essentially the same result as in those viewed from the clinical standpoint alone. Furthermore, it has been our experience that prognoses based upon bacteriological findings are unreliable and that in this regard cases are much better considered from the clinical side. In these series are patients in whose blood streptococci were found, and yet recovery took place; while others, with negative cultures, died with the classical symptoms of general infection.

Vineberg,⁴ Lenhartz,⁵ Semon⁶ and others have noted the same discrepancy.

Of the cases treated indoors, ninety-five followed labor at term and forty-two miscarriage, with a respective mortality of 42.2 per cent and 50 per cent; while of those treated outdoors, ninety-six followed labor at term and thirty-seven miscarriage, with a death rate of 19.8 per cent and 34 per cent, respectively. The greater mortality after miscarriage is due to the fact that the majority of these were the result of induced abortions. Only such cases, however, are included in the latter class as were admitted primarily for sepsis, the uterus being practically empty. The treatment of early septic miscarriages has been considered by the writers in a previous paper.⁷

From the clinical standpoint, puerperal infections are best divided into two classes: First, those with no appreciable localized inflammatory process outside the uterus; second, those with a definite involvement of the adnexa, pelvic veins or peritoneum. Naturally, the dividing line is not absolute, and either may result secondarily in a general infection; but this classification is fully as practical as a division into local and general infection, because it is often impossible to differentiate the local from the generalized process, even with the aid of blood cultures. Moreover, it has been possible repeatedly to

Table I.
Comparison of Results of Indoor and Outdoor Treatment According to Clinical Forms of Infection.

	INDOOR TREATMENT.			OUTDOOR TREATMENT.		
	Number Cases.	Deaths.	Mortality. Per Cent.	Number Cases.	Deaths.	Mortality. Per Cent.
I. Without localized inflammatory process in pelvis:						
(a) Without secondary process in other organs (including septic endometritis and pure septicæmia).	68	26	38.0	70	14	20.0
(b) With secondary processes in other organs (pneumonia, endocarditis, multiple abscesses, etc.).	24	11	45.8	12	7	58.3
II. With localized inflammatory process in pelvis:						
(a) Without secondary processes in other organs (but including cases with also pure septicæmia).	55	26	47.2	43	8	18.6
(b) With secondary processes in other organs (pneumonia, endocarditis, arthritis, multiple abscesses, etc.).	10	7	70.0	8	3	37.5
Totals.....	157	70	44.5	133	32	24.0

demonstrate, clinically, an apparently localized infection, either by the conditions present during the illness or by those found at some later operation.

The results of the treatment according to this classification and also from the bacteriological standpoint may be seen from the following tables, but the number of cases under the less common infections is too small to warrant definite conclusions. They are included for completeness.

Two objections may possibly be raised to the statement that the outdoor treatment was responsible for the lowered mortality during the past five years: First, that patients were sent to the hospital earlier in the disease; second, that the reduction in mortality was due to improvement in some other line of

Table II.

Results of Indoor and Outdoor Treatment According to Bacteriological Examination of Uterine Cavity in One Hundred and Ten Cases.

	INDOOR TREATMENT.			OUTDOOR TREATMENT.		
	Cases.	Deaths.	Mortality, Per Cent.	Cases.	Deaths.	Mortality, Per Cent.
Streptococcus (pure).....	27	11	40.7	23	7	30.4
Streptococcus and other bacteria.....	21	5	23.8	15	2	13.3
Staphylococcus aureus.....	6	2	33.3	7	.....	.....
Staphylococcus aureus and B. coli....	1	.....	.....	7	.....	.....
B. coli.....	.....	.....	.....	1	.....	.....
Gonococcus.....	1	.....	.....	2	1	50.0
Pneumococcus.....	.....	.....	.....	2	1	50.0
B. ærogenes capsulatus.....	2	2	100.0	.....	.....	.....
Saprophytes.....	2	.....	.....	.....	.....	.....
Totals.....	60	20	33.3	57	11	19.3

treatment. If the first objection is valid, there should be a decrease in the relative number of cases, moribund on admission to the wards, in the second series. Such, however, is not the case, for in the ten years from 1896 to 1906 there were 17.3 per cent who died within forty-eight hours after admission, against 18.4 per cent of those constituting the second series.

Table III.*Results in Cases where Blood Cultures were Taken.*

	INDOOR.		OUTDOOR.	
	Cases.	Deaths.	Cases.	Deaths.
Streptococcus.....	3	.....	4	2
Staphylococcus aureus.....	2	1	.....	.....
Pneumococcus.....	2	1	.....	.....
B. ærogenes capsulatus.....	1	1	.....	.....
Sterile.....	6	2	12	2

The second objection must be answered by a somewhat detailed consideration of the treatment employed.

This includes curettage, intra-uterine douches, the use of antiseptics in the uterus, antistreptococcus serum, vaccines, drugs and food.

The dangers of curettage are plain from the accompanying table, the results bearing out the statements of Williams,⁸ Edgar,⁹ v. Herff,¹⁰ Pinard¹¹ and others.

Table IV.*Results of Indoor and Outdoor Treatment as Affected by Local Treatment.*

	INDOOR TREATMENT.			OUTDOOR TREATMENT.		
	Cases.	Deaths.	Mortality, Per Cent.	Cases.	Deaths.	Mortality, Per Cent.
Sepsis after miscarriage:						
Curetted.....	15	11	61	19	9	47
Washed out only.....	7	3	43	8	2	25
No local treatment.....	20	7	33	10	2	20
Sepsis after term labor:						
Curetted.....	53	23	43	21	4	20
Washed out only.....	27	11	40	35	8	23
No local treatment.....	35	15	43	40	7	17
Total:						
Curetted.....	68	34	50	40	13	32
Washed out only.....	34	14	41	43	10	23
No local treatment.....	55	22	40	48	9	18

Winter¹² and Carstens¹³ condemn even the intra-uterine douche. While our series shows slightly better results where no local treatment was attempted, yet this special group consists almost entirely of cases with involvement of the adnexa or pelvic veins and therefore cannot be compared with those subjected to douching or curettage. The writers have never seen any untoward happening as the result of an intra-uterine douche properly given, and, on the contrary, have seen much foul and decomposing material washed away with advantage to the patient. They do not, however, advise repeated intra-uterine douches, and consider, as a general rule, that where the process has spread beyond the uterine wall, such procedures are distinctly contra-indicated.

Although the relative number of cases not curetted was greater in the series treated out of doors, it is not sufficient to explain more than a small part of the improvement in results.

The results following the use of antistreptococcic serum have not been encouraging. The committee of the American Gynecological Association,¹⁴ which investigated this subject in 1899, found one hundred and one cases in the literature, with a mortality of 32.69 per cent — Marmorek's¹⁵ serum was used in all these cases.

Bumm¹⁶ has reported a series of thirty-two miscellaneous infections treated with Aronsohn's¹⁷ and other sera, with 21 per cent mortality. Peham¹⁸ used Paltauf's serum in nineteen pure streptococcus infections with one death; but in spite of some favorable reports, the treatment has given unsatisfactory results.

As the antistreptococcic serum is bactericidal, it must be used early, and at the Boston City Hospital all patients reach us after the opportunity for its use has passed. The induced abortions most often show mixed infections, a fact which would further tend to make the serum treatment of less account.

Antistreptococcus serum was used four times in patients treated in the wards, with 75 per cent mortality; and nine times in patients outdoors, with a fatality of 11 per cent — the combined mortality being 20.6 per cent. Some of these cases have been previously reported by one of the writers.¹⁹

According to the report of Williams, Cragin and Newell²⁰ to the American Gynecological Association on the vaccine therapy of puerperal sepsis, little may be expected.

Vaccines were employed nine times in the outdoor cases, and in each instance an autogenous vaccine supplied. The infecting organism was the streptococcus seven times, and the pneumococcus and staphylococcus aureus once each. Of the streptococcus cases, one died and one maintained the same temperature for four weeks. In the others, the temperature had a distinct downward trend before the vaccine could be prepared, while in the pneumococcus and staphylococcus cases the vaccine appeared inert. No improvement can be ascribed to vaccine therapy.

Drug treatment has remained without decided change during the fifteen years, and thus can exert no influence upon the result.

Hysterectomy has not been performed, nor has any case been admitted which made the consideration of this operation advisable.

In the face of 58.7 per cent mortality in sixty-one cases by Fehling,²¹ and 50 per cent in sixteen by v. Herff,²² it has seemed unjustifiable.

Ligation of the ovarian and internal iliac veins, as advocated by Trendelenburg,²³ Bumm²⁴ and others, is theoretical, and the indications for such treatment uncertain; while according to our experience, the less the tissues are disturbed the better the ultimate outlook.

In all cases when pus has formed in the broad ligaments or elsewhere, it has been evacuated by the nearest route with as little trauma as possible and under local or general anesthesia.

Among the indoor patients, pelvic abscesses were drained eight times, with 50 per cent mortality from the accompanying general infection. For diffuse peritonitis, the peritoneal cavity was drained nine times with 100 per cent mortality.

In the outdoor cases, four pelvic abscesses and an equal number of cases of diffuse peritonitis were drained, with recovery in 75 per cent and 25 per cent, respectively.

Neither collargol nor the nuclein treatment have been used.

The outdoor treatment rests upon a solid scientific basis. Schottmüller and others have demonstrated the hemolytic power of virulent streptococci, and it needs but common powers of observation to perceive the rapid change which such patients undergo in the first few days of a severe infection. Anemia is characteristic, to a greater or less degree, of all septic processes, and changes in the blood have apparently much to do with the final outcome.

Arctic explorers have found that exposure of the skin to the light of an open fire tended to combat the anemia, which the administration of iron did not control, and it has been our experience that sunlight has appeared to have a marked beneficial influence upon all these women. We have made no observations of its effect upon the opsonic index or leucocytosis.

The explanation of the action of fresh air and sunlight in the treatment of puerperal infection appears to lie in increasing the patient's resistance by increasing the hemoglobin or by decreasing the hemolysis.

In urging the importance of outdoor treatment the writers do not wish to be understood as condemning other methods except such as have appeared valueless or dangerous. Nevertheless, there has been a marked tendency in later years to conservatism in intra-uterine manipulation, which has been given its most pronounced expression by Winter¹² and Carstens.¹³ It is our experience that, in all cases of puerperal sepsis, intra-uterine treatment should be avoided, if possible; and in the most severe types the cavity of the uterus is much better untouched and the sole treatment directed to preserve the general condition of the patient, taking care, however, that free drainage of the uterus is maintained.

The writers consider the outdoor method the most valuable means we possess at present for treating severe puerperal sepsis, and one which in no way interferes with whatever additional measures may be considered beneficial to the disease.

The manner of carrying out this treatment at the Boston City Hospital is as follows:

The patient is kept out of doors on a wheel bed which can be moved into the ward whenever attentions of any kind are necessary. Sunlight seems to be quite as important as air, and, except in very hot weather, the patient is placed directly in the sun.

The majority improve rapidly. The pallor disappears, appetite improves, flesh and strength increase and they become deeply tanned. The effect on temperature is not immediate, but gradual, as the patient's resistance increases. The most striking results are seen in the prolonged pyrexias, where after several weeks of high temperature the general condition is wonderfully maintained.

Of drugs, iron and arsenic are valuable aids to sun and air in replacing hemoglobin. Strychnia is given as a stimulant

to the vascular and nervous system. Alcohol increases the appetite and stays the loss of flesh in long-continued fever.

Fluids are supplied copiously by mouth, and in severe cases salt solution is given by rectum to increase the urinary secretion and aid the excretion of toxins. Alcohol and cold sponge baths are given for the pyrexia.

Hot or cold applications are used to relieve abdominal pain and distension.

This completes a brief résumé of the treatment as carried out at the Boston City Hospital.

SUMMARY.

1. The outdoor treatment has reduced the mortality of severe puerperal infections by nearly 20 per cent.

2. This treatment probably exerts its action chiefly by increasing the amount of hemoglobin in the blood.

3. Sunlight is probably quite as important as fresh air.

4. Curettage is contra-indicated in puerperal infection, because it increases the mortality nearly 10 per cent.

5. A single intra-uterine douche of sterile salt solution should be the only local treatment, and some writers deny the value of even this.

6. Antistreptococcic serum and vaccines have not proven of much value.

7. The outdoor treatment is the most effective known at present for puerperal infections, but the search for new methods should be continued.

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