should not lead to the antagonism of any reasonable member of the profession. In our efforts toward what we regard as progress we should proceed with great deliberation and by recognized logical methods. To this end we should quote cases and exploit methods which have stood the test of experience. We should hesitate in appearing before the public with a detailed expression of our views and theories until we have secured the acquiescence of the conservative members of our own profession. We should not ally ourselves with movements over which we have no immediate control; we can ill afford misinterpretation, especially at the hands of our brother physicians. Our essential aim should be to develop a permanent interest in the psychotherapeutic movement within the ranks of the profession, and to do nothing which can in any way retard this effort. To this end we should urge reasonable but adequate recognition of the claims of psychotherapy as a legitimate and necessary element in medical education. Finally, our one object as members of a liberal profession should be to insist upon the importance of psychotherapeutic methods with an enthusiasm which should only be increased by the legitimate limitations set upon its action. By these means I believe the beneficent results which are destined to result from an acceptance of psychotherapy by the whole medical profession will soonest be attained.

THE USE OF X-RAY EXAMINATIONS IN PULMONARY TUBERCULOSIS.*

BY FRANCIS H. WILLIAMS, M.D., BOSTON.

THE profession is now so much occupied in the study and prevention of pulmonary tuberculosis that it seems opportune to emphasize some of the results of x-ray examinations, which were begun in 1896, in this disease, and to point out again that, notwithstanding the difficulties of the method, they deserve systematic and frequent use, especially because they contribute toward making an early diagnosis and thus help to save lives and prevent the spread of the disease.

Under the term x-ray examination, I include an examination with the fluoroscope and a radiograph, the latter made during full inspiration.¹ Much experience is required to interpret what is seen on the fluorescent screen and in the radiograph, and the best results are obtained from x-ray examinations when they are made by the practitioner who also makes the ordinary physical examination. There is no danger of harm or injury to the patient in carrying out an x-ray examination if it is properly made.

This method may be useful, for example, in:

1. Making an early diagnosis.
2. Making a precautionary examination where there is a possibility that the disease is beginning.
3. Cases simulating pulmonary tuberculosis.
4. Determining the extent of the disease.

* Presented at the meeting of the Association of American Physicians, held in Washington, May, 1907.

¹ The first of these I took in deep inspiration were made in 1899.

5. Determining whether it is diminishing or increasing.

6. The diagnosis of acute miliary tuberculosis and fibroid tuberculosis.

7. Recognizing central tuberculosis.

8. Recognizing sometimes an old tuberculous lesion.

9. Cases in which emphysema or asthma and pulmonary tuberculosis are associated.

10. Making an examination for cavities.

1. X-RAY EXAMINATIONS FOR EARLY DIAGNOSIS.

By the term "early diagnosis" I have in mind an earlier stage of the disease than is usually meant by these words. The x-ray signs of tuberculosis in the early stage are often a restricted excursion of the diaphragm on the affected side, due to the fact that the lung expands less fully than normal; the heart and mediastinal contents drawn by the diseased lung and pushed by the healthy lung somewhat toward the affected side in deep inspiration; the bronchial glands perhaps enlarged, especially in children; and a darkened apex of one lung, although instead of this some other part of the lung may cast the shadow. It is probable that two or more of these signs will be found very early in the disease, and the fact that a group of them may be present at this time adds greater weight to the method. The x-rays show clearly the small heart that is sometimes found in tuberculous patients in the early stages, and this may affect the prognosis unfavorably.

Diaphragm, glands and apices. Importance of quality of light in fluoroscopic examinations.—When one lung is nearly or entirely normal and the other only is affected, the difference in the maximum excursion of the diaphragm on the two sides is often great, but when both lungs are diseased, the difference may be slight. Many so-called early cases are seen when the difference in the excursion of the diaphragm on the two sides is not very marked, which may mean that the x-ray examination has not been made until both lungs have become affected. The position of the diaphragm should be traced on the skin (or on a sheet of glass or celluloid held over the chest), in inspiration and quiet breathing, and then in forced inspiration and forced expiration on both sides, and a record made of these positions for comparison with future examinations. It is well that the source of light should always be opposite the median line on a level with the lower border of the fourth rib, and about twenty-four inches from the fluorescent screen, as by this arrangement, examinations made at different times are comparable.

The glands should be examined with the light going through the body from three directions. To accomplish this object with ease, the patient should be seated in a pivoted chair.²

In the early stage of the disease, the practitioner has the opportunity of comparing the

² See Allbutt's and Rolleston's System of Medicine. The Macmillan Co., London, second edition, 1905, p. 491.

FIG. 1. — Tuberculosis of both apices. The physical signs showed trouble at the right apex only.

FIG. 2. — Showing small areas of calcification, probably indicating an old tuberculous.

normal with the abnormal lung. To do this to the best advantage, the patient should take a full breath and the light should be turned down so low that it barely illumines the healthy side. When this very small amount of light is used, a slight increase in density only of the apex of the lung or other parts is necessary to shut out most of it, and, therefore, the practitioner can detect slight differences in density not revealed in any other way. Few practitioners realize the importance of using a small amount of perfectly steady light when examining the chest with the fluoroscope, and the failure to appreciate this fact may prevent them from seeing that the lung is abnormal, until the disease is much more marked. (Hyaline casts cannot be seen in the microscope if there is too much light, as is well known.) By a small amount of light, I mean, as a maximum, in many cases, so little, that five minutes is required to radiograph a hand at a distance of sixteen inches from the tube. This light should be so arranged that it can be readily turned up and down during the examination. Before using the fluoroscope, the eyes should be tested with the spinthariscopes.

Radiographs. — To take radiographs of the chest quickly, a strong light is necessary.

The following case illustrates the value of the x-rays in assisting the practitioner to make an early diagnosis: A man, aged about thirty years, who had been overworked, complained to his physician of feeling listless and below par. He took a vacation and returned better, but soon began to feel as before. At this time his physician found no physical signs in his lungs and was in doubt as to whether the cause of his ill-health was tuberculosis or was due to over-anxiety and extra work. About Oct. 1, 1903, he was brought to me for an x-ray examination. He had a pulse of 72, and a temperature of 99°. His physician and I found no physical signs in the lungs at this time. The fluoroscopic examination showed that the excursion of the diaphragm on the right side was 1½ inches, on the left side 3½ inches, and that the right apex was a little less bright than the left. It seemed wise, with his history and with these x-ray indications of pulmonary tuberculosis, that he should govern his life as if he had this disease. He therefore gave up his work and went away. I expected to see him again in a few weeks, but he did not return until January, 1904. About the middle of this month, a second x-ray examination showed that the excursion of the diaphragm on the right side was 1 inch, instead of 1½ inches, as in October, 1903, and that the apex of the right lung cast a distinct shadow. The excursion of the diaphragm on the left side was 2½ inches instead of 3½ inches, as in 1903, which suggested that the left lung was not in as good condition as it had been at the time of the previous examination. This patient went to the Adirondack Cottage Sanitarium, and his examination there in March, 1904, was as follows:

Palpation. — V. F. increased, right base front.

Percussion. — Good note.

Auscultation. — Right, expiration a trifle pro-

longed; apex, above clavicle. Few fine râles (?), and an occasional rhonchus V. R., normal. Left, fair breathing; V. R., trifle increased to second rib. Few fine râles to second vertebra spine on cough.

Fourteen examinations of his sputum were made and in no case were tubercle bacilli found.

The last examination, on Dec. 2, 1904, showed: Right, breathing better; no râles; no dullness. Left, good note and breathing; no râles.

After leaving the sanitarium tubercle bacilli were found. This patient recovered and has, I am told, been well since that time. Practitioners often suspect pulmonary tuberculosis when they do not feel justified in making this diagnosis. At such a time, x-ray examinations may afford the determining evidence earlier than the usual physical examination.

2. X-RAY EXAMINATION AS A PRECAUTIONARY MEASURE.

The wife of the patient, just mentioned, developed tuberculosis after the recovery of her husband. Precautionary examinations might well have been made in her case.

Such conditions or symptoms as the following may indicate the advisability of x-ray examinations:

(a) Patients whose family history suggests the possibility of this disease.

(b) In which the patient has been exposed to tuberculosis; for example, because some member of the family or household is or has been ill with this disease.

(c) In which the thermometer, as suggested by Trudeau, shows slight increase in temperature during part of the day, or after exercise.

(d) Hemoptysis, or loss in weight.

(e) Slight but persistent cough, especially in the morning.

(f) In which there is tuberculosis in some other portion of the body, and it is a question whether the lungs are or are not affected.

3. CASES WHICH SIMULATE PULMONARY TUBERCULOSIS.

X-ray examinations are used to advantage in these cases, as illustrated by the following instance: The diagnosis made by three physicians was pulmonary tuberculosis. The friends of the patient had presented him with a purse to enable him to go to Colorado. Before attempting to start, he came to the Boston City Hospital to ascertain how extensive the disease was. His record is as follows:

David G., aged thirty-nine years. Admitted to Boston City Hospital, Sept. 26, 1898. Pleurisy one year ago; cough for two years. Caught cold six days ago; chill, knife-like pain in left side.

Sept. 26. On admission, pleuritic pain in left side. Temperature 99.2°; pulse, 80; respiration, 23.

Sept. 29. Right apex front and behind prolonged expiration; slightly higher pitched than on the other side. Vocal resonance slightly increased, and marked whispered bronchophony. No râles

over this area, and no change in percussion. In right base behind, numerous medium and moist râles heard best with inspiration, and without change in percussion and voice sounds. No tubercle bacilli in sputum in two examinations.

Oct. 6. Patient shows some improvement. Cough nearly gone. Chief symptom is weakness and pallor. Desired to go home.

Oct. 20. Returned. Cough returned; whitish expectoration; some pain in side; appetite poor. Has had chills for three days. Temperature, 99.3°; pulse, 80; respiration, 23.

Lungs: Slight dulness at right apex in front and behind, with increase in vocal fremitus and resonance, and considerable whispered bronchophony; no râles. Question of malaria; no plasmodia found; no temperature.

Oct. 25. Feels stronger; no chills; no temperature. Coughs very little.

Nov. 5. Given 5 mgm. tuberculin.

Nov. 6, A. M. Temperature 102.5°. This temperature thought afterward to have been due to malaria, not to the tuberculin, as plasmodia were found later.

Nov. 13. Tuberculin 5 mgm. again given; no reaction.

Nov. 16. In right back tactile fremitus increased and percussion slightly duller than normal over whole of right back. On left, from apex to third rib in front, expiration is harsh and prolonged, and fremitus increased.

I made an x-ray examination of his chest and found that his lungs were clear and that the excursion of the diaphragm on the left side was 2½ inches, and on the right side, 2¾ inches. He deferred his trip to Colorado by my advice, and eventually gave it up altogether. I have seen him at intervals since that time and he did not develop tuberculosis. He died of cancer of the throat, eight years later, in September, 1906, at the Massachusetts General Hospital, after operation.

I think the diagnosis of early pulmonary tuberculosis should be carefully reconsidered if a properly made x-ray examination does not reveal an abnormal condition of the lungs.

4. X-RAY EXAMINATIONS IN DETERMINING THE EXTENT OF THE DISEASE.

In deciding on the best course for a patient to pursue, who has already well-marked signs of the disease, not only the condition of the patient, but the extent of the disease should be known as accurately as possible. The x-rays in many cases reveal more exactly the extent and distribution of the disease than any other method. They frequently show that both lungs are involved, when, without the use of this method, only one lung would be suspected. In other words, the x-rays indicate early the advent of the disease in the second lung as well as in the first (in such a case the advantage of comparing the normal with the abnormal lung is lost). Before admitting patients to sanatoriums as early cases of tuberculosis, they should be examined by the x-rays, for if this is

not done they will sometimes be sent there with the mistaken idea that they are in an early stage of the disease.

5. X-RAY EXAMINATIONS IN DETERMINING THE DEVELOPMENT OF THE DISEASE, WHETHER IT IS DIMINISHING OR PROGRESSING.

Another use of the x-ray examination is to show with what rapidity the disease is progressing. For example, let me take the case of a patient, one of whose lungs seemed to be involved, but not to any considerable extent. The first x-ray examination showed that the disease was more extensive than the physical examination indicated, and each subsequent examination, made at intervals of two or three weeks, demonstrated that it was rapidly extending. This progress of the disease was indicated only by the x-ray examination. The physician of the patient had planned to send him to Colorado. I advised and urged that the plan be given up. He started, however, and after a fatiguing journey, resting here and there on the way, arrived in Colorado, but left for home a few days later and died ten days after reaching home. It is hardly necessary to dwell on the suffering which this man must have endured in the two long journeys, which the x-ray examinations had shown would probably be worse than useless at that time.

7. CENTRAL TUBERCULOSIS.

It is well known that central pneumonias may be readily seen by means of an x-ray examination before they extend sufficiently near to the surface of the lung to be recognized by a physical examination. The dense portion of the lung casts a shadow on the screen whether it is central or superficial. In like manner the increase in density, obtaining in pulmonary tuberculosis, is revealed by the x-rays even when deep seated.

8. OLD LESIONS.

Where we find indications of calcification, as illustrated by the accompanying figure, it should suggest an old pulmonary lesion.

9. CASES IN WHICH EMPHYSEMA OR ASTHMA AND PULMONARY TUBERCULOSIS ARE ASSOCIATED.

An x-ray examination is useful in recognizing pulmonary tuberculosis when other conditions are present which complicate the case. For example, when a patient is suffering from emphysema of the lung and pulmonary tuberculosis, the emphysema masks the ordinary physical signs of tuberculosis, but the density of the lungs is even more clearly revealed than usual, when the chest is examined by the x-rays, if the patient is also suffering from emphysema.

USE OF THE X-RAYS IN SANTORIA.

It is hardly necessary to point out, from what I have already said, that the x-rays would also assist in determining the favorable course of the disease and could be of service in sanatoria and other places where there are many patients who should have every advantage which the best

methods of examination can afford. The importance of these examinations at sanatoria has been shown among others by Brook and Green.³ They say:

"The conclusions we arrive at are formed from the study of a large number of cases in all stages of the disease:

"1. In no single case, where the physical signs have pointed to disease, have the x-rays failed to detect the mischief.

"2. In some cases where physical signs have been absent the rays have shown a deposit in the lungs, and in these cases physical signs have subsequently been detected.

"3. That the early diagnosis is certainly helped.

"4. That the extent of the disease, in many cases, is shown to be greater than the physician thinks.

"5. That the progress and results of treatment can be watched with great accuracy."

X-ray examinations are valuable for life insurance companies.

X-ray examinations are difficult to carry out. Proper precautions should be taken to protect the practitioner as well as the patient.

Practitioners who are devoting themselves to diseases of the chest should have a suitable x-ray apparatus, just as an ophthalmologist has an ophthalmoscope, but the task of the latter is far lighter than that of the physician who desires to make a complete examination of the chest.

Practitioners who have had experience with x-ray examinations appreciate that, as a rule, they give a more definite and correct picture of conditions in the chest than any other method. This information is valuable not only in assisting the practitioner to make an early diagnosis, but also in later stages of the disease. There is now, according to some observers, an average delay of perhaps a year or more after the first symptoms of tuberculosis are observed, before the diagnosis is made. X-ray examinations assist in shortening this delay and thus help to lengthen the lives of tuberculous patients and diminish the spread of the disease. When patients realize that early diagnosis usually means recovery in a comparatively short time, and that a delayed diagnosis may exclude recovery, they will, I believe, seek x-ray examinations.

THE RESULTS OF THE CHEMICAL INVESTIGATION OF TUMORS.

BY S. P. BEEBE, NEW YORK.

DURING the last ten years the public interest in problems of scientific medicine has increased in large degree and many laboratories have been founded for the scientific investigation of particular pathological conditions. Nearly all of the special laboratories and funds for the study of malignant growths have had their origin during this period. You are all familiar with the remarkable advances that have been made in the

application of the exact methods of chemistry to problems of biology during this same period. We need scarcely add, therefore, that our knowledge of the chemistry of neoplasms is a very modern product. However, only a small portion of the abundant tumor literature of the last decade has been devoted to chemical subjects. Such contributions as have appeared have aroused very little discussion because of their fragmentary character; and because they have formed no essential premise in the arguments regarding the nature of neoplasms, which are the chief contribution of the pathologist. The chemist has not been familiar with the past history of the tumor discussion, nor its present condition, and the pathologist has not been fully acquainted with the ways of chemistry and its language. The two are therefore just beginning to appreciate the necessity for mutual co-operation, and we find that the results of the chemist are being used more and more as a basis for the hypotheses of the pathologist. It is, I believe, a good thing that such a condition of affairs is coming, for the findings of chemistry are those of an exact science, and the personal equation is likely to cause a larger error in drawing conclusions from and properly interpreting the data of clinical and histological observations than can be admitted in an experiment where the various factors are subject to the control of the chemical balance.

In presenting the results of the chemical investigation of tumors, I shall not attempt to give a résumé of all the analyses that have been made, but I shall select those which I think are of most interest, and it is convenient to group these somewhat in the order of their complexity.

1. THE INORGANIC CONSTITUENTS OF TUMORS.

Few systematic analyses of tumors for the important inorganic elements are reported in the literature, and yet there is an abundant physiological evidence that such elements are vital factors in the proper functioning of various tissues. Four years ago, I analyzed a number of these tumors in various stages of growth and degeneration for the elements sulphur, iron, phosphorus, calcium, potassium and sodium.¹ No conclusions of great value can be drawn from these analyses, but an interesting suggestion was found in the fact that the actively growing tumors contained a much larger amount of potassium and sodium, and a much smaller amount of calcium than was found in the old, necrotic tumors. The later work of Clowes and Frisbie,² who analyzed a series of transplantable mouse carcinoma in various stages of their growth, has confirmed these findings.

The work of Loeb,³ Howell, Matthews and their students, during the last few years, has revolutionized our ideas regarding many fundamental physiological processes, and has demonstrated in how great a degree vital activities are dependent upon the physico-chemical environment—an environment profoundly influenced by the nature and amount of the inorganic salts.

We know, for example, that the secreting cells

³ A Preliminary Note on the Use of the Röntgen Rays as an Aid to the Early Diagnosis of Pulmonary Tuberculosis. *Quart. Med. Jour.*, Sheffield, 1902, 1903, xi, 268-272.