Miss W., aged 23, had pustular acne for twelve years, and had been little benefited by any treatment. X-ray treatment for three months caused a complete disappearance of the disease. It is now two years since the last treatment was given and there has been no recurrence.

Many similar cases would serve to illustrate the same course of recovery.

TINEA AND FAVUS.

In tinea and favus the Roentgen ray has proved a useful epilating agent. By proper radiation more or less complete epilation can be secured, and with this a complete disappearance of the foci of infection. Care must be exercised not to cause permanent alopecia. In many places in Europe sufficient rays are applied at one séance to complete epilation, but I believe that it is safer to give this dose in eight or ten sittings. The hair usually falls out in from fifteen to twenty days after the treatment. The scalp then should be treated by the usual methods, such as washing with naphthol soap, or daily application of a 20 per cent. iodine solution. Regrowth of the hair usually begins in from six to eight weeks.

In the treatment of tinea tonsurans and favus, Sabouraud concludes that both diseases are amenable to the Roentgen treatment, which lasts weeks only, in place of years, as under the old method. Radiotherapy has been successful in this manner in sycosis. The following case will illustrate this group:

Mr. C., referred by Dr. Miller, had sycosis involving the right eyebrow and part of the beard. There were two large infiltrated patches about the size of a dollar, and another somewhat smaller. During this time the disease had been very resistant to treatment. After eight exposures to the Roentgen rays, marked improvement was noticed and in two months the disease was apparently cured.

TUBERCULOUS ADENTITIS.

In the treatment of tuberculous glands, the results obtained by the use of Roentgen rays will compare favorably with those from any other method, as a large proportion of the patients can be apparently cured. The treatment usually requires about three months, at the end of which the glands have undergone a degeneration, leaving a hard fibrous nodule, which, as a rule, never gives any further trouble. The radiation must necessarily be intense with the tube placed at least 12 inches from the surface, in order to influence the whole of the diseased area. The important part of the treatment is to have a tube placed the proper distance, giving off rays, rich chemically, and with the proper degree of penetration.

Miss B., aged 18, referred for x-ray treatment, had been operated on six months previously and when she came a very unfavorable prognosis was given. There was a glandular mass in the right side of the neck extending from the ear almost to the clavicle. There were two masses about the size of a hen's egg. It was with difficulty that the patient could move her neck and she was very much emaciated. After nine treatments she became comfortable and began to improve in general health, while the glands began to reduce in size. Sixty treatments were given in six months, when all the smaller glands had disappeared and the two larger masses were reduced to about the size of a hickory nut, hard and freely movable. Treatment was then discontinued, and two months ago, one year after the last treatment, this patient was in about the same condition.

Now the question arises, in the cases in which these hard nodules are left, whether it is advisable to have them removed or not.

No further attempt should be made with the x-rays, as the epithelial tissue, which is easily influenced by the rays, has undergone a fatty degeneration. The fatty

substance is absorbed, leaving the fibrous stroma. I believe that these should be left alone and watched carefully.

GOITER.

Many cases of goiter have been greatly benefited by the Roentgen rays. This is what should be expected from the structure of the thyroid gland after a careful study of the physiologic action of the rays. A certain few cases of goiter which resisted other forms of treatment have responded readily to the rays. The treatment will usually relieve the annoying symptoms, reduce the size of the gland, and in some instances apparently cure the patient. It can hardly be expected to reduce the size of the gland to normal when there is immense tumor. The rays most likely reduce the gland by fibrous degeneration. This requires intense radiation, with the tube placed at least 12 or 15 inches from the surface of the skin.

Many cases would serve to illustrate the benefit derived from the Roentgen rays after other remedies had proved useless.

Mrs. A., aged 35, had goiter for four years and had taken the usual medicinal treatment without much benefit. Pressure symptoms had developed, and the growth was rapidly increasing in size. Treatment was given three times a week for two months, when all the annoying symptoms had been relieved. Treatment was continued for two months longer when the gland was reduced to about one-third the size than when treatment was begun. It is now two years since she was exposed to the rays and during that time she has had no annoying symptoms.

THE TREATMENT OF MALIGNANT GROWTHS BY THE ROENTGEN RAYS.*

ENNION G. WILLIAMS, M.D.

RICHMOND, VA.

In the field of Roentgen ray therapy we are still a band of pioneers endeavoring to discover the possibilities of this new and mysterious agent. Its first decade has been productive of much new and valuable knowledge concerning the therapy of those diseased conditions which have heretofore proven most obstinate to all forms of treatment.

We should be slow to condemn the ray because it has not fulfilled the expectations of the early enthusiasts, or because the results and observations of different operators have varied so greatly. It is only natural that the results should differ when we consider how great are the variations in the agent itself and the methods of application. What it has undoubtedly accomplished should be our standard and the beacon light to guide us in establishing its real value.

To determine the value of the ray as a therapeutic agent we have to consider, first, the factors concerned in the production of the ray and the methods of application in treatment; second, the physiologic and histologic changes due to the ray, and third, the nature and location of the growth to be treated.

First of all one must appreciate the great variability in the different qualities of the ray, that is, its penetration and also its intensity and effective energy. This variability is readily exemplified in the taking of radiographs with different machines. Some static machines will require minutes to do what some coils will do in the same number of seconds. Furthermore, the ray being a form of radiant energy conforms to the law of

* Read in the Section on Pharmacology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

varying inversely as the square of the distance, or in other words, to have the efficiency at ten inches the same as at five the exposure must be four times as long. Lack of appreciation of these facts will of necessity bring about a great variation in results.

Another serious obstacle in the development of this work has been the fact that there is as yet no unit or standard to measure the different qualities of the ray. Such a standard is necessary in order to record an exposure accurately, and to duplicate a treatment. This, however, can be done approximately. We may assume that the radiant energy from the tube is proportional to the electrical energy flowing in the tube circuit. We will therefore have a measure of the radiant energy if we know the amperage and voltage of the tube circuit. The voltage may be approximately estimated by the length of the equivalent spark gap in this circuit. It is then necessary to note further the duration of the exposure and the distance of the anode from the exposed surface if we wish to measure and to record the amount of radiant energy received by the patient.

The penetrative quality of the ray is dependent chiefly on the resistance in the tube circuit, including of course the tube itself, and is measured by the voltage or the equivalent spark gap.

The volume or intensity of the ray is dependent chiefly on the amperage. With a proper appreciation of these factors all variations in the quality of the ray may be obtained and approximately measured and recorded.

The above principles have been eminently satisfactory to me and practically indispensable in accurate radiographic and therapeutic work.

The property of the ray with which we as therapists are concerned may be called the physiologic efficiency. To a certain extent, this is in proportion to the energy given off from the tube. It depends more, however, on the degree than on the total quantity. This is more apparent in the bactericidal influence; one strong intense exposure may destroy bacteria whereas a number of weaker exposures will not do so, although the total amount of energy may be the same. It is on the same principle that one strong blow may accomplish what numerous small blows or a continuous pressure will not accomplish, although in each the total energy expended may be the same. The principle is analogous to the coagulation of albumin by heat. Albumin only coagulates when the heat is applied at a certain degree. The degree of heat is necessary. In the same way, a high degree of radiant energy can accomplish results that could not be accomplished by a smaller degree of radiant energy although longer continued. This seems to me to be true notwithstanding the fact that the physiologic effect of the ray is to a large extent cumulative, that is, the effect of one treatment persists for many days, and subsequent exposures during this time are superadded.

The physiologic efficiency, or the influence of the ray on the tissues, is determined by observation and study of the tissues exposed. Dead organic matter seems not to be affected by the ray. The effect on the living tissues varies from stimulation to complete abolishment of the vital principle and the changes incident thereto. If we knew the physical nature of the ray and if we knew the physico-physiologic nature of that principle that constitutes the difference between living and dead protoplasm, we could probably explain the action of the ray. It is a temptation to draw on one's fancy for a possible explanation. Can it be that the vibration periods of the ray are similar to the vibration periods of the atomic

or subatomic activities which constitute the vital principle in a mass of protoplasm, and that the action of the ray is analogous to the influence of music in stirring to activity or putting to silence a tuning fork by sympathetic vibrations?

Certain it is that the action of the ray seems to influence the vital force. It does not immediately affect the tissues as do mechanical, chemical or other physical agents, such as heat. The only immediate results are functional ones, such as the relief of pain. The changes which are brought about in the tissues develop slowly and are such as would occur in consequence of the taking away of their life. Life resides only in cells. It is the cells that we find chiefly affected by the ray. The other elements of the tissues probably are affected indirectly.

It is observed that the ray affects living normal tissues in the following order: The epithelial cells of glands, hair follicles, the skin and those lining the blood vessels and to a very much less extent the cell and fibers of muscle and connective tissues.

We would conclude, therefore, that the elements of the tissues that are most affected are the cells and in the proportion as they exhibit the manifestations of life, and that the tissues themselves are affected in proportion as they have cells and in proportion to the activity of the cells.

The tissues that have the largest proportion of vitally active cells are those of malignant growths, particularly the carcinomas. We, therefore, see the specific or selective action of the ray on these growths.

Sarcomas contain a larger proportion of intercellular material and more blood vessels. The cells have less vital activity, as evidenced by the fewer mitotic figures. They are as a rule more deeply seated. These facts would explain why more carcinomas than sarcomas have been healed by the ray.

Benign tumors are composed chiefly of intercellular substance with a small proportion of cells which are not very active. Such tumors are therefore only slightly or not at all influenced by the ray.

We conclude that in the treatment of tumors by the ray the result depends on the constituent tissues of the tumors and on their accessibility to the proper quality of radiant energy. Since we have shown that the tissues composing the malignant growths are especially susceptible to the ray, success in their treatment depends on their accessibility to the proper ray.

For superficial malignant growths unless they have invaded adjacent bones and cartilages the ray should be used because when rightly applied the result is so uniformly successful. Its application is painless, there is less scar and deformity and a recurrence is in proportion to the thoroughness of the treatment. Carcinomas on the lip or connected with any mucous membrane should, in my opinion, be excised, because for some reason they seem to be especially resistant to the ray.

For malignant growths of the deeper structures, including the breast, radical surgical procedure should be recommended. It is but rational that the surgical operation should be followed by sufficient exposures to the ray to destroy malignant cells that may have been left. It is possible to destroy such cells an inch or two from the surface, and the patient should have every possible chance to have the malignant cells completely eradicated or destroyed. Recurrent growths of the breast often yield readily to x-ray treatment, because the recurrence is so near the surface. The prognosis in these cases depends on whether the neighboring glands or the thoracic cavity are invaded.

In conclusion I would reiterate that we have in the Roentgen ray an agent that has a selective destructive action on the tissues of malignant growths and that the prognosis in their treatment depends on the ability to reach such growths with the proper quality and quantity of this agent.

111 North Fourth Street.

[FOR THE DISCUSSION ON THE PAPERS OF DRs. LEONARD, BOGGS AND WILLIAMS, SEE PAGE 364.]

STARCH SUGAR (GLUCOSE AND GRAPE SUGAR) AS A FOOD ADULTERANT.

HENRY LEFFMANN, M.D.

Professor of Chemistry and Toxicology and Hygiene, Woman's Medical College.

PHILADELPHIA.

The fact that starch can be converted into dextrose and allied bodies by the action of dilute acids was discovered nearly a century ago, but long remained unappreciated as to its commercial value. Its manufacture on a large scale has been pursued for over 25 years and it is now an industry of great importance and extent. Like many other industries of large output, it has passed into the control of a trust, and the quality of the material is not much influenced by competition.

MANUFACTURE OF STARCH SUGAR.

On the large scale, the starch is usually treated with dilute sulphuric acid. The conversion, essentially a process of hydrolysis, differs in degree according to the conditions of operation. In commerce, two types of product are usually recognized: glucose, the syrupy form, and grape sugar, the solid form. Commercial glucose is not of constant composition; it is probable that its exact analysis has not yet been made, but it is known to contain a considerable proportion of one of the dextroses, with more or less dextrans, maltoses, non-fermentable carbohydrates and nitrogenous matters. The solid form (grape sugar) usually contains more dextrose and less of the other ingredients. In the United States corn starch is the main source of these products, but any starch will yield them; potato starch is employed in Europe. Many dilute acids will produce the transformation.

Apart from some limited special applications for which it is alone suitable, commercial glucose and grape sugar are almost entirely employed as adulterants and substitutes for natural carbohydrates. Its employment for such purposes began to be extensive soon after its manufacture on the large scale was undertaken, and the question of its permissibility was, therefore, raised.

REPORT OF COMMITTEE OF 1884.

In 1884, a report was made to the Commissioner of Internal Revenue, by a special committee of the National Academy of Sciences, which had made an investigation at the request of the commissioner. This report expressed the opinion that commercial starch sugar is not harmful. So far this constitutes the principal official utterance in this country, and as, like the land of Sir Joseph Porter, "it is characteristic of this happy country that official utterances are regarded as unanswerable," glucose has been almost unrestricted in its use in food products.

An examination of the original report of the committee shows that the investigations on which was based the decision as to the non-harmful action of these articles in

food were entirely insufficient according to modern standards of physiologic inquiry. This does not reflect on the ability of the members of the committee. They proceeded according to the light available at that time. After some dissertation on the history of the manufacture, the report gives analyses of commercial samples. The committee was not unmindful of the imperfections of analytic methods. At the time of the inquiry very little was known about the unfermentable carbohydrates.

The physiologic inquiry was limited to some feeding experiments on a medical man who volunteered for the purpose. Samples of commercial glucose, which had been analyzed as far as possible, were fermented and the residual extracts were taken in considerable quantity for two months by the experimentee, in whom no subjective or objective symptoms of illness were noted. No details are given of any clinical tests applied by the members of the committee or any one else to determine the physiologic condition during the experiments in comparison with the condition in a previous period, nor of any record of inquiries as to metabolism. It would seem from the report that the only information was that the experimentee felt well during the test period, and, as he was a young man and presumably a vigorous man, the test was a superficial one. A capital mistake in the composition of the committee was the lack of a clinical expert. The members of the committee, without exception, were chemists not working in physiology.

The experiments throw no practical light on the effect of starch sugar, as such, used freely and for considerable time. It must be borne in mind that the physiologic action of such an article must be considered from both negative and positive points. Its direct effect as an article of food is one question; its indirect effect as substituting, and thus eliminating from diet, a standard article is another question. Starch sugar might be uninjurious in itself, but as its principal function is to exclude cane sugar from our diet the balance of the food ration is disturbed and physiologic harm may be done. The older notion, often quoted, that starch sugar is substantially identical with the normal digestion products of starch and cane sugar is now not available, for it is known that commercial starch sugar is very different from such products. It is the use of starch sugar as a substitute and adulterant in confections, desserts and syrups, and not its use in the fermentation industries, that is the most important, although, as will be seen below, the latter use must not be overlooked.

INJURIOUS CHARACTER OF STARCH SUGAR.

In the light of modern methods of inquiry, the report of 1884 can not be taken as of value in determining the permissibility of starch sugar in food. I base this statement not merely on the evident insufficiency of the physiologic data presented therein. These are, indeed, wholly insufficient as a basis for the conclusions of the report; but the more serious objection to the decisions of the report is that it takes no account of the possible contaminations of the commercial article, contaminations which are apt to occur in any product involving the use of sulphuric acid, or acids made by its aid, since this acid is especially liable to contain arsenic and lead, two of the most dangerous and insidious of the metallic contaminations of food. The extensive poisoning in England a few years ago by arsenical glucose and brewing sugars is typical of these dangers to public health. The general opinion that such products are harmless led to their unrestricted use, and an unnoted change in the source of the sulphuric acid used for