Dr. John A. Witherspoon, Nashville, Tenn.—Will Dr. Lyons explain from his observation of pulsus alternans where he gets one full bounding systole, then a weak one? What difference is there? I have observed, as he says, that it is usually significant of myocardial degeneration or is a pulse of danger. In a number of cases which we see so often in neurotics and in gastric cases, where we have several strong beats and then several weak ones, there is nothing so significant of danger as these alternating beats. I have noticed that in several instances. I have seen a number of cases where we had several beats (four or five) of strong volume, then a weak pulse not equal to the other. I have never seen that attended with the danger that I have noted in these varying pulses.

Those who are practicing general medicine should recall that there are very few blood pressure instruments that are accurate after being used a short time. They get out of order and are difficult to keep in good condition. You cannot make a test so delicate as Dr. Lyons spoke of. The mercury instrument is the only one to depend upon according to my observation, and I doubt the value of relying upon so many different things in taking diastolic and systolic pressures, because these instruments are not always kept in good condition.

In myocardial degenerations possibly Dr. Robinson's explanation is right, that the other ventricular muscle is not involved in this condition. If that be true, is it due to faulty condition of nerve impulse, or does the sino-auricular node, which is sending out the impulse, vary? Or is it evidence of myocardial weakness? These are difficult problems. How can one part of a muscle contract without the use of the other? And if so, under what influence does that occur?

Dr. Lyons (closing).—My purpose in bringing this paper before you was simply to bring out the point that by the ordinary clinical methods we are able to detect this condition if we are on the lookout for it. This has been my own experience, so that I am in the same boat as those of you who have not found it. The recent literature shows that cardiologists who make routine tracings of all heart cases find many instances of pulsus alternans. For instance, Dr. Pratt, of Boston, reported having had 70 cardio-renal cases traced by graphic records without selection and of this number he found 8 cases of pulsus alternans. White thinks it is as common as auricular fibrillation. Gravier believes that alternation is a frequent symptom of cardiac insufficiency. One of the reasons why clinicians find pulsus alternans comparatively rare is that, although they may possess a sphygmograph they do not take tracings unless the pulse is irregular. Unfortunately where pulsus alternans exists the pulse is frequently regular. The clinician takes the blood pressure, but he is not looking for pulsus alternans, consequently is apt to overlook its presence here.

In regard to the diastolic pressure of the weaker beat where you get alternation in the pulse, the reason Dr. Eustis did not find it is that he had the same trouble I had. I heard it, but did not recognize it.

The explanation of Dr. Roberts may be correct

as to why the diastolic pressure of the weaker beat is higher than that of the stronger beat.

I do not think Dr. Jones and Dr. Eustis are far apart in regard to the prognosis of these cases. It depends upon what you are speaking about. These five cases and one other I saw three years ago were of the transient type with the exception of this particular one. The outlook of permanent alternation of the pulse must be a great deal more serious than in the transient type. For instance, in transient types due to heart strain plus infection or toxemia, the removal of the infection or toxic factor combined with rest may be sufficient to restore the function of contractility. For example, in Case 2 we found that the removal of the toxic factor was enough to rid her of the alternation.

The only case that I have seen with anything like normal blood pressure was observed three years ago. This man had a systolic pressure of 150. He had myocardial degeneration and arteriosclerosis and was working very hard. He suffered from some dyspnea and precordial pains. When put at rest, the angina and alternation disappeared and the patient is now living after a period of three years.

I am sorry I cannot answer Dr. Witherspoon's question because I do not understand it. He may have described a transient alternation. Transient alternations are found after attacks of paroxysmal tachycardia. There is a mechanical exhaustion of the heart muscle due to rapid action, and when that stops the outlook is very good.

OBSERVATIONS ON THE USE OF THE COPPER FILTER IN THE ROENTGEN TREATMENT OF DEEP-SEATED MALIGNANCIES*

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The substitution of the single massive dose for the repeated fractional dose method in the roentgen treatment of superficial malignancies marked a distinct advance in the treatment of these lesions. Such lesions can be destroyed by a single dose, with every prospect of a permanent cure, provided they are in fact superficial; are strictly localized; and are accessible. This method of dealing with such

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lesions compares very favorably with other forms of treatment.

For several years the efforts of roentgenologists have been directed toward the application of the same general principle in the treatment of malignancies more or less remote from the surface of the body. With this end in view, cross firing was developed, and voltages and filtration have both been increased. For a number of years a parallel spark length of 8 or 9 inches; filtration with from 2 to 6 millimeters of aluminum, and cross-firing through a variable number of portals was looked upon as a more or less standard method of attack, and was the one employed by us prior to the adoption of the technic forming the subject of this communication. Usually these seances have been repeated at intervals of from three to six weeks for a variable period of time. To call such treatment "intensive" or "massive" is correct only in a relative sense. As a matter of fact the effect of such treatment on cancer several centimeters below the surface is quite comparable to the old fractional dose method of treating superficial lesions. It is comparable not only as to the relative amount of radiation delivered to or absorbed by a given cell in a given time, but also from the standpoint of clinical results, due regard of course being given to the great variation in the malignancy of different tumors.

It is not our purpose at this time to discuss the value of treatment in accordance with this technic, but that it is wholly inadequate in greatly modifying the mortality from deep-seated malignancy will be admitted by all unbiased observers who have had much experience in its use. While there are no available statistics on the subject, it is certain that the percentage of cures of deep-seated cancer that can be accredited to roentgen therapy alone is very small. It is recognized that its independent use has been restricted almost entirely to the most unfavorable cases, but in spite of this fact, the results are in marked contrast to the high percentage of cures that can be obtained in superficial cancers by a single massive dose, and but emphasize the ne-

cessity of further efforts to enable us to deliver a knock-out blow to the lesion within the body as readily and efficiently as we do to those on the surface.

Recognizing this fact, we became much interested in certain laudable reports from foreign sources incident to modifications in technic which were heralded in this country about a year ago. These reports indicated the use of higher voltages than were being used by American roentgenologists; the substitution of other metals for the customary aluminum filter; an increase in the skin-focus distance; a reduction in the number of portals of entry; and a great increase in the time of exposure for a given area. One advantage of such a modification, if indeed there is an advantage, is predicated upon the assumption that a greater amount of secondary radiation would take place within the body, and that these secondary or scattered rays would greatly increase the depth dose.

In an attempt to approximate the technic, as we understood it, we adopted the following standard, which has been adhered to with only slight modifications from time to time to meet what were considered to be the indications of some particular case:

Spark gap measured between blunt points $8\frac{1}{2}$ to $9\frac{1}{2}$ inches.

Milliamperes, 5.

Filtration, 0.5 millimeter of copper under which was placed 1 millimeter of aluminum.

Skin-focus, 12 inches.

Time of exposure for each area, 3 hours.

The treatments have been given with three different machines, all of different make, with so far as can be observed no difference in result. Since we were restricted by the capacity of the apparatus available there was no increase in voltage over that previously employed.

The number of areas treated has varied from one to four, thus making the exposure time vary from three to twelve hours. Not more than two hours' treatment has been given in a single day, and as a rule not more than one hour daily or on alternate days. In only a few instances has the series been repeated. In

certain locations an exposure time of two hours at a skin-focus distance of ten inches has been given rather than the customary three hours at 12 inches. We have found that more than one or two hours' treatment daily is too fatiguing for the average patient.

Roentgen sickness during such a course of treatment is often quite severe, but we are not convinced that it is more so than with the older method. The fact, however, that it is extended over a much longer period, sometimes renders it difficult to persuade the patient to complete the series. The degree of sickness is very variable. Some patients have not been made sick by six or more hours' treatment, and one patient was made quite sick on the first day, but remained unaffected by subsequent treatment.

The effect on the skin has varied from an intense bronzing, with subsequent desquamation, to a considerable amount of vesication over the entire surface exposed. We believe that hot weather has been the determining factor in the cases in which vesication has occurred to any great extent. The thickness of the part may also explain certain variations in the degree of skin reaction when opposite points of the body surface have been exposed. In cases in which vesication has occurred the promptness with which healing has taken place has been quite noteworthy. In no case has it required longer than four weeks to disappear, leaving the skin smooth, soft and pliable.

In this connection it may be well to point out that the "skin dose" or "erythema dose" is one that may have a very indefinite meaning. One hour's treatment by the technic under discussion will cause a definite erythema, and yet exposure for two additional hours will be readily tolerated without serious damage. Cases have not been observed for a sufficient length of time to determine the possibility of late skin changes.

If the treatment is administered about the neck or upper thorax, difficulty in swallowing frequently occurs. Its appearance is coincident with the skin reaction, and it has also subsided with the skin reaction, except in two instances

which will be referred to later. The act of swallowing is not particularly painful, but the difficulty in getting food, particularly solids, to go down may occasion some apprehension. The salivary secretion is greatly lessened and the saliva becomes thickened and tenacious if the salivary glands come within the irradiated field. Huskiness of the voice may also occur. In two cases of cancer of the tongue in which the neck was given a maximum amount of x-radiation, together with radium in the tongue, a peculiar brawny induration of the tissues of the neck has supervened. The tissues on palpation had a myxedematous feel, and swallowing became increasingly difficult. It is not known whether these phenomena have been due to metastasis or whether the radiation has been wholly or in part responsible.

In a considerable number of cancers of the breast which have been treated by this method, an irritative unproductive cough has developed at or about the time of appearance of the skin reaction. Shortly afterward certain pulmonary changes have been demonstrable in the roentgenogram in cases which have previously shown no evidence of intra-thoracic pathology. These changes begin as an infiltration at or near the hilus which spreads quite rapidly and in the course of three or four weeks may involve practically the entire lung. Coincident with the spread there is a certain amount of dyspnea. The roentgen appearance of the lung lesion at certain stages is strikingly like that seen in influenzal pneumonia. In at least one case the infiltration after rapidly reaching a maximum has been observed to undergo a definite regression, and to assume a more fibrotic appearance. The natural assumption would be that these pulmonary phenomena are due to metastasis, but certain clinical observations have led us to consider seriously the possibility of their being caused by the treatment instead. Certainly if they are due to metastasis, their production and rapid spread are directly related to the treatment, as their behavior is altogether different from the lung metastases observed in untreated cases. The physical

well-being of some of these cases is far better than would be expected in patients with extensive metastatic malignancy. Some have actually gained in weight and except for slight dyspnea on exertion consider themselves in good health.

It is at once apparent that it is of vital importance to determine the significance of these pulmonary phenomena. If they are due to cancer metastasis it seems reasonably certain that the treatment is a factor in their development, and if due to the treatment, independent of metastasis, they become of very great therapeutic significance.

A number of cases of uterine cancer has been treated usually in conjunction with the intra-vaginal or intra-uterine application of radium. In some of these diarrhea has occurred which has lasted in some instances for two or three weeks. In one case the stools contained blood for several days. It may be stated that this particular case, which was one of recurrent cancer in the vaginal vault following hysterectomy, is now in good condition after a lapse of six months. It is suggested that treatment of these cases in the Trendelenburg position may aid in obviating damage to the intestine and also perhaps render the treatment more effective by allowing some of the bowel to gravitate away from the field of radiation. It has also occurred to us that it would be possible to deliver considerable radiation to the pelvic structures by treating through the perineum, and with this idea in view we have constructed a piece of apparatus resembling a commode on which the patient sits while the treatment is being administered.

In a case of cancer of the cecum which was treated, the patient developed an attack of uremia a day or two following completion of the series, which, however, did not prove fatal. It is known that prior to the treatment the urine was normal, and it may be that the treatment was responsible for the uremic attack.

In attempting to summarize the injurious effects which can with any reason be attributed to the treatment itself, it may be stated that while certain potential dangers are recognized, we are convinced

that they are not prohibitive, unless it be developed by further observation that the treatment is a factor in the development and spread of metastatic foci deep within the body.

It is also obvious that any therapeutic measure must be of definite benefit and superiority to justify its continued use and the technic under discussion is no exception to that rule.

In discussing this phase of the subject it is manifestly improper to claim or even suggest the cure of a single cancer that has been under observation for a year or less. We are able, therefore, only to call attention to the obvious effects of the treatment on tumor masses, and in a general way compare the results with those obtained by the older technic.

The technic has been used in seventy-five cases. With the exception of eight cases in which the treatment was given soon after operation, and two borderline cases, all were hopeless from a surgical standpoint. A majority of the cases were post-operative recurrences. Thirty-eight of the seventy-five cases were cancers of the breast; ten, cancers of the uterus; and the remaining twenty-seven were variously distributed throughout the body.

In general it may be stated that the effect of the treatment on the tumor masses has been far more striking and consistent than we had ever before observed with the older technic. In cancer of the breast, for instance, we have repeatedly seen large tumors, both primary and recurrent, with axillary and cervical metastases, completely disappear so that no local evidence of disease could be detected by the most careful physical examination. This occurs within six or eight weeks after treatment.

As might be expected in a series of cases which were wholly unfavorable from every standpoint, some have finally succumbed, and it is quite certain that many of those still living will finally die from cancer. The fact remains, however, that the treatment will in many cases cause a complete disappearance of all local evidence of disease, and naturally raises the question as to what might be accomplished in a series of more favor-

able cases. We are of the opinion that the time is not far distant when a readjustment will be necessary with respect to the relative places of radiotherapy and surgery in the treatment of malignant disease. We consider it not improbable that the present status of surgery and radiotherapy, particularly as they relate to cancer of the breast, may in the final readjustment change places, so that the former may come to be regarded as the adjunct of the latter. This has already occurred to a large extent with respect to the treatment of cancer of the cervix uteri, and with improvement in technic will doubtless be extended to other fields.

As has been pointed out in a previous paper,¹ the best that can be expected in the treatment of cancer of the breast by the most radical and efficient surgery is a cure of one out of every four cases, and this only applies to carefully selected cases. Where the limits of operability are less rigidly adhered to, the percentage of cures is very greatly diminished.

Without again going into the pros and cons of pre-operative and post-operative radiotherapy in cancer of the breast, we should at present be disposed to recommend primarily a single series of roentgen treatment in accordance with a technic not less intensive than is herein set forth, and defer the question of surgical intervention for a period of approximately two months.

We believe that by pursuing such a course the following advantages would accrue:

(1) The actual volume of cancer tissue would be greatly lessened and would in some cases disappear entirely so far as could be determined by physical examination.

(2) The danger of cancer dissemination incident to surgical trauma would be lessened.

(3) A number of inoperable and borderline cases would become definitely operable.

It is realized that the danger of operative delay in malignant disease is so

thoroughly ingrained in the medical mind that the course proposed will meet with general disapproval, but we believe that a more intimate knowledge of what can be accomplished by efficient radiotherapy will result in a changed point of view.

Perhaps the chief danger of such a course would be the fact that the obvious decrease or disappearance of tumor tissue would lead to a false sense of security, and engender a hope that the subsequent course of the disease would not justify. However, in a disease in which the results of present methods of treatment are anything but brilliant, it would seem justifiable to try out on an extensive scale a procedure which is not only logical in theory, but is also supported by many well established facts.

Discussion follows paper of Dr. Ernst, page 455.

EUROPEAN IMPRESSIONS AND PERSONAL EXPERIENCE IN THE USE OF HIGH VOLTAGE X-RAYS IN DEEP-SEATED MALIGNANCY*

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It is not the purpose of this paper to give a detailed account of my observations of deep roentgen therapy in Germany. Complete reports of the observations of Schmitz, Stern, Sittenfeld, Stewart, and other American writers have already been published. But I shall attempt to give a very brief statement of those points in the use of high voltage x-rays as practiced in European clinics which I believe are of greatest importance.

A visit was made to Opitz and Friedrich Clinic in Freiburg, Baum's and other gynecological clinics of Berlin, and Sitz and Wintz of Erlangen. The general technic in use in all these clinics did not differ materially. With the various workers there seemed to be little difference of opinion as regards general principles of the application of roentgen and radium

(1) Groover, Christie and Merritt: The Present Status of Roentgen and Radium Treatment of Cancer of the Breast. *Journal of Radiology*, September, 1921.

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