is no reason why in the absence of the normal process of longitudinal growth, and where there is a great demand for it, the cells of the shaft should not proliferate and increase the length of the bone.

DR. J. T. RUGH, Philadelphia: I think the important lesson for us as practical orthopedic surgeons is the postponement of our operative work in this type of cases until adult life or until the expectation of any natural increase in growth is past. I know in my own experience I have been sorely tempted at times to replace a very imperfect hip joint, in the case of congenital dislocation, or similar condition, with the head of the fibula, but have thus far refrained, and I shall continue to do so in the future. The lesson I have learned from this experimental work of Dr. Haas has been of enormous importance.

DR. ROLAND MEISENBACH, Buffalo: The work of Dr. Haas, in my opinion, is of great value. Although he has gotten some negative results, I think it touches on many things of value which will in the future give us a better understanding of one of the most important parts of the long bone; namely, the epiphysis. It may also assist in giving us a better understanding of the function of the epiphysis. I am particularly interested in this work because several years ago I did some research work on the chemical and mechanical stimulation of the epiphysis. In this work, I had occasion to observe the epiphysis both microscopically and macroscopically in about two hundred rabbits. In studying the epiphyseal and diaphyseal lines, it was interesting to see from the experimental work the close relation to the practical work; that is, the cases which we see daily that have interference of growth or which have stimulation of growth of the epiphysis. This work is really the fundamental source of all fracture and bone-graft work. I would like to ask Dr. Haas whether the transplant is divided from above or below the diaphyseal line. This will, I believe, change the results of the experiments materially. In my experiments I was able to stimulate and retard bone growth, depending on which part of the epiphyseal cartilage was attacked in the experiment. I have a few lantern slides which I prepared for the Pan-American Congress which show sections of the epiphysis and epiphyseal line in different stages of stimulation. That is, that by either toxic or mechanical means it is possible to cause more bone to form in the region of the epiphyseal end of long bones, as in my experiments with tibias, or to almost cause an arrest of growth. One slide shows that by means of toxic agents it has been possible to cause the entire epiphyseal line to close at a much earlier period by months than normally. This explains, I believe, many of the cases which have focal infection at some part of the body that later on developed joint lesions, and in which the joints became deformed; also it explains the arrest of growth following fractures, and therefore I think that an attempt to transplant the epiphysis depends largely on the point from which we take the transplant and the technic employed.

DR. S. L. HAAS, San Francisco: As Dr. Phemister has mentioned, cartilage is a very resistant tissue. It is able to withstand a considerable amount of injury and is dependent on the surrounding tissues and fluids for its nourishment. I have only studied a few microscopic preparations from these experiments and have found that the cartilage near the perichondrium remained alive. It is possible that some of this cartilage may continue to proliferate, but I doubt if it would cause any decided increase in the length of the bone. There is a distinction between growth in length and increase in size. It was noticed in some of these experiments that there was a marked swelling about the epiphyseal cartilage without any increase in length, showing that although there was cell growth there was no purposeful longitudinal increase like the normal epiphyseal cartilage. It was merely the regular cell division and multiplication which manifested itself by spreading in the line of least resistance. It was shown in the old experiments of Hunter and Duhamel that the longitudinal growth of bone takes place only at the epiphyseal ends. In these experiments two pegs were driven into the diaphysis and

in spite of an increase in length of the bone there was no change in the distance between the two pegs. As to the increase in length following destructive osteomyelitis, it might be due to the general wild multiplication during the processes of regeneration, which, being unrestricted, spread in all directions.

In regard to Dr. Meisenbach's question as to whether the transplantation was made above or below the epiphyseal line, I presume he wishes to ascertain the relation of the incisions to the metaphysis, which is the most actively growing part of the bone. In all the excisions of the epiphyseal cartilage a piece of adjoining epiphyseal and diaphyseal bone was removed so as not to injure that particular region. Heller, in a postscript to his article, stated that he had succeeded in transplanting the epiphyseal cartilage in the form of very thin sheets of cartilage and that there resulted almost a normal growth. He does not give the exact details of his experiments, but from the results of my experiments I am forced to entertain some doubt as to the correctness of his conclusions. It is possible that by some special method he is able to get these good results.

THE RELATION OF THE ROENTGENOLOGIST TO THE HOSPITAL*

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The reason for presenting a paper dealing with the relation of the roentgenologist and the hospital comes from the very great variation of such relation at present. Were any one of the methods now in vogue approaching idealism, it would be shown by the number adopting such a method; while a study seems to show greater variation as time goes on. My attention was first called to this subject by the investigation made by a state committee in regard to patients coming to hospitals under the Massachusetts workmen's compensation act. This investigation showed no two institutions in the entire commonwealth making arrangements that could by any means be called similar. In medicine a multiplicity of drugs recommended for a particular disease shows a competency of none, and so it is fair to suppose the roentgenologist and the hospitals have not yet found a satisfactory arrangement one with the other.

The growth of the applications of the Roentgen ray is responsible for this condition. When first given to the medical profession, it promised to be one of the most limited specialties. The locating of dense foreign bodies and fractures of the bones of the extremities was its entire field. Now I say without hesitation there is no broader specialty in medicine. I cannot think of a single branch of the profession which does not call the Roentgen ray to its aid at times. Any medical journal is proof of the wide scope of this specialty, and more than half the articles show the dependence placed on the ray, either in diagnosis or in treatment.

The original roentgenologist was usually a photographer, electrician or a young and budding physician, hoping to use this as a stepping-stone to something more tangible. It was the way this original work was done that to a certain extent is the fault of the present condition. Many hospital superintendents and not a few physicians have failed to keep pace with the Roentgen progress and know the kind

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of man now required. A competent roentgenologist must have primarily a good knowledge of medicine in its various branches; he must be well versed in general science, with special information in regard to electricity, and, furthermore, he must have a working knowledge of photography. All these requirements being fulfilled, he must have the ability to acquire special acumen in interpretation of the shadow shown on Roentgen-ray plates. This mental coordination of the shadows and placing the right significance on each is almost an instinct, and if one fails in this, all other qualities cannot make one a real roentgenologist. Thus the roentgenologist must have combined medical, electric and photographic information to succeed.

Many serious operations rest entirely on the Roentgen-ray findings. Why have less than the best skill in determining these findings? When the people come to know that their hospital treatment often rests on the Roentgen evidence found at entrance, they will select a hospital where this work can be best done. They should know that the expense of maintaining the rapidly improving Roentgen-ray apparatus is great, and proper fees must be arranged. A price per plate is the poorest way to estimate the cost, as the plate is the smallest item of expense. Hospital managers should trust their roentgenologist to carry on the entire department, including the financial policy, or take time to make a more thorough and comprehensive study than many are doing at present.

In writing this paper, I have had in mind more particularly the hospitals of 150 beds or less. A paper written recently by Dr. I. S. Hirsch¹ of New York has dealt admirably with the requirements of a large metropolitan hospital. Many of the requirements of such a hospital do not, however, apply in the one with the number of beds just referred to. In such hospitals it is not practicable to maintain a Roentgen staff, but one man with an assistant or two can make a creditable reputation for himself and the institution.

The cost of equipping and maintaining the Roentgen-ray department of hospitals is constantly under discussion. The rapid evolution of the Roentgen-ray machine has made changes necessary so often that up to the present time the money for instruments must come from other sources than the daily revenue of the department. When such a time comes that no radically new type of instrument is required, this expense will immediately be materially lessened. The cost of maintenance, however, except where the free bed system or outpatient department is very large, should be derived from the patients themselves.

This brings us to the question of private patients' fees. I maintain that they should be the same as in the roentgenologist's private laboratory; otherwise he would be a competitor with himself. The division of this fee between the roentgenologist and the hospital will vary, of course. The greater the skill of the roentgenologist, the larger his proportion. It should always be kept in mind that it is the perfection in technic and skill in plate reading that is required, rather than the sale of so many plates made on an instrument costing so much. Ordinarily, hospitals should not retain more than 25 per cent. of the fee charged private patients to cover the overhead expenses. Under few circumstances should the roentgenologist (who, I have said, should be a physician)

sell his services at a fixed sum per year to a hospital. It opens opportunities for practices which are not elevating professionally, and are a source of constant friction.

The relation of the roentgenologist to the hospital staff is another question often discussed. If he is a real roentgenologist, his place on the staff should be the same as that of any physician doing special work. This place has not always been conceded him, owing in part to the confusion in the early days as to who should be a roentgenologist.

His report should also be in the nature of a consultation rather than that of a laboratory report. This report may be written, but I believe should be supplemented when possible by a verbal one, going into the various possibilities that may be recognized only by the roentgenologist in consultation with the clinician. It is only in this way that the patient can get the full benefit of our professional skill. The method of stated staff consultation is in vogue in Germany, and much of the diagnostic acumen of the Germans is due to this close relation into which the members of the staff are thrown.

The necessity of the preservation of the finished plate is not recognized sufficiently by the vast majority of hospitals. Too many times every one has access to them, and plates may be removed to be replaced at will or even not at all. These plates are an accurate record of the condition of a patient at a given time, and in many cases cannot be duplicated. A plate which, when taken, seems of ordinary moment may later become of the greatest value, either in treatment or medicolegally. All should be preserved. No one but the roentgenologist or his assistant should have the right of access to the files, and if for any reason plates are removed, they should be signed for and a record blank deposited in the place of the plate, showing who has taken it; and when it is returned, credit should be given for its return.

The plate legally belongs to the hospital or the roentgenologist, and never to the patient. He is entitled only to the information obtained from it, and given through his physician.

A medicolegal aspect too little recognized is that the roentgenologist must identify the plate himself in court. A medical man who simply borrows the plate to appear in court has evidence of no value. He cannot under oath connect it in any way with the patient. He did not see it developed, he has no mark on it which shows there was not an exchange made in the dark room, and moreover, he is not an expert in plate interpretation. The roentgenologist should have full control of the plate library, demonstrating the plates when required.

The method of preserving these plates hardly comes within the scope of this paper. It will vary with the size and requirements, as teaching, etc. It is a duty to the hospital, owed by the roentgenologist, to see that these plates are well preserved.

My plea in this paper has been for a closer relation medically of the roentgenologist to the hospital, and for a recognition of his ability. On his part, it is a duty to use his general medical acumen as well as his technical Roentgen information. Also there is a necessity for his being in entire charge of the department, which should be well correlated in all its branches.

19 Maple Street.

1. Hirsch, I. S.: *Mod. Hosp.*, January, 1915, p. 11.

ABSTRACT OF DISCUSSION

DR. A. R. WARNER, Cleveland: The Roentgen-ray department has become an important specialty of hospitals and it has gone beyond the stage of a novelty. It is an essential. The principle brought out as to diagnosis and the handling of diagnoses and information in regard to patients as expressed in the paper I am quite sure is correct. We have had some trouble with this matter on several occasions in Ohio and each time the courts have held as the paper expressed.

DR. JOSEPH M. SPELLISSY, Philadelphia: Dr. Van Allen mentioned the possession of the plates. I think we all agree that the plate should belong to the hospital. Where a great many plates are made the storage and preservation of the plates has become a bugbear in a large institution doing a large amount of work, so that plates are destroyed within a year. I know at the University Hospital, Philadelphia, with which I am closely associated, they have a department of photographic records there in which I am interested in standardizing photographic records and also Roentgen-ray plates. I have made Roentgen plates myself. I presented this morning a Roentgen-ray tracing such as we use in St. Joseph's Hospital. The paper is either "onion skin" or what is called buff manifold paper. It is transparent. It has printed on it the date of taking the plate and then the roentgenologist makes a tracing of the plate on the paper and that paper is bound with the records of the patient, so that if the plate is destroyed it still remains of value to the physician or surgeon.

MR. F. M. NESMITH, Oakland, Calif.: I would like to ask Dr. Spellissy if that record is accepted in court?

DR. SPELLISSY: I do not know. It has been mentioned that a roentgenologist sometimes goes to court. The testimony I should think would be acceptable that that was his tracing of what he saw in the plate. Where a plate is produced itself I have known the most eminent roentgenologists to disagree in the interpretation, and they would throw out the testimony.

DR. W. H. WALSH, Philadelphia: I do not believe that the roentgenologist of a hospital should be permitted to have anything to do with the financial policy of the Roentgen-ray department, this question being one entirely within the province of the management of the institution. There should be no question as to the desirability of consulting the roentgenologist in all questions regarding the equipment of his department, but when questions of cost are involved they must be finally decided by the administrator. I can see no more reason in permitting the roentgenologist or the pathologist to handle the financial policies of their respective departments than I do in allowing the visiting physicians or surgeons of the staff to meddle in the financial matters.

With respect to the question of the division of fees between the roentgenologist and the hospital, I must express my disapproval of such an arrangement, as I do not think they work out to the ultimate benefit of either of the principals. There is no good and sufficient reason why the roentgenologist or members of the staff should not be the recipients of salaries for their work, a procedure which in no way affects the dignity of their position, nor which could prejudice their professional standing. Being opposed to the very proposition of dividing fees, any division would be objectionable to me; but I am rather inclined to think that the hospital that only retains 25 per cent. of the fees received, supplying as it does the apparatus, supplies, electrical current and assistants, is not getting its due, and I should feel inclined to reverse the arrangement, allowing the roentgenologist 25 per cent. and the hospital 75 per cent., a more equitable division.

DR. H. W. VAN ALLEN, Springfield, Mass.: In Massachusetts, at least, tracings of plates are not admitted as evidence in court. The actual plate is the only exhibit allowed. Tracings may accompany the plates in an explanatory way, as they are much more easily understood by the jury. If a plate has been lost or destroyed the roentgenologist may

state his best memory of the plate, but cannot introduce a diagram.

Of course I do not have as large a Roentgen clinic as Dr. Spellissy of Philadelphia, but in proportion our space is as valuable. We, however, keep our plates easily accessible until one year old and then they are taken to space less valuable in the hospital and permanently stored. This is a necessity, as frequently they are required for reference to note changes in chronic cases, as well as for teaching and for court cases; the latter not required at times for several years after the plate is made. One recently was required after an interval of seven years.

In regard to the financial part, I believe it should be under the roentgenologist's control. It is so in the hospitals I am connected with, and the plan works nicely. Superintendents do not know the requirements of such a rapidly changing specialty, and I have found they appreciate careful financing, which can only be done by one familiar with the work. As to the 25 per cent. taken out for expenses by the hospital on private patient's fees, careful study of the subject makes me think this is about correct. It may vary in some hospitals slightly. This percentage (at rates charged in private laboratories) will cover actual expenses on private patients and it is self evident that the remainder is paid for the skill of the operator, and any of this going to the hospital would be as deplorable as fee-splitting is between doctors.

MANUFACTURE AND ADMINISTRATION
OF NITROUS OXID FOR
ANESTHESIA

THE EXPERIENCE OF LAKESIDE HOSPITAL *

A. R. WARNER, M.D.

CLEVELAND

At Lakeside Hospital, nitrous oxid gas has been used for anesthesia extensively for about eight years, and has been manufactured as a routine in the hospital for more than six years.

For the first four of these years, the gas we manufactured was not entirely satisfactory to any one, and at times was not without harmful effects. This was overlooked at first, partly because, on the whole, we had as good results as others, and partly because it was then believed that a certain amount of cyanosis was necessarily present during nitrous oxid-oxygen anesthesia, and that bad after-effects were in a measure to be expected. As our anesthetists developed more skill with this anesthetic, they were able to demonstrate to us that the cyanosis, the irritation, and the symptoms of toxemia following the anesthesia were present to a greater or less extent in all or in several patients on the same day, and that on other days there were no such symptoms at all: they convinced us that the gas made in the hospital contained a variable amount of some poison. Commercial gas, although producing at times the same symptoms of toxicity, seemed more uniform and distinctly less irritating. This difference was fairly constant, although our plant and methods of manufacture were the same as the commercial plants and methods known to us. On our worst day one patient of the gynecologic service died with all the symptoms of a severe toxemia a few hours after a simple operation; one patient of the surgical service was severely poisoned, and three others suffered to a lesser extent. The predominating symptom of the poisoning was a cyanosis that no amount of oxygen could dispel. The hemoglobin was evidently

* Read before the Section on Hospitals at the Sixty-Sixth Annual Session of the American Medical Association, San Francisco, June, 1915.