Presidential address delivered November I, 1900 / by Dr. John Macintyre.

1903 Glasgow University Society.

ROENTGEN SOCIETY, LONDON

PRESIDENTIAL ADDRESS

DELIVERED NOVEMBER 1, 1900

BY

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PRESIDENTIAL ADDRESS

DELIVERED TO THE ROENTGEN SOCIETY AT THE BEGINNING OF THE SESSION 1900-1901,

By Dr. JOHN MACINTYRE, F.R.S.E., F.R.M.S., M.I.E.E.,

On November 1, 1900.

LADIES AND GENTLEMEN,

My first duty to-night is to render my sincerest thanks for the honour you have conferred upon me in electing me President of the London Roentgen Society for the ensuing year, and to express my good fortune in beginning the duties of office to be able to refer to the great success which has attended the efforts of the original founders of the Society. It remains for me to try to the best of my ability and opportunities to aid you, and with a deep consciousness of the difficulties, to follow in the steps of those who have so ably preceded me in this office.

A careful perusal of our last annual report must be pleasing to every member; but even in a Society like ours—very young, because of the recent date of the announcement of the discovery which gave rise to it, November 8, 1895, five years ago this week—we have, unfortunately, already to follow the precedent of others and refer to losses. Since our July meeting we have to put on record the death of one of our ablest and most

enthusiastic workers, Mr. Thomas Moore, F.R.C.S. Like other members of his profession, he had to carry out his scientific work in the spare moments of a busy life, but he, nevertheless, found some time to devote to the advancement of science. As an active member, our honoured treasurer, and one of the Editors of THE ARCHIVES, he did much by his individual efforts to promote the interests of the Society, and I take this early opportunity, while recording our deep regret, to express our sense of gratitude for the willing services rendered from the time his name was enrolled as an original member until his sudden death.

In this address I should like to place before you some thoughts upon the present position of the Roentgen rays, and it may be convenient in doing so if I first call your attention to the consideration of apparatus, methods and improvements; next devote some little time to the physical aspect of the study; then to attempt to refer to a number of the important questions which have arisen of late in connection with our special branch of science, some of which have necessarily led to a certain amount of controversy; and lastly, by way of suggestion, briefly to show in which directions our Society's efforts may with benefit be directed, deeply conscious as we are that, notwithstanding what has been done, we have still more in the future to accomplish. For us it is probably better that the last-mentioned should be most carefully considered; for while we are quite justified in feeling pleased with success, the earnest worker in X rays, and particularly in its application to medicine and surgery, has already forgotten, if he ever really experienced, the emotions excited by the novelty or the somewhat over-estimated and even grotesque anticipations which immediately followed the ever-memorable communication. To-day, at least, he is

much more impressed with the difficulties to be met with every day in practising his art.

Perhaps the simplest way of approaching the first part of our task, viz., apparatus, is to take up the different parts and review them in succession. By general consent it is admitted that the most privileged workers are those who are able to obtain their source of electricity from the mains. There are occasions, however, when it is quite impossible to do so, and hence the value of good primary and secondary cells. The makers of these have responded so far to our requests, but much remains to be done. Improvements in portability, efficiency, strength and duration of life are as necessary as ever, whether we use them in civil or military practice. On this point I shall have something elsewhere to report.

The arrangements for controlling the apparatus have received greater attention, and instrument-makers are more than ever grasping the idea that our rheostats require special arrangements, not present in many ordinary forms, for varying voltage and ampèrage at will. Greater portability, combined with efficiency and strength, are being manifested in the production of such instruments, and where currents go beyond the range of rheostats, improved transformers specially suited for our apparatus are being introduced. It is gratifying to note also that more attention than ever is being paid to these, because the corporation supplies in the great cities are not always suited for our special work. Day by day, therefore, it is becoming easier to get what is required, and so our work is being facilitated.

The question of the best transformer for our work has not yet been settled. Most workers prefer the coil, but an increasing number are beginning to employ the in-

fluence machine. The tendency of late in coils has been to use a larger size than was at first suggested. A glance at the literature on the subject will also show that builders of coils have been impressed with the necessity of reconsidering the principles and methods of construction. With the advent of new interrupters and different conditions required in the Crooke's tube, many questions, such as high voltage and low current *versus* low voltage and high current, have arisen. It is therefore with a sense of satisfaction that we anticipate during the present session a demonstration of what we trust and expect may be of some service in solving these problems, namely, a closed circuit-coil, which promises exceedingly well. And in this connection we have to remember that at the address given by our first and distinguished President, Professor Sylvanus Thomson, a new induction coil for oscillatory discharges was mentioned as the outcome of experiments by that great genius, Nicola Tesla, one of our honorary members. Since then many of us had hoped to hear more of this, and it is therefore with great pleasure I am able to say that in a communication which I received from him last week, he states that much material has been accumulated since his last contribution to this branch of scientific literature. Although delayed, as his time is occupied with other matters, he has been able to bring it into a finished form, and has made satisfactory advances in construction which he hopes will enable him very soon "to be in a position to furnish apparatus enabling scientific men to more successfully investigate the interesting field which Roentgen's great discovery has opened up." We shall look forward with profound interest in this direction, and hope ere long to witness a demonstration of his recent successes. The true position and function of the influence machines in X ray work have not yet been

acknowledged. In the many discussions which have taken place we see it stated that each transformer has its advantages and disadvantages. Advances in construction of interrupters have done much to raise the coil to the level of the influence machine in one of the greatest points of recommendation, viz., steadiness of the image on the fluorescent screen. In this country the one most frequently employed and well known to us, thanks to the genius and indefatigable labours of our member Mr. Wimhurst, who first demonstrated its principles and theory, has proved of the greatest value ; but even those most familiar with it welcome all attempts to improve influence machines. For this reason we remember with satisfaction, amongst others, the demonstration by Mr. Jones of the new Holtz machine, the views of Mr. Cotton and his work on sectorless machines, the modifications due to Pidgeon, and Mr. Gardner's papers on the measurement of absorbability, and the variation in the latter with spark-gaps. Experimental results like these must be increased ere many of the questions still *sub judice* can be approached with a hopeful view to a satisfactory solution.

One of the most striking papers, however, lately written and reported in *Nature*, has somewhat upset our views in these directions. Professor John Trowbridge, at the meeting of the American Academy of Arts and Sciences, made some important observations upon results obtained with storage batteries of 20,000 cells. By means of the Planté type he could obtain 42,000 volts, and by the use of Leyden jars step up to 3,000,000. After referring to many interesting experiments, he found, like Tesla and others, that the air at atmospheric pressure becomes a fairly good conductor beyond 2,000,000 volts, that large electric discharges, 6 or 7 feet long, resembling lightning, can be obtained, and that these long sparks are oscilla-

tory. Great heating effects could be produced, and he points out one direction in which such enormous currents may some day be useful in surgery, furnishing as they do a new source of X rays. Professor Trowbridge considers this the ideal method of producing Roentgen rays, viz., by means of a large storage battery. He finds X rays can be obtained with a steady current at a voltage of 5,000, strongly at 20,000, and with extreme brilliancy at 40,000 volts—and this with a small current, 10 milli-ampères being dangerous to the tube employed. One of the most important statements is that his photographs show great contrasts, much better, he claims, than in the picture he obtains by using a coil. The writer of this article is fortunate in being in the position of experimenting with such apparatus, which, for obvious reasons, is not open to the most of us, and whether his suggestion that this may be advantageously employed in surgery is within the range of practice in the future or not, his conclusion that a constant current can produce such effects is of great value. The importance of the method can hardly yet be estimated, and future experiments will be eagerly looked for. The great advantage claimed for this method is the steady illumination of the screen, and, although the writer believed that an oscillatory discharge was necessary for the strongest manifestation of the rays, he now finds this is not so, as he points out that in his experience the discharge could not take place through the large resistance which he employed of 4,000,000 ohms.

Passing to the question of interrupters, it may now be fairly stated that we have advanced so far, particularly since the discovery of the Wehnelt, as to go beyond our present strength in tubes. Great energy and ingenuity have been taxed to make improvements which will withstand the terrific bombardment of

molecules on the anticathode. Continuous work over a prolonged period has been secured in even such an arrangement as the Wehnelt by a form supplied by De Mare, for which it is claimed we can now almost work for an indefinite period owing to automatic circulatory arrangements for cooling. The vibrating string interrupter and Hirschmann's turbine have each lately been employed and recommended with advantage in particular work. The risk involved with tubes in the present day is so great that many have sought refuge in the excellent mercury jet interrupter of Levy, and another rotating form by Mr. MacKenzie Davidson, to whom we owe so much. His ingenious and admirable interrupter, only the other day placed in our hands, promises to give great and good results.

The question of the tube, to my mind, however, as far as apparatus is concerned, is the most important. No doubt many of our difficulties, in the deep-seated structures of the body, arise from that irregular refraction or dispersion which the rays suffer as they pass through the tissues. Nevertheless, we have seen by the experiments of Mr. Campbell Swinton that, even when the vacuum remains the same, we can cause variations in tubes by comparatively simple methods, and this has been taken advantage of by Dr. Dawson Turner. I am quite aware that there is scarcely a part of the tube which has not been submitted to the most careful scrutiny, that endless experiments have been made, especially in the highly refractive substances and dense materials used as anticathodes, also in cooling arrangements by Levy and Grunmach. No doubt these have furthered our work. Notwithstanding all, however, and great improvement in intensifying screens—which of course we really desire to dispense with if possible—we have not

yet reached a satisfactory position, at least, for the most difficult part of our work.

In alternating currents, Chaband's form is worthy of attention, and Tesla has been further experimenting greatly with his special monopolar form. Lately he sent me a specimen of this which had taken many photographs, and had been illumined 60 feet from his transformer, there giving brilliant illumination of the screen.

I need hardly refer for more than a moment to the need of still greater improvement in the production of photographic plates, films, and papers ere we get as rapid photographs and as clear definition as we desire. The necessity of such was fully indicated in the last presidential address, delivered here only three months ago, and the ideas advanced by Mr. Wilson Noble, for future experiment, should be met by some of the many able makers of such materials.

That our methods of applying X rays have improved in every respect is well known, and is suggested, amongst others, in a curious way, viz., by the study of the lesions which were often produced during the exposure of the patient's body to the influence of the rays. You will remember that the question was carefully discussed in this Society, and a committee appointed to investigate the causes and report. At first considerable apprehension was raised in our minds, but it is gratifying to notify that most of those who endeavoured to elucidate the causes have failed largely because of the very small number of cases presented to them for examination. Most lesions, indeed, occurred during the earliest work—a gratifying result to announce at this early date in the history of the application of the rays.

Elihu Thomson may be accepted as the exponent of the views that the X rays, and not their influences,

produce these effects as the result of experiments, while Leonard of Philadelphia may be looked upon as one who, with many others, has come to the conclusion that the X rays have little or nothing to do with them; and indeed his papers, as published, would show that his views are diametrically opposed to those of the former writer.

The papers read by Oudin, Barelemy, and Darier, at the International Congress at Moscow in 1898, did much at first to suggest how such injuries could be avoided, and went far to justify the optimistic views ultimately expressed, and reasonably explained by Mr. Mansell Moullin in his presidential address last year.

The demand for accurate localization of foreign bodies and fractures, which is an absolute necessity, has been well answered in the form of practical methods based upon theoretical considerations previously demonstrated. In addition to the earlier arrangements and methods of Moore, Payne, Fleming, and the deservedly popular ones of MacKenzie Davidson, we have to record with satisfaction, amongst others, further attempts to make our work easier, by Shenton's practical suggestions, Barrell's method without plumb-lines, and the most interesting demonstration given to our Society by Professor Rémy—all indicating that different operators, as experience matures, are still striving to further our object and to simplify our work.

I believe that it is to Elihu Thomson that we are first indebted for a clear description of apparatus and methods for the production of stereoscopic photographs, but it is interesting to note that its genuine value is now being more and more recognised in the practical field of medicine and surgery. That it has been taken use of to the extent it deserves is extremely doubtful, entailing as it does so little extra trouble. From stereoscopic

photographs it was natural to desire to see things stereoscopically upon the fluorescent screen, which is but a step; but, as in many other things, the step was one which was much more easily suggested than carried into effect. My predecessor had the privilege of stating that this had at last been successfully accomplished by Mr. MacKenzie Davidson, and it is mine to announce that a practical demonstration, with some of the results accruing from its use, will form a feature of this session's work.

It is true that the study of X rays from the physical aspect has presented almost, as yet, insurmountable difficulties. The absence of reflection, refraction, and polarization, as we mean by such terms when applied to light, may be referred to as examples. Other rays, some of them the natural outcome of Roentgen's work, have been discovered, and all before or since Roentgen's great discovery must be investigated. In this direction, Lenard, Sylvanus Thomson, Becquerel, Goldstein, the Curies, and Russell have opened our eyes to possibilities in the physical world, and I may be permitted to add, probably in the future in the region of therapeutics, of many forces of which we were entirely ignorant. Reflect upon the thought that the loss of material through a body emitting these rays is so small as almost to look as if the statement were opposed to all we know as to the conservation of energy, and we get a keener insight into the difficulties of advancing. Not one of these different rays can be overlooked in such a Society as ours—at least, until we have been able to define the nature and properties of each kind. Yet a glance at our literature proves that many of our great physicists, in all parts of the world, are grappling with such problems. Let us consider for a moment some of these. Winkelman, who has made experiments upon the gaseous

pressure upon which X rays can be produced, points out that hydrogen yields them on greater pressure than air or carbonic acid. We are indebted to Arnold for some interesting work upon the influence of luminosity of the anti-cathode rays on the emission of the X rays ; and to Moffat for his investigation into the power of the X rays. Zeleny finds that during condensation of the gases under the influence of the Roentgen rays, convection currents are produced, moving towards the electrodes. Inchmann has pointed out different potentials in two different metals under the influence of X rays. J. D. Thomson has investigated the difference between the chemical constitution of gases, while Wilson tells us that condensated neuclei are produced in gases by the action of the X rays. Townsend describes two kinds as the result of X rays falling upon metals. Perrau finds that the X rays reduce the resistance of selenium. Curie and Sagnac have shown that the X rays are not electrically charged, but secondary rays, produced by their transformation, are negatively charged. Brunhes has attempted the measurement of the velocity of the rays, and shows that the emission of them produced by the rupture of the interrupter lasts only $\frac{1}{10000}$ part of a second—a fact of great interest in our practical work when we remember that fluorescence in a tube lasts considerably longer than the passage of current through a vacuum tube, and, secondly, that photographs of certain parts of the body have been taken by a single flash, the result of one discharge from a mercury interrupter. Villard, in his experiments, suggests what might have been expected, that arc incandescent tubes may be giving out cathode rays. Another important thought is suggested by his experiments, that, apart from physical, the X rays may be capable of chemical action, as demonstrated in the violet coloration of certain glasses under their influence

—a fact which has also been remarked upon in our own Society by Mr. Payne and others. Wiedemann and Wehnelt have shown that while cathode rays are deflected, Goldstein shows that they are not directly influenced by the magnet. These rays emanating from a hollow cathode cut one another, and that there are variations in the discharge in the cathode dark space corresponding to the ultra-violet of Roentgen rays. The views of Elster and Geitel upon the source of energy in Becquerel rays are of importance, one at least to us—the suggestion that Becquerel rays may be Roentgen rays of small intensity. We must not omit the names of Hagar and Wynd, and their able attempts to give something like an idea of the measurements of the wave-lengths. Nor would it become us to forget the studies of two other distinguished members of the Society—Mr. Campbell Swinton, and Mr. Herbert Jackson, the former on the phenomena observed in vacuum tubes, which have already been referred to in this paper and by former Presidents, as throwing more light upon our practical work; and the magnificent course of studies and writings by Mr. Herbert Jackson on phosphor-escence, to whom all X-ray workers will ever remain indebted for his practical work in tubes.

This selection by no means exhausts the list. On the contrary, it is quite impossible to do justice to what is being done in the time at our disposal, nor is it easy to give relative value to each worker; for who knows, in the present state of our knowledge, which is to be the most important factor in suggesting or bringing about other practical developments? The works, however, of Becquerel, the Curies, and Crookes stand out in great relief. The excitement caused by the discovery of radio activity in uranium salts, polonium, radium, actinium, and others, although probably, as has been said, the

natural result of the great discovery of Roentgen himself, is easily understood when we realize that we are dealing with forces some of which, at least, may excite fluorescent screens, discharge electrified bodies, are capable of chemical action, converting oxygen into ozone, may be subject to deflection by magnetic influence, are probably composite; that some of the substances emitting the rays lose these properties when heated to a certain degree, and regain them when cooled, and that this radio-activity can be communicated to other bodies, a result not due to the passing of vapours but to induction.

Important advancements made in diagnosis have been justifiably referred to by nearly all writers on X-ray matters, and the enumeration of the advances made in medicine and surgery may be studied with advantage by all who are interested in the subject. Notwithstanding this, however, we have not been without indications from sources commanding our respect that there are two sides to the question. We have it on authority of the Editor of one of our leading medical journals that the results in fractures have been overestimated, and distinguished physicians have, on more than one occasion of late, given expression to their regrets about their limited value in medicine. That it would prove more valuable, at first, in surgery than medicine work was to be expected; but this, to a very considerable extent, has been remedied within the last two years. I have no desire to raise subjects for controversy in this address, but, when one reflects upon the work which has been done in fractures, dislocations, exploration of cavities, diseases in bone, on the one hand, and investigations for the detection of thoracic pathological lesions, such as aneurism, changes in the lung—*e.g.*, in tubercle—mediastinal abscess, diseased glands, and the presence of

fluids as shown by the writings of Bergonié, Carrière, Thomson, Walsham, and many others, it is difficult to see what can give rise to extreme disappointment unless it be from too high an estimate and expectation at the beginning of what is a very recent, but we are pleased to add, progressive science.

Leonard, of Philadelphia, has written one of the most interesting monographs on calculi in the kidney, and goes the length of stating that, as a result of careful study of the proper conditions of the tube, one of the Queen's pattern, etc., he can affirm, not only that such can be detected, but where a negative result on the photographic plate has been obtained, that no stone is present.

The confutation of all such views as we have referred to above may be safely answered by the natural and practical results which are daily flowing in upon us, and it may be here again stated that no one is more conscious of what has not been done than those who are best acquainted with the subject. Meantime, they have some satisfaction in knowing the intrinsic value of the work, and believe that, however difficult and arduous the task before them, their views need not be tinged with extreme pessimism. The same disappointment, moreover, has been expressed in other branches of science. When the microscope was first introduced into clinical work too much was expected of it, and the hopes of those who thought microscopical examination of tissue would solve all pathological problems were speedily crushed; yet the microscope has taken its place in every clinique, and in its most recent branch of study, namely, bacteriology, the student has passed, or is passing, through a similar experience. Like all other things, moreover, X rays will, in due time, find their true place; but those who look most hopefully into the future and are best

acquainted with them, are least ambitious to over-estimate their value; nor are they likely to forget that there is no branch of science applicable to diagnosis which can ever neglect corroborative evidence from any and every reliable source.

The question of the employment of the X rays in war has everywhere naturally created a considerable amount of interest. Although something was attempted in the Græco-Turkish War, it was only after the Soudan Expedition that anything like a definite idea could be obtained of their utility in the field. Surgeon-Major Battersby, whose extremely interesting paper formed one of the notable demonstrations of the Society, showed us how far he had been successful. His excellent cycle motor, as photographed in our ARCHIVES, is destined to play an important part, in conditions where, partly owing to distance of charging stations, and partly owing to defects, it is difficult to recharge batteries, as has been experienced in South Africa. As we again see his name honourably mentioned in reports from the Transvaal, it is to be hoped that some day we shall again have the pleasure of listening to him in the Society. It is too recent to say anything about the work in South Africa generally, but doubtless the reports will in due time come to us. Meantime we are looking forward to a paper from one who has been engaged in the field, ere our session closes. I am pleased, however, so far, in a general way, to be able to report, on the authority and by the courtesy of Surgeon-General Jameson, the Director-General of the Army Medical Department, that the X rays were found most useful in the hospitals at the base and on the line of communication, though not actually on the field. There is now a regulation list of apparatus for army work, and in his communication he informs me further that seventeen sets of these were

sent to South Africa, and that, as a proof of the value attached to such, they are now being adopted and supplied in all the larger military hospitals. Many reasons may be assigned as the cause of the above reference to the X rays not being actually useful within, or near, the fighting lines, but should surgeons from the Transvaal who have employed the apparatus indicate that either for reasons of portability or defects they were unable to use them in some instances where they might have been advantageously employed, we have little doubt the majority of all such difficulties will, by patient labour and preparation, be avoided in the future.

Of the reports upon questions which have agitated the professional as well as the lay mind during the past four years, in connection with our subject, none is of greater interest than that of the committee appointed by the American Surgical Association to consider the medico-legal aspects of the X rays. As the result of a communication published in 1897 by Dr. J. Wilson White, of Philadelphia, a committee was formed to consider the question. We have now had the reports, and a series of resolutions have been accepted as the finding of the Association. A circular was sent to every member with a series of questions; answers were generally returned, and the conclusions arrived at are the results of mature consideration from many sources. Amongst others, the question was considered whether patients sustaining injury should be examined as a matter of routine; the possibilities of exaggerating deformities were fully demonstrated, mistakes in connection with foreign bodies and the search for calculi through structures in the deeper tissues, faulty interpretation of photographs, evidence of fractures which were known to exist, but evidence of which did not appear on the photographic

plate, and incomplete union where other indications showed that the case was proceeding in a normal and satisfactory way. Records of operations which had been performed uselessly by the surgeon being misled by the photographs were submitted; the value of photographs in court was also dealt with, and complexities of opinions of judge and jury referred to where claims for damages had been set up in cases of mal-praxis, or where the practitioner sued because in taking a photograph accidental burns or other lesions had been inflicted upon the patient.

This distinguished surgical association unanimously adopted the conclusions of the Committee, which were eight in number, and, briefly stated, were as follows:

That, while the surgeon should make use of every other available method of diagnosis, the employment of the X rays in cases of fractures is not at present of sufficient definite advantage as to justify its use in every case; that in certain regions of the body, *e.g.*, the skull, spine, hip, etc., the X-ray results have not been thoroughly satisfactory; questions of deformity arising from photographic appearances alone, without surgical interpretation, are generally useless and frequently misleading; the appearance of deformity is easily obtained, and existing deformities as easily exaggerated; the impossibility of distinguishing between perfectly satisfactory callus and cases which will go on to non-union in recent fractures is admitted; X-ray burns may be prevented in the majority of cases, the causes being yet under dispute, and idiosyncrasy in some cases, probably a small number, may render the patient more liable to injury; that the recognition of foreign bodies in skiagraphs is of the greatest value; localization has sometimes failed, and that, while the mistakes in the former cases might easily be avoided, the latter are

becoming frequent, and may ultimately be limited, although the possibility of such errors must ever be remembered by the surgeon; that the interpretation of the law may vary in different States by different judges, but that photographs will undoubtedly be a factor in medico-legal cases; and lastly, that the technicality of its production, the manipulation of the apparatus, are at present left in the hands of the specialists or experts, but that the surgeons should familiarize themselves with the appearances of photographs, their distortions, and the relative value of shadows and outlines, so as to be able to judge for themselves and not have to depend on the interpretation of others who may lack surgical experience necessary for a proper interpretation. Such an expression coming from this source is of great value.

It may here be pointed out where doubt is expressed the findings of this or any other association may require to be changed any day; they do not stand for all time. By way of comment further, we may emphasize the point that in every branch of science corroborative evidence from every other source should always be obtained; that every X-ray photograph does not reveal all that could be revealed by photography, and that sometimes the best results can only be obtained where the surgeon combines in himself professional knowledge with that of the expert in X rays. There is one further comment allowable in connection with the legal aspect of the question and the interpretation of photographs generally, to which allusion has already been made, and strangely enough, to a large extent, omitted in these discussions—that is, the value of stereoscopic observation by plate or screen. If there is a province in which these particular methods are of value, it is surely in medico-legal work.

From the moment Roentgen announced his discovery, the question of employing the rays therapeutically has engrossed the attention of many, and the interest has not become diminished as time goes on. From our present standpoint, in an age which is familiar with the therapeutic application of electric waves in a variety of forms, of heat, of light, whether from the sun or incandescent lamp, with Finsen's ideas in the employment of ultra-violet rays, nothing else could be expected. Whether viewed from the standpoint of Roentgen rays being longitudinal or transverse in ether, or that of Stokes, the facts remain that they are capable of great penetration of tissues, upon which they can produce changes, and that they resemble the above-mentioned forces in producing kindred effects upon tissues and inorganic bodies, chemical or chemico-physical in nature. The superficial tissues have naturally been first investigated by Freund, Hahn, Holland, and amongst many others the discussion in our Society introduced by Miss Shairp; and no one who has studied the results can fail to observe that definite changes in pathological lesions can be produced when a patient is subjected to the influence of the excited Crooke's tube. Considering the modern theory of bacteriological origin of diseases, the possibility of destroying micro-organic life could not be overlooked, and the earliest reports by Reider and others, attributing to them great germicidal power, naturally raised our expectations.

These earliest experiments have not been confirmed, and as a result of further investigations by experts such as Thorburn, Wolfenden, and Forbes-Ross, many are diametrically opposed to such a conclusion. No one can read the experiments of the above-mentioned writers in our ARCHIVES without being struck with the care with which all possible errors have been excluded, and so we

are driven to another line of reasoning. Granting for a moment it is proved they are not germicidal, and according to Wolfenden and others, the rays positively stimulate the growth of these organisms, the subject is by no means exhausted. As was very properly pointed out by Mr. Mansell-Moullin in his address, if we cannot destroy pathological micro-organisms in the tissues, we may try to excite what was long known by such an expression as the *vis medicatrix naturæ* an obscure term of which the modern doctrine of phagocytosis has given us a scientific, if meantime incomplete, explanation. But let us reason this one step further. If we destroy animal life, as in the removal of superfluous cells and the production of burns on the one hand, yet by modification of the process stimulate tissues on the other, it follows that the application of X rays may also stimulate micro-organic growth in the tissues. No doubt in this lies some of the difficulty experienced by those who have attempted the therapeutic use of X rays in the lungs and deep-seated tissues of the body, and it must be admitted that, notwithstanding some hopeful reports, as yet in these latter cases great progress has not been made. How we are to stimulate the tissues without injury to them and still overcome the vitality of micro-organic life at the same time is the question. We are encouraged, so far, that, in some lesions, definite, if as yet limited, results have been obtained, and by the fact that the same reasoning to an extent might be advanced about ordinary sunlight, the benefit of which is beyond dispute in many affections.

The question cannot be allowed to rest here; no one doubts that definite physiological changes and alterations in some pathological conditions can be produced by transverse waves in ether, notably electric. The same

may be said of heat and light, and of the ultra-violet rays as expounded by Finsen. In an earlier part of this paper it was pointed out that others than X rays are radio-active, and that they possess many properties in common with the X rays. It is true that the best experimenters have not been able to say as yet that they are capable of taking the place of the X rays—certainly not in fluorescent screen-work or photography—nor, indeed, how far they are allied to them. The application, however, of the Roentgen rays is not limited in any branch, far less in medicine and surgery, to taking photographs or viewing structures on the fluorescent screen. Whatever may be claimed for them in therapeutics, we have, at least, by no means exhausted our research in this direction, and if so it takes no great stretch of imagination to suggest that many radio-active forces may also yet be employed therapeutically. In certain superficial structures of the body some such substance may lie on the affected part and so keep up continuous stimulation. It is by no means unlikely that before long a wide field of investigation of therapeutic research will be opened in this direction. Experimentally it is now being tried.

The questions involved here are great, and without hope of elucidation we might despair of a complete scientific basis for much therapeutic research. Take any sample drug we are in the habit of administering. How much do we know of how it acts? We know it largely by its results, but whether taken into the alimentary canal or injected into the circulation, it must act in some subtle, but often in an unknown way, upon the tissues, and frequently upon the great nerve-governing cells at a distance. We can conceive definite changes being produced by chemical effects in some, but in others only by physical or chemico-physical action. We

cannot think of the work being done simply by the presence of one body being near to another. Apart from definite changes in structure, movements must be induced in many instances which bring about the results familiar to the physician and surgeon. Recent revelations in physical science have shaken our beliefs to their foundations; nothing seems at rest, and wherever we turn we are confronted with the idea of molecular unrest in everything—a universe in motion. All radio-active bodies, waves in ether, however produced, must be studied, their exact relation to one another determined, and their properties investigated, ere we know how to select the best and most suitable agent in a given case. We must also remember that many agents may produce similar effects at the time, but the after-results may not be the same, as an example of which we have the different kinds of scars following lupus as a result of burning with the cautery, or the application of X rays, or Finsen's method.

Many objections and doubts have been raised against the employment of X rays in disease. In the first instance they have hopelessly failed in many cases, and in the hands of expert operators. In the second place, the duration of the treatment and the number of the sittings required have been quoted as often being excessive, and that the same results might have been more easily obtained by other agents. Lastly, grave doubts have been expressed as to whether such results may not be the result of other forces acting upon the patient, and coming from, or being associated with, the Crooke's tube, to which also immediate and therapeutic effects may be attributed. All such questions, in our present knowledge, require greater elucidation and consideration, and much remains for X-ray workers to do.

In drawing some conclusions from the questions which

we have taken into consideration to-night, we cannot but be impressed with what remains to be done. There is no part of the apparatus, no method, physical or chemical, which cannot be improved, and upon which much light must yet be shed. In the application, whether in diagnosis or in the great field of therapeutics, we have unlimited scope for experiment and observation of the most engrossing nature. The particular question of medico-legal work, correct interpretation of photographs, ordinary and stereoscopic, the production of an atlas of normal appearances to assist surgeons and physicians, and the collection of a library before the study becomes too old and many of the early works are lost, are all worthy of our immediate attention.

Speaking of apparatus, it may be here convenient to say that in some directions we have advanced more than in others, and two of these may be once more referred to—one of them, improvement in photographic plates, films and papers; and the other, the construction of tubes. My predecessor three months ago did justice to the former, and in the hope of calling special attention to the latter, it has been decided by the Council, as a slight stimulation, to permit me to award a gold medal for the best X-ray tube for practical purposes submitted to the Society during the year 1901.

I am pleased to be able to report, in conclusion, that Mr. Vezey has accepted the position of honorary treasurer, and to acknowledge that we are already much indebted to him for his ready assistance in taking on the duties in an emergency and at the request of the Council; and it is also with much pleasure that I announce that Mr. Mansell-Moullin has agreed to co-operate in the production of The Archives, a fact which speaks well for our future publications.

We therefore begin this session hopefully, with strong

membership, and in the consciousness of much work to be done. The members of the Society can contribute much by mutual help, candid and sincere criticism—factors which lie at the very foundation of the justification of the existence of such a Society as ours. It would be strange in a branch of science which has already done so much—and which promises yet in a greater degree—to alleviate human suffering, were we not interested in practical results. With us, however, it is the same as in every other branch of science; we can well afford to let results come as a natural result of sincere and honest labour. Sufficient will it be for us to realize that year by year those elected to occupy the honourable position in which you have placed me may find our branch of science richer than their predecessors did at the beginning of their respective terms of office.

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