been expected as a matter of course, the disease has proved to be of much shorter duration when the red-light treatment has been carefully adopted; as a consequence the stay in the hospital is shorter, and this renders an epidemic less expensive to the taxpayers. Some authors are even of opinion that the danger of infection is lessened when suppuration is prevented.

It may perhaps be thought that I have been using too many words in endeavouring to prove the advantage in the management of small pox of avoiding the suppuration of the vesicles. The essential point is therefore as to the correctness of the statement that light is of such great influence and that suppuration may be prevented—a statement many do not accept. But even if there is no belief in scientific investigation and proofs which are now before the world and which, in my opinion, are absolutely convincing, the matter, I think, is of sufficient importance to be inquired into. The evidence given by so many men of science from all countries who have tried the method is, no doubt, of sufficient weight to justify an inquiry.

I should greet with the greatest pleasure the appointment of a Commission to make a thorough investigation of the matter, and I should be very happy to place myself at its disposal with all information at my command. If this proposal meets with approval, may I suggest that the Commission should consist, besides small-pox physicians, of dermatologists who are acquainted with the action of light on the skin?

I can hardly believe that scepticism in regard to this method is so great that the idea of a careful scientific investigation would be flatly refused at a moment when the therapeutic importance of light—as a means of treating lupus and other diseases of the skin—must be said to be generally admitted everywhere.

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AMERICAN CONGRESS OF TUBERCULOSIS.—An American Congress of Tuberculosis is to be held in St. Louis in July, 1904. There will be about sixty delegates from each State and Territory in the United States making an aggregate of about three thousand official representatives. It is expected that in addition to these hundreds of students and others, interested in tuberculosis will be present.

RECENT ELECTROTHERAPEUTICS,

WITH SPECIAL REFERENCE TO MALIGNANT DISEASE.

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MANY of the recent discoveries in physical science have attracted great attention of late in the medical profession because of the possibility of applying them in the region of therapeutics. Long before the Roentgen rays had attained a permanent place in diagnosis the accidental dermatitis which occasionally took place suggested the possibility of their being used in the treatment of certain affections. The results of experiment came somewhat slowly at first, but of late the utmost activity has prevailed in many schools at home and abroad and in consequence a considerable amount of hope has been raised as to their therapeutic value in a number of affections, but most of all in malignant disease. While it might be fair to say that just as in the department of physics Roentgen's original paper has stimulated unexpected and serious research in other branches of science, so in medicine the result has been to create profound interest not only in the newer forces but also in others which had been previously known to the profession. For example, Tesla's great work was followed by the now historical physiological researches of D'Arsonval, and in view of the great interest taken in high-frequency currents of late it is difficult to understand how they failed to stimulate thought to a greater extent previous to the year 1896. Again, in the year 1893 Finsen gave us his researches in phototherapy in small-pox to be followed by another important paper in 1895 upon light as a stimulant. Two years later came his still best known work upon the treatment of lupus by concentrated chemical rays. Downes, Blunt, Duclaux, Arloing, Roux, Geissler, and Buchner had previously claimed for light a bactericidal influence, Thayer had submitted patients to the influence of sunlight by means of a convex lens, Mehl had in addition to the layman tried the effect of a burning glass in lupus, and Ziegler and Lehmann had also used the electric light—facts which Finsen himself fully acknowledges—but the credit of the great development of this special agent is due to Finsen. Clearly, therefore, these two examples may be quoted as showing the direction of men's minds in therapeutics previous to Roentgen's discovery, although research in this branch of science has by comparison of results caused greater interest in both since 1895.

RELATIONSHIP BETWEEN THESE FORCES.

In the first part of this paper I shall group the different forces in order to show that they bear some relationship to each other, that some of them at least possess properties in common, although each may possess some thing or things not found in others. This statement will be found to apply to the different forces, whether studied from the standpoint of the student of physical science or that of the clinical observer. For example, some can be polarized but others cannot. On the other hand, many of them act on the photographic plate, such as light, radiant matter (Crookes), and even heat (Abney). In the same way, in therapeutics we find that radiant heat, light, natural and artificial, and x rays possess certain properties common in different degrees, but they differ in other respects. Great power of penetration is possessed by the x rays, and the tendency to flow over large and extensive surfaces as is characteristic of high-frequency and high-potential currents.

In Fig. 1 a diagrammatic spectrum is represented based upon the familiar one of the spectrum of light. On the left there are first the electric waves, next heat waves, then follow the usual light waves divided into the red, yellow, blue, violet, and ultra-violet. Further, to the right, are groups of waves which have only recently become familiar to us in the studies of fluorescence, such as Becquerel rays, and some of the rays recently described as emanating from radium and polonium. Lastly, we have on the extreme right the x rays, that is, granting they are transverse vibrations in

ether. In connexion with the last two kinds mentioned points of interrogation have been placed in the diagram because of the incompleteness of our knowledge. The figures in the diagram refer to the periodicity of each force.

Fig. 1.—Diagrammatic representation of different waves in ether to the right and left of the ordinary light spectrum and including this.

From the clinical standpoint something may also be said of these forces in the same way speaking more particularly of their recent applications in the treatment of chronic affections. Taking them in the same order as above, the constant, faradic, and sinusoidal currents may have been used to improve the general health, but with the exception of the constant currents in rodent ulcer and mercuric cataphoresis lately tried in malignant disease (Massey) they do not at present directly interest us. Of high potential currents as produced by the static machine and so long known to the profession some experimental work has recently been recorded. Much more has been heard of high-frequency currents (so prominently associated with the names of Tesla, E. Thomson, and D'Arsonval) in the treatment of malignant disease, but these will be more fully dealt with in a particular part of this paper. So much for the electric waves.

As far as the heat waves are concerned, we know how much has been done in the past to alleviate pain, and more recently we have had parts of the body subjected to dry radiant heat at temperatures thought to be impossible in the past. Beyond this at present we need not say anything further. When welcome to the question of light, however, while less attention has been paid to the red, yellow, and green waves with the exception of Finsen's work in small-pox, the waves, known as violet and ultra-violet have been largely employed, particularly in lupus. Thus we have Finsen's apparatus modified by Lortet, Génoud, Sequeira, and still more recently Bang's iron arc lamp and the applications of the spark of the coil itself by Goerl, Walsham, and Dawson Turner. Of the next force in order less has been heard of in therapeutics in the past, but it is not unlikely something more may be made of them in the future. In all probability physical science will soon fill in some of the gaps in this spectrum between the ultra-violet and the *x* rays.

Thanks to the magnificent researches of Crookes, Becquerel, and M. and Madame Curie, we have the Becquerel rays or the fine bodies of matter coming from them, the so-called electrons given off by uranium salts or from radium and polonium and their salts. These important discoveries have already given some results in the physical world, and three kinds of waves have already been described as coming from the extraordinary radio-active substance known as radium, which is constantly giving out heat and light from some source unknown at present. It will easily be comprehended that if we could stimulate the tissue and produce similar effects as are at present got from the excited Crookes tube by simply applying a salt directly to the parts, much complication in apparatus would be avoided.

Owing to the difficulty in obtaining this ray substance few

experiments have yet been made, but the following may be of interest. I obtained some bromide of radium, and having tested its physical properties, such as fluorescence of barium, platino-cyanide, and other salts, the passage of the radio-active substance or waves through wood, aluminium, and the power of making the air a conductor by discharging an electrified body, the following experiment was tried: Keeping in view the resemblances between these phenomena and those observed by means of the *x* rays in the ordinary way, and the dermatitis which followed, I applied two or three milligrams to the skin of my arm. The experiment was so arranged that the waves had to pass through a layer of air and one of mica for one hour only. The immediate result was erythema. Next day there was evidence of a dermatitis the area of which was six times larger than the size of the original salt. On the third day it was evident that the epidermis had been destroyed, and on the fourth there was a small ulcer in the centre of the inflamed patch. For days afterwards there was slight though distinct pain. The evidence of irritation did not disappear for many days afterwards. Becquerel has reported burning of the skin of the abdomen from a few milligrams of radium in a small glass tube which he carried in his pocket, the sore lasting for several weeks. As the result of these and similar observations I am at present conducting some experiments in therapeutics, the results of which, of course, are at present too premature to record.

Of the *x* rays, the last of the forces to which we have here to refer at present, it may be said at once that in the treatment of malignant disease they have been more frequently applied than any of the others. Reference to the medical journals will show that whatever success has been obtained in the treatment of rodent ulcer and superficial epithelioma, most of it is due to the application of the *x* rays. The light treatment has not proved of much service in my own cases at least, and I am pleased to say that Dr. Walsham (to whose apparatus I have already referred, and of which those in charge of the electrical department of the Royal Infirmary think highly) takes the same view. In a private communication to me Dr. Walsham, whose opinion is based upon careful, accurate observation and extensive experience of light treatment particularly, says he prefers *x* rays in rodent ulcer and malignant disease. As far as my own experience goes, if I were asked the question in reference to superficial malignant disease, or in the cavities of the nose, mouth, and throat, which agent I had found the most efficacious, I should unhesitatingly say the *x* ray tube. In stating so I am purposely not saying the *x* rays from the Crookes tube because the electric field outside the Crookes tube, as well as the *x* rays themselves, have to be considered, and I have seen a case of rodent ulcer completely cured with a *x*-ray tube excited in the usual way, but purposely made of such a high vacuum that no *x* rays could be detected by means of the fluorescent screen. My first case treated in this way was one of the most successful, and it was in a patient who had been three times previously operated on surgically. The satisfactory result was obtained in three weeks, and there was no recurrence. The rays were applied nearly four years ago.

APPARATUS.

The apparatus necessary for the production of these different forces is necessarily complicated, and in the diagrams here produced some of the apparatus employed in the Glasgow Royal Infirmary and my private laboratory will be seen. The electrical pavilion in the hospital is an extension of the electrical department which has been in existence since the year 1887, and the necessary funds were obtained owing to the generosity of some of the subscribers and citizens. The new building is independent of the general hospital, but the currents have been carried by means of wires to the different wards. The supply may be divided into three distinct installations. First, the rooms themselves are lighted by the 250-volt circuit from the mains; secondly, a transformer which gives 55 volts and 50 amperes from the Corporation supply; thirdly, there is a gas engine, with dynamo and secondary cells, giving 56 volts and 30 amperes. The last two are intended for all medical and surgical purposes, whether for diagnostic or therapeutic use, and by means of turnover switches either can be used, so that, in the event of a breakdown with the Corporation supply through the transformer, the gas engine and cells can be utilized, or vice versa.

A main switchboard has been fitted up on the Corporation side of the transformer, which controls the whole supply to

the department. This is provided with the necessary starting switches. On the other side of the transformer is

Fig. 2.—Interior of electrical pavilion, Glasgow Royal Infirmary.

a large distributing board with six switches going to different rooms, so as to send the energy where it is required.

The transformer was specially built for medical work, and the voltage was selected because the first apparatus in the house was worked from a similar supply; hence the old as well as the new instruments can be used. It is, moreover, safe to work with such a voltage.

Fig. 2 gives a general view of three of the rooms and in Fig. 3 a transformer and switchboards are seen, as well as three of the sets of Finsen's apparatus for light treatment. In addition, Bang's modification with iron electrodes has been

Fig. 3.—Room for transformers and light treatment, Glasgow Royal Infirmary.

fitted up, and Walsham's apparatus for utilizing the electric spark directly from the coil forms a part of the installation.

In Fig. 4 will be seen the static machine for medical purposes and also for the treatment of lupus and other chronic affections, which was built specially for the hospital by Lord Blythwood in his laboratory at Renfrew. The machine is of the Wimshurst type, and has forty plates of 36 in. diameter. It is driven by a one-horse power electro-motor, and has a special fan motor with ventilating shafts and apparatus for driving out any gases which form within the case when the machine is in action. Suitable insulating stools, and tables with discharge rods and spark-gap apparatus, form part of the

installation, and there are also a number of electrodes for giving the current to different parts of the body.

Fig. 4.—Wimshurst machine for high-potential currents, Glasgow Royal Infirmary.

Fig. 5 shows the arrangement made for high-frequency currents. The pattern of D'Arsonval's apparatus employed is that constructed by Dean, of London. On the switchboard, all the arrangements for measuring high-frequency currents, reversers and rheostats for the motors, are provided. A large number of electrodes, including Oudin's resonator, brushes, vacuum tubes, etc., for use in nervous and muscular affections, as well as in the treatment of lupus and rodent ulcer, are included in the equipment. The current is applied to the patients while resting on a specially devised couch.

Fig. 5.—High-frequency apparatus, Glasgow Royal Infirmary.

In Figs. 6 and 7 the arrangements for x-rays are represented. Five large coils, capable of giving 10 in. to 14 in. spark respectively, have been included in the installation. All the ordinary forms of interrupters have been fitted up, including the Wehnelt. A specially-designed switchboard has been attached to the wall, with rheostats for motors, volt and ampère meters. There is also a special set of switches, so that any one of the interrupters with suitable condensers can instantly be employed as required for different purposes. Stands and vacuum tubes (Queen's, Dean's, and Cox's record designs) have been provided as well as fluorescent screens, and all the most recent accessories for therapeutic as well as photographic

purposes. Couches have been provided for taking photographs from above or from below and for therapeutic work, also localizers of the most recent design for detecting the situation of foreign bodies. All the apparatus necessary for the taking and demonstration of stereoscopic photographs has been added to the department.

Fig. 6.—X-ray department, Glasgow Royal Infirmary (showing arrangement for taking photographs, with dark room, and therapeutic work).

In Fig. 8 will be seen the largest size of Gaiffe's machine built. It consists of a 20-plate machine, each 21 in. in diameter, driven by a one-horse continuous current motor with suitable rheostats to control the speed. The plates are made of vulcanite and can be run up to a 1,000 revolutions per minute at least without risk of fracture. The plates are sectorless, and the great feature of this excellent machine is the quantity of current as well as the high potential obtained.

Fig. 7.—X-ray department (showing arrangement for taking photographs and therapeutic work).

In this illustration will be seen my own arrangement for utilising the static machine to give high frequency currents, and to which reference will be made further on in this paper.

In addition, there are rooms containing all the rest of the apparatus for medical and surgical purposes, such as illumination of the cavities, transillumination, constant and faradic currents, drills, electro-magnets, and general electric appliances which do not at present interest us, however.

SELECTION OF A PARTICULAR FORCE.

The operator has to consider which of the forces we have been describing will best suit a particular case. In coming to a decision much depends upon the experience of the surgeon himself, but he is influenced by many of the conditions present. Whichever he tries may fail, and it may be necessary to try more than one. For example: In Figs. 10 and 11 will be seen a case of epithelioma which came under my observation. The lady, aged 58, had for many years suffered from what was considered lupus. When I saw her the diagnosis clearly pointed to malignant disease, and this was afterwards confirmed by microscopic examination. She consulted, at my

request, Dr. Sequeira, who very properly refused light treatment. She had x-ray treatment in London, however, with some success, but recurrence took place. In February, 1902, the mass completely filled the nasal cavity, and had destroyed its contents. Eight months afterwards the whole neoplasm had disappeared under the x-ray treatment, while high-poten-

Fig. 8.—Twenty-plate sectorless machine (showing arrangement for using high-frequency apparatus).

tial currents, at first tried, completely failed. Since then a new development took place at the end of last year. The gums near the incisor teeth took on a spongy, swollen, ulcerated condition. This also yielded to six weeks' treatment with the same agent. All pain has disappeared in this case, breathing is thoroughly re-established; but the septum and turbinated bones have all been destroyed. When last seen, three months ago, the interior of the nostril was quite healed over.

Fig. 9 Diagrammatic representation of Fig. 8.

While in all experimental work it is better to keep to one agent alone, still we have now reached such a stage that in certain cases it may be permissible to combine high-frequency currents or the static machine with the x rays. The one may be given constitutionally, and the other locally. Further, much depends upon what is hoped from treatment. For example, alleviation only may be all that can be expected, such as the reduction in size of the tumour itself, the removal of fungating growth, the arrest of foul discharges and haemorrhage. On the other hand, the hope may be to completely remove the neoplasm. Again, the situation of the affection is of the utmost importance, because the best results so far obtained have been either in the superficial parts of the body, or in accessible cavities. Notwithstanding all that has been written upon the subject, we have little to report in carcinoma of the deep structures and internal organs. That x rays penetrate and act at some distance is possible. Sheppegrell has reported a successful case of malignant disease

of the larynx with the rays applied through the neck, but in this instance there was no microscopic examination of the tissue to confirm diagnosis. In my own experience, in one case only have I seen even a partial result of this kind. The patient suffered from a large carcinoma of the neck and throat of old standing, and the inner end of the mass filled the hyoid fossa, pressed the epiglottis to the one side, and interfered slightly with breathing, but more with swallowing. After

Fig. 10.—Epithelioma of nasal fossa (February, 1902).

three weeks' treatment, when an *x*-ray dermatitis had been caused externally, the inner end of the mass became inflamed and the throat generally very painful, sloughing took place with slight haemorrhage, and ultimately the pharynx became practically normal, while breathing and swallowing were accomplished with perfect ease. The great mass of the tumour persisted however, and during a month's interval of rest from treatment, the patient unfortunately exposed himself to cold, and, as might have been expected in a man 64 years of age and weakened by disease, died from peritonitis.

Fig. 11.—The same patient as seen in Fig. 10 (September, 1902).

Bryson Delavan, in a paper on the *x* rays in laryngeal cancer (*Medical Record*, October, 1902), says "up to the present time not a single case of carcinoma of the larynx has been cured by the *x* rays." The case above referred to has been published since then. The fact that so little has been reported by way of improvement with the *x* rays in laryngeal cancer is very striking, especially when we consider the number of cases reported as improved at least, and which occurred in the nasal and buccal cavities, and of superficial epitheliomata generally. It is all the more so when we think that the larynx is so situated as to be practically a superficial organ.

Apart from the disease being on the surface, its extent may help one to decide. One case of lupus was sent to me, a lady 54 years of age and who had been 46 years ill. One eye was completely destroyed, the other nearly so, while the face and neck were covered with sores. The disease had invaded the whole of the nasal and buccal cavities, and it was for this last condition she saw me. Nearly all the ordinary methods of treatment had been tried during her lifetime with slight success and constant recurrence, but nothing seemed to arrest the disease. In this case the whole surface and cavities healed up after eight months' treatment with the *x* rays. She offered herself for treatment at one of the London hospitals, but the surgeon refused to try Finsen's light in this instance.

Further, the acute or chronic nature of the case, idiosyncracies, and the fact that some patients suffer more from *x* rays than others may induce the operator to try the high-frequency or the still less painful and irritating high-potential currents. As the result of my own experience I should say that in malignant disease certainly the most powerful influence of all is the *x*-ray tube, because there you have quantity of energy. I go further, and say that if one wishes this agent pushed to its maximum, the best result is got when the tube is excited by means of the coil rather than the static machine or high-frequency current. The question of quantity of energy, however, will be referred to again in this paper when speaking of high-frequency currents. In certain instances it is only by experience that one gets to know what is suited for a particular case, and on this account let me say that most serious results may follow, such as dermatitis and its consequences. Not only, therefore, must a patient be watched as far as the local results are concerned, but the general condition must also be strictly recorded, and the excretory and secretory organs in particular. The changes taking place in the last-mentioned may cause one to change the agent employed.

QUESTION OF HOW THE FORCES ACT UPON THE TISSUES.

It may at once be said that for the most part we are here dealing with theory. Finsen, recognizing the work of Downes, Blunt, Marshall, Ward, in addition to his own, founds his practice on the bactericidal power of light, and for this reason profoundly impresses his readers with the necessity of expressing all the red colouring matter of the blood from the part upon which the violet rays have to act. This view, however, is not everywhere altogether received. To begin with, if he had failed to satisfy himself about the action upon micro-organic life, his own paper on light as a stimulant might have been quoted in support of the theory that the waves may stimulate the tissues to cast out or destroy micro-organic life. Further experience has taught us that the *x* rays can cure lupus without the precautions of pressure referred to, and we have experiments by Wolfenden and others which would seem to indicate that the *x* rays, far from destroying the vitality of micro-organisms, in some instances at least seem to stimulate them. Then, there is a serious difficulty in accepting the bactericidal theory, inasmuch as in rodent ulcer, sarcoma, and carcinoma we have no proof as yet that they are due to micro-organisms at all. Others fall back upon the theory that these forces merely stimulate unknown forces of Nature inherent in all the tissues, or, as we say, the *vis medicatrix Naturae*, which, of course, is a term that explains nothing. Others have tried to reconcile these two views by saying that the tissues are first stimulated, and then the germicidal action begins through their agency. It has been suggested also that while *x* rays first stimulate the growth of micro-organisms, the reproduction is so active and rapid that in the end the virulence becomes attenuated. A recent theory is based upon the view that the tissues of neoplasms have much lower vitality than the normal ones, so that in the destructive action of these different forces the former die before the latter. The truth is, however, that at present we do not know, and much investigation will be necessary ere we do.

CLINICAL RESULTS.

My own experience in malignant disease agrees with all I have learned of the subject, and the results may be classified under three headings:

First, whatever force is used, in a number of cases the results have been a complete failure.

In the second class amelioration or alleviation of symptoms only has been obtained. There can be no doubt that many workers have seen great alleviation of pain. Indurations have disappeared, oedema and glands (even at a distance as recorded by some) have also been reduced, ulcerated surfaces have been known to take on healthy action and heal after long duration. Proliferating or fungating masses have unquestionably diminished in size, and in some instances the healthy granulations which take their place have been covered with healthy epidermis. General improvement in the patients has been recorded, and in some instances, owing it may be to the restorations of functions, an increase of weight when the patient has previously been wasting has also been seen. In many instances, however, the effects have been temporary only. In my own experience I can say that I have seen some of these results follow the application of high-potential currents and also high-frequency currents; but I should say for indurations, oedema,

glands, and ulcerating neoplasms, x rays have been the most efficacious, and, of course, only in cases of superficial carcinoma or within accessible cavities.

In the third class of cases—a smaller one—the lesions have altogether disappeared. It is to such cases that the term cure, if admissible, is to be applied. In saying so, I wish it to be clearly understood that I do not here refer to lupus or scrofuloderma, but to sarcoma and epithelial affections. Even if we regard rodent ulcer as a form of carcinoma, from its clinical history, glandular involvement (or absence of it), slow progress, and rare recurrence, it had better be kept in a class by itself. For therapeutic purposes, whatever be the ultimate outcome of the discussion between different pathologists as to this affection being classed as a carcinoma or not, such an arrangement may save confusion. It is scarcely necessary to point out that when such cases are described as successful cures of carcinoma the layman is not unlikely to interpret the statement as if it meant "cure of cancer." What the public mean by cancer usually is the virulent and serious type affecting too often the internal organs. Such views are apt to mislead our patients or their friends, and to raise false hopes in a class of cases for which none of these forces can as yet bring about a cure. That rodent ulcers have been known to heal by one or other of these agencies must now be accepted as a fact, and many cases are recorded from different centres. In a smaller number of cases—when we think of the many workers and the number of experiments made, it would be fair to say in a very small number of cases—genuine malignant tumours of the skin, mammae, and some within accessible cavities have disappeared. Such cases I have myself seen and placed on record. In a still more limited number of cases sarcomatous tumours have also disappeared. What the proportion of satisfactory results may be to the number of failures we cannot now say, and time will be required for the elaboration and collection of statistics ere an authoritative opinion can be ventured upon.

With regard to the agent employed with any prospect of success, in my own experience the x rays have been the most efficacious, and a reference to medical literature will show that most workers have selected this agent. It need hardly be pointed out that before any reasonable or accurate view can be taken of a case or series of cases, the true diagnosis is of vital importance, and whenever possible it ought to be confirmed by microscopical examination. This has, of course, been done in some of the cases reported, and even the histological changes before the disappearance and during absorption of the tumour as well. At present, whatever views may be held upon the subject, it should be remembered that these processes are not without danger, as it has been stated that in some instances dissemination has taken place and other organs have become affected. A few workers in x rays have developed malignant disease, and in one case at least there was a fatal termination. Further, there is the great question of recurrence which undoubtedly has occurred. Generally speaking, it is impossible at the present day to give an opinion about this, inasmuch as sufficient time has not yet elapsed to supply statistics upon which we may rely. Certain it is that notwithstanding that these agencies have been for the most part employed in advanced cases, most operators as yet would not suggest that the ordinary surgical procedures should be set aside for them. Most workers have so far recommended them in cases of recurrence after surgical operation or in inoperable cases. Lastly, I think it fair to say, however hopeful a view any one may be inclined to take of the results, one is less impressed with the success which has yet attended the applications than the amount of work yet to be done.

HIGH-FREQUENCY AND HIGH-POTENTIAL CURRENTS.

High-frequency and high-potential currents differ in one respect clinically interesting, inasmuch as the former is an alternating current, and so each electrode is alternately negative and positive, whereas with the latter one side of the machine is negative and the other positive. The possibility of doing away with the current on one side in high-frequency apparatus has often suggested itself, and it is not unlikely that this will one day be accomplished. When this is done—and I have already partly succeeded in so doing—one will be able to compare the effects of the two methods better than at present. As a rule the high-frequency coil is excited from the mains by means of an alternator, or in this country most frequently by means of an induction coil. It is possible, however, to use the static machine instead of the coil, and in Figs. 8 and 9 will be seen my own arrangement for so doing. This consists of a static machine with Leyden jar condensers,

suitable in size, and a small d'Arsonval coil. With a view to being able to utilize the active or passive discharge when applying them to the patient I have introduced a reverser with very satisfactory results. My own experience has been limited to the excellent apparatus of Cox, Dean, and Gaiffe.

Fig. 12.—Gaiffe's arrangement with oil condenser for high frequency currents.

When reading the accounts in the medical journals one is constantly struck with the tendency to speak of the great intensity or its effect—the so-called *effluve*—as measured by the length of the spark. In my own experience, whether dealing with x rays or any of the other forces under consideration, I have found it of great advantage to have quantity, and this remark applies to x -ray photography as well. I know that other workers do not agree with this, and some Continental operators seem to think that the high-frequency current excited by the static machine, not the coil, will be found more efficacious in the treatment of malignant disease. I do not wish to speak dogmatically upon this point, but others share my views. To my friend Dr. Lenard of Philadelphia I am indebted for the full description of a high-frequency apparatus manufactured by Leeds and Northrup, the distinguishing feature of which is the enormously powerful discharges or sparks, some of them $\frac{1}{2}$ in. thick and 6 in. in length, which may be obtained with this machine. What the effects of such a quantity of energy may be remains to be seen, but the apparatus seems to be well constructed and capable of the finest gradation. In this connexion Mr. Isenthal has shown me an electrode for local treatment in which the sparks are very thick, and the results of the application of which will be watched with interest. For general application of the high frequency on the couch I have found the apparatus seen in Fig. 12 of the greatest advantage. It is made by Gaiffe, and consists of an oil condenser with one single thick spiral copper wire or tube really. Here there is no secondary coil, but by using a lesser or greater number of turns of the apparatus and tuning by means of a suitable number of plates in the condenser and the spark gap, the effects are most satisfactory. With such an arrangement, it is easy to give from 100 to 500 milliamperes or more. Speaking of high-potential currents in connexion with this question of quantity, the new twenty vulcanite plate machine of Gaiffe's which is sectorless gives a magnificent result. In my own experience I confess to having pushed quantity in both high-frequency and high-potential currents to a very great extent.

Both forces may be applied generally to a patient or locally by means of special electrodes. High-frequency currents may be applied in various ways, the principal being auto-conduction, auto-condensation, or locally. In this country the two latter are mostly used. In the first the patient or a part of his body is enclosed in a solenoid. In auto-condensation the patient is resting on one or other of the well-known forms of couch made for the purpose. With this method it is easy to get comparatively accurate measurement of the dosage given, a fact of great importance.

While many workers when treating a localized affection of

the skin or accessible cavity, whether it be simple or malignant, prefer to apply the current locally by the well-known electrodes of Oudin and Bissérie, still many of them like to combine the general with the local treatment. Further, in one reported case which caused considerable interest owing to the so-called cure of a tumour in the region of the cervix uteri, the treatment was entirely general.

In dealing with neoplasms I have seen improvement with the high-potential currents as well as the high-frequency. The latter I regard as more powerful, while the former is less painful. The methods and results obtained are described in the *Transactions* of the Glasgow Medico-Chirurgical Society during the last two years. Suitable electrodes for introducing into the nasal and pharyngeal cavities for both currents are also there described, and one or other was chosen not because they were better than the *x* rays, but simply because they could be applied where it was impossible to use the latter.

While it is not within the scope of this paper to deal with the general physiological and therapeutic effects of these currents it is necessary in trying to do so briefly to explain what is occasionally seen when treating patients for malignant disease. For example, improvement without cure may take place in this as well as in any other chronic affection; but the same remark may be made about any other form of treatment which relieves suffering or gives strength to the patient. While the physiological effects of the static machine have been studied—and the general invigoration and soothing effects of these are well known—still more work has been done in connexion with high-frequency currents. In this connexion let me say that the profession is greatly indebted to Dr. Denoyes, of Paris, for the collection of facts to be found in his work on high-frequency currents published last year. The results therein described as having been obtained by d'Arsonval, Tuerton, Quillaume, Tripet, and others on the circulation, respiration, and secretion may be studied with advantage by every one engaged in this work. Now, it is generally claimed for these currents that they will produce analgesia, changes in the arterial tension, increased activity in the action of the skin on the respiratory and secretory organs, and in some cases diminution of toxicity when these currents have been passed through a diphtherial toxin. Many patients in general terms describe the immediate effects as exhilarating, although this is often followed by a period of marked depression. Accepting these statements for the moment as being accurate, let us ask the question how far they may explain improvements in patients suffering from malignant disease. Pain may be soothed and it is quite possible that vasomotor changes by alteration of the blood supply may reduce the fungating mass which is giving off offensive discharges or blood. Nutrition may improve, the patient's weight may increase, sleep may be less disturbed, and yet as far as the malignant tumour is concerned the patient may not be cured, indeed he may be very far from it. The more carefully one watches relief to each of these symptoms the more one is impressed with the necessity and difficulty of giving the true value to each. As an example of this let me quote two cases bearing upon the subject of pain. In one case of severe neuralgia of the second division of the fifth nerve, where after months of intense suffering and consequent loss of general health and when nearly everything else had been tried of a constitutional or local nature to increase the strength or assuage the pain the removal of the teeth and afterwards of the alveolar process by surgical procedure had failed, the pain completely disappeared after three weeks' treatment by direct local application with Oudin's electrode, using high-frequency currents. There was no recurrence for six months, at the end of which time the patient I believe died of malignant disease of the liver, but the medical attendant assured me the pain in the face never returned. So far this case raised considerable hopes in the method. In a second case, however, where, after months of suffering and great deterioration of the general health and where 1 in. of the third division of the fifth nerve had been cut out after opening the canal, recurrence took place with the same intense pain. The same method above described was tried with success because for one year there was no pain. The patient herself anticipated when recurrence took place that another course of high-frequency currents would be followed by the same result, but the application of them, and in mild doses, exaggerated the pain so much that I at once recommended an operation sufficiently extensive to remove the whole of the inferior dental nerve on the affected side. For these and other reasons, I do not look upon high-

frequency currents as a substitute for operation, although they may sometimes stand between the ordinary remedies and operation. The same necessity for lapse of time before forming an opinion, and the need of great care in drawing conclusions applies to nearly every other symptom which may be ameliorated by the methods of treatment to which we at present refer.

Granting, therefore, that high-frequency or other currents may cause improvement locally or constitutionally in those afflicted with malignant disease, the grave question has to be faced, in view of the expectancy which has been raised in certain quarters, how far they have as yet effected cures.

Had these hopeful views of cure been expressed or founded upon the results which have already been obtained by means of the *x*-ray tube, they would probably have been more easily understood. Reference to medical literature will show that most workers prefer the latter. Dr. James Allan (*West London Medical Journal*, July, 1902) reports disappearance of the tumours with high-frequency currents in two cases of sarcoma and one of epithelioma, and other cases have been recorded, a number of these being in the region of the uterus. With high-frequency and high-potential currents in genuine malignant disease so far in my experience, while I have seen amelioration I am not in a position to speak of any case as cured. Not only so, but I have taken the opportunity, wherever it was possible, to ask many active workers if they could refer me to any real cases of cure where the diagnosis had been verified by microscopic examination. The invariable answer has been amelioration, not cure. While this applies more particularly to superficial cases, or where the disease was within accessible cavities, it does much more so in what the public mean by cancer, that is to say, the gravest cases of all and those situated in the internal organs, for all of which very little, if anything, has been done. In making this statement I do not wish it to be assumed that developments in the future may not take place, or that even better results will not be obtained, but I am speaking mainly of the results as they present themselves at this time.

THE X RAYS IN THE TREATMENT OF LUPUS, RODENT ULCER, AND OTHER SKIN DISEASES.

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The therapeutic potency of the *x* rays has of late been vaunted with so much sensational exaggeration in the daily newspapers that there is some danger of this promising method becoming enveloped in a miasmatic vapour of quackery that must seriously interfere with the development of its practical usefulness. The mischief thus wrought is twofold: False hopes of cure are excited in the minds of sufferers and their friends; and the treatment itself comes to be regarded by medical practitioners as pitch that defiles them that touch it. In this way, a thing having in it large possibilities of good may be unjustly discredited in the eyes both of the profession and the public. Hence it is at the present time especially important that the results obtained by means of the *x* rays by practitioners whose work is open to the inspection of their professional brethren should be fully and accurately recorded with the single purpose of showing what has been attempted and what has been done. Observers of equal honesty receive different impressions from the same phenomena, and even their records of facts take the colour of their mental temperament. Inexperience is generally prone to an unfounded optimism. On the other hand impatience and want of attention to detail lead to an equally unfounded pessimism. One of the obstacles to the progress of medicine is what may be called the summary mode of dealing with methods on their trial. A method should not be condemned because, applied improperly and in unsuitable cases, it fails. These are perhaps truisms, but we think it necessary to insist upon them here because we have seen enough both in this country and abroad to convince us that the want of success obtained by some who have tried Finsen's light treatment and the *x* rays is to be attributed not so much to the method as to the operator.

In previous papers¹ we have reported the results obtained