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DIATHERMY
AND ITS APPLICATION TO
PNEUMONIA

(*Frontispiece*)

FIG. 1.—Showing routine diathermy treatment for lobar pneumonia given in U. S. Marine Hospital, No. 21.

DIATHERMY
AND ITS APPLICATION TO
PNEUMONIA

BY

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WITH FORTY-FIVE ILLUSTRATIONS
AND FIFTEEN CHARTS

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To Dr. Claude H. Lavinder
in grateful acknowledgment of his
kindly cooperation, this
book is respectfully
dedicated

PREFACE

The ever-widening indications for the use of diathermy in therapeutics makes it of the utmost importance that every physician whether he be a general practitioner, surgeon or other specialist be familiar with the physical properties, physiological effects and therapeutic indications for the use of this current. There are certain pathological conditions occurring in practically every type of practice in which diathermy has proven of great value. Therefore both medical and surgical diathermy are described and details of technique are gone into not only in order that the physician may understand what is to be expected by the use of diathermy in pneumonia, but so that he will be able to meet other indications for its employment in his practice.

Lobar pneumonia is one of the greatest scourges of the human race. Like typhoid fever it attacks the rugged as well as the

weak. Unlike many diseases in which acquired immunity is developed, one attack is apt to increase the liability to subsequent seizures. Artificial immunization of the patient is still experimental. Not even serology is as yet any more than a doubtful aid and then in only one of the types of the disease.

Up to the present time no specific has been found, therefore this disease is with reason one of the most feared by the physicians who have to contend with it.

The cumulative experience of the profession has taught caution in the acceptance of any treatment as being of great value in pneumonia. The disease varies so greatly in seasonal epidemics and in its different types that there must necessarily be a uniformity of results in regard to both of these factors before a new method of treatment can be generally accepted. The cases here reported while relatively few in number cover four different seasonal epidemics and include all the types of the disease. In addition the opportunity is here given for comparative study with a group of controls.

As is often the case with new work along medical lines, the results obtained in the treatment of pneumonia with diathermy by one group of physicians to whom the author had taught his technique were given publicity by the lay press. This was due to the fact that a brother of one of the patients was a reporter and information furnished him thus found its way into the newspapers.

Immediately upon the appearance of the first of these articles, the author put the matter in the hands of Dr. David R. Lyman of New Haven, chairman of the Public Affairs Committee of The New Haven Medical Association and all requests from the press for information were referred to Dr. Lyman. The author has at no time furnished any information to the press, even to correct such obvious misstatements as the one that "the metal electrodes were attached directly to the light socket."

Since the use of insulin and other new methods in medicine have in a similar way reached the public unprofessionally, the

author feels certain that physicians will judge this work on its merits regardless of the unfortunate notoriety it has received.

The author takes this opportunity to thank the various manufacturers who have so kindly furnished illustrations of their latest apparatus, and the publishers and their editorial staff for their assistance in the preparation of the book. He also wishes to express his appreciation for the cordial coöperation of the staff of the U. S. Marine Hospital, No. 21 of N. Y., which made a large part of this work possible. To the head aides in physiotherapy, Miss Cargill, Miss Randall and Miss Voris who personally administered the treatments, and to Drs. William T. Boland and Henry V. Broeser whose assistance was invaluable, the author is especially grateful.

H. E. S.

New Haven, Conn.,
October, 1923.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

DIATHERMY AND ITS APPLICATION TO PNEUMONIA

CHAPTER I

INTRODUCTION

Diathermy is one of the most valuable single agents in our entire therapeutic armamentarium. In the bipolar application of this—the D'Arsonval current, we are able to obtain, by variations in the current density, almost any degree of heat desired, and to localize it at will, within the tissues.

This type of heat usually called "conversive" differs from every other method used in the attempt to raise the temperature of the deeper tissues of the body. Diathermic heat is developed more or less centrally within the tissues themselves, and is not

dependent upon an effort to drive heat through the skin and the subcutaneous tissues by thermic applications from without.

To American physicians belongs the credit of having been the first to suggest the use of diathermy in lobar pneumonia. Among others, Byron Sprague Price,[1] Chris. M. Sampson[2] and Frederick DeKraft[3] of New York have mentioned not only the rationale of its employment but have actually employed it in a few scattered cases diagnosed as pneumonia.

Lest this work seem too new and too experimental to the majority of the profession a brief review of the recent experience upon which it is based, is in order.

Modern physiotherapy became an entity when, during the world war it was found

[1] Price, Byron Sprague. Treatment of Pneumonia. *Am. J. Electrotherap. and Radiol.*, XXXIV, 445, September, 1916.

[2] Sampson, Chris. M. Physiotherapy Technic, chap. VI. St. Louis, 1923.

[3] DeKraft, Frederick. Discussion of diathermy in pneumonia. *Am. J. Electrotherap. and Radiol.*, October, 1922.

necessary to gather together every potent therapeutic agent which might aid in the rehabilitation of the disabled soldier. In the Army Medical Corps and the other governmental agencies dealing with the care of the veterans, physical therapeutics were for the first time applied on a large scale under ideal conditions. These included the employment of a large corps of medical officers and aides thoroughly grounded in all branches of physical therapeutics, an almost unlimited supply of the best of modern apparatus and vast clinical material of widely varying type.

Considerable experience was gained in this extensive work which, five years after the war, still amounts to the giving of between 250,000 and 500,000 treatments per month. The results obtained are most gratifying, and clearly point the way to the use of physical therapeutics as an important adjunct in the treatment of other conditions not so treated to any extent in the army service. *Pneumonia* is one of these conditions.

Electricity in its various forms has proven to be the backbone of all the physical agents

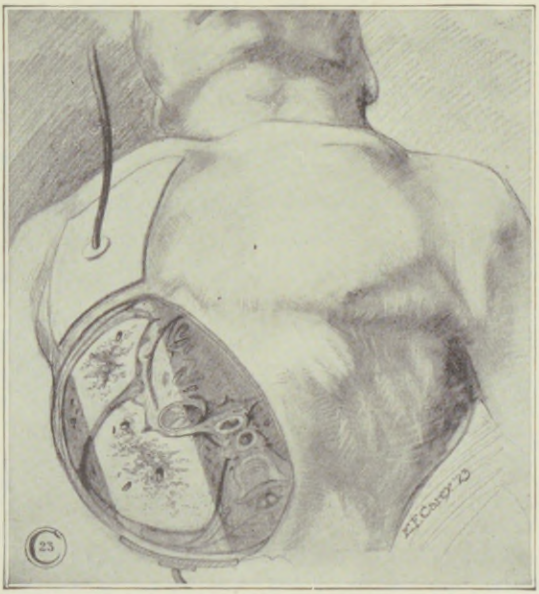


FIG. 2. The diathermy heat pathway through the lungs.

used in this rehabilitation work. All of the electrical modalities have been utilized as well

as the various modifications of each type and none proved more effective than diathermy.

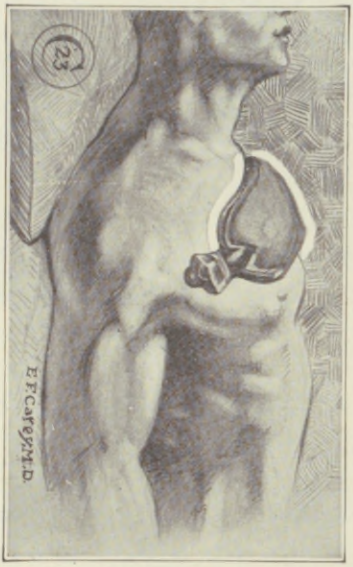


FIG. 3. White area indicates the slight depth of heat penetration of living tissue from the "conductive" type of application.

The use of diathermy in pneumonia has been long considered. From every point of view it has seemed reasonable to suppose

that a centrally located heat of from 110° to 120° F., developed in the affected lung (Figs. 2 and 3) without any cost to the body in instituting this rise of temperature, should have a favorable effect upon the pneumonic process. It was known that this heat would dilate the pulmonary capillaries and lymphatics thus promoting a more active circulation. Perhaps to some extent it might also "melt" the exudate, thereby increasing the amount of pulmonic ventilation. It was also thought possible that it might inhibit and to some extent destroy the organisms and reduce, through its known analgesic effect, any associated pleuritic pain.

Until recently there appeared in the literature no reports of the use of diathermy in pneumonia which included full case reports giving the type of the organism, full clinical findings, and the results of the treatment. Nor does there seem to be any mention to date of this subject in the foreign medical literature.

Through permission received from Senior Surgeon George B. Young, then Medical Officer in Charge of U. S. Marine Hospital No. 21, N. Y. and with the coöperation of Dr. Bryan who was chief of the medical service, this work was undertaken by the author's department at that hospital. It was agreed that when accepted means of treatment had proven unavailing, diathermy should be tried in the first case in which there was otherwise apparently no hope of recovery.

In January, 1922 such a case occurred and the treatment by direct diathermy was started. The result in this first case was one of the most dramatic in the author's medical experience. The relief the patient received from severe pleuritic pain and dyspnea was immediate. His cyanosis disappeared about seven minutes after the treatment was begun. The temperature began to fall immediately by lysis. He received from two to four hours of complete relief after this,

and each succeeding treatment and made an uninterrupted recovery.

While this result might have been in large measure accidental it encouraged the further use of diathermy in pneumonia.

In the first series of ten cases, a report of which was read before the American Electrotherapeutic Association[4] and in the fairly large group treated since, the following routine was carried out. The detailed physical findings were made by the ward surgeons, Drs. Trimmer and Boland and by the chief of the medical service. The charts kept by the nurses were carefully checked up. The laboratory work was done by Dr. Taylor in the hospital laboratory and the department of physiotherapy was concerned only with the application of the treatments. The group of cases occurring in the fall of 1922, winter and spring of 1923, were treated under the direction of the present chief of the medical service, Major John

[4] Stewart, H. E. Diathermy in pneumonia: A report of ten cases. *Am. J. Electrotherap. and Radiol.*, October, 1922.

Ridlon and his assistant, Dr. W. T. Boland, and are reported by permission of Surgeon C. H. Lavinder, the present Medical Officer in Charge. The author is especially indebted to Dr. Boland for his assistance in gathering and analyzing a large amount of clinical data in these cases. His painstaking work on the effect of the treatments on the blood-pressure added important information in the study of the results of the treatment.

The cases occurring in this hospital together with some from the private practice of the author and a number of his colleagues comprise a group of about seventy which include all types of the disease, all checked up carefully as to physical findings. At the same time there were a fairly large group of controls untreated by diathermy in the hospital during this period. It is an insufficient number of cases on which to base positive conclusions regarding the multitude of questions this work will bring to the clinician's mind, but the general average death rate has been so greatly

reduced in four different groups of cases, both in comparison with the usual average mortality and with that of the controls studied, as to justify apparently the immediate and wide-spread employment of diathermy in pneumonia.

The symptomatic relief, which is almost invariable, would alone justify its employment provided we are certain there are no contraindications. *It can be stated positively that with the proper technique no harm can be done the patient.* The author is willing to state without fear of contradiction that we have in the application of diathermy to pneumonia added a powerful agent to our therapeutic resources, applicable (though probably with unequal efficiency) to every stage and type of this condition. The length of the period of illness does not seem to be shortened, nor have we prevented relapses, although in our technique we did not include the application of diathermy to the unaffected lobes. *In 97 per cent of the cases the temperature started down immediately by lysis.*

The saving of the body's vital forces by shortening the period of sustained high temperature must be obvious.

It is hoped that a detailed report of the results so far obtained together with simple concrete directions in regard to the technique will encourage the profession at large to the increased use of this physiotherapeutic agent in pneumonia. It may be interesting to note in passing that practically all aides, nurses and physicians who have actually seen treatment properly given have expressed faith in its being a therapeutic adjunct of distinct value. Being fully aware that the future may show that diathermy is less efficient, even possibly contraindicated in certain types or stages of the disease, even allowing for this possibility, it is only by extensive use of it that these points will be made clear.

The physics and physiological effect of the D'Arsonval current when passed through living tissue must be thoroughly understood and the technique of its administration

mastered by those who are to employ it. The technique although not complicated is exact. *Hit or miss methods will not obtain good results in this work any more than they will in drug therapy or surgery.* For this reason a complete, condensed and plainly written chapter on all phases of diathermy is included. The description of all of the essential factors of good technique is given so that the general practitioner will obtain a knowledge of the indications for this effective agent in the treatment of conditions other than pneumonia. There is, however, none of the usual lengthy description of apparatus, found in so many texts on electrotherapeutics.

We commonly hear it said: "Oh yes great work was done in the service with physiotherapy but it is not available to the average doctor." It cannot be emphasized too strongly that this is not true. Various types of a good quality of portable apparatus equipped with meters and delivering a good D'Arsonval current of 2,000 ma. (at least this

milliamperage is essential) are now on the market at quite a reasonable price, no longer limiting the use of this treatment to large institutions.

As is the general rule in all forms of therapy the earliest possible administration of diathermy is desirable after a diagnosis of pneumonia has been made. This is emphasized by the fact that *not a single case of pneumonia has been lost* (as far as the writer is aware) *in which the treatment has been instituted before the third day*. This does not mean that cases treated immediately *may* not be lost, but it emphasizes the value of early and intensive treatment. The profession may feel that the author has presented a new treatment for pneumonia without having sufficient evidence to justify its acceptance. With the certainty that the employment of this method is absolutely harmless to the patient it is necessary to present the material to our colleagues so that they may be sufficiently convinced of its value to give it extensive trial. Thus will be obtained the facts neces-

sary to form absolutely certain conclusions as to its efficacy. Although the use of diathermy in pneumonia is still very new the results so far obtained by the writer and his associates would seem to justify such trial.

The word "cure" is not used nor is it meant to be implied in this book. In the author's opinion diathermy is an agent which may be applied to *all* types of pneumonia and is at least as effective as serum has proven to be in type I.

The use of serum in type I of this disease presents certain disadvantages. In the first place it is rarely possible to obtain a satisfactory laboratory report before the second or even the third day. The efficiency of the serum treatment is considered to be in an inverse ratio to the time within which it is given. It is applicable only to one particular type of the disease and outside of Rockefeller Institute it has not seemed to lower the mortality materially. As careful a worker

as Locke[5] of Boston has reported slightly greater mortality with its use.

In estimating the value of any given treatment in disease there are a number of factors with which to reckon. In the first place, we must consider whether the procedure under discussion is dangerous in itself, or whether it adds even temporarily to the shock or toxemia incident to the condition treated. We can think of many conditions where certain treatments are indicated in an emergency when other aids have failed which are not in themselves free from danger. Diathermy certainly does not fall into this group. It is not only *harmless when properly given*, but has already been proven to bring immediate symptomatic relief to the patient.

Another point of importance in the use of diathermy is that practically no other indicated measure in the hygienic, nursing or medicinal care of the patient is contrain-

[5] Locke, E. A. The treatment of type I pneumococcus lobar pneumonia with specific serum. *J. Am. M. Assn.* LXXX, 1507–1511, May 26, 1923.

dicated because of the use of diathermy. The old-fashioned "pneumonia jacket" is perhaps the only exception to this rule.

In estimating the value to the profession at large of any new method of treatment, wherever it is properly employed, no factor is of more importance than uniformity of result. If the method be one which requires long experience, special technical knowledge, or intricate apparatus it can never be very generally useful except in ambulatory cases. The treatment of pneumonia here outlined presents none of these disadvantages. In fact the writer gladly acknowledges that several of his co-workers have surpassed the results he has obtained in the use of diathermy in this disease. He feels that what they have done may be duplicated by the profession in general.

CHAPTER II

GENERAL DIATHERMY TECHNIQUE

Definition. Several different terms have been used to define the use of the bipolar high frequency current of D'Arsonval as applied in therapeutics. Nagelschmidt was the first to apply the name "diathermy" to this form of current. It has been variously termed by other writers "transthermy," "diathermia," and "thermopenetration." Any of these terms are acceptable with the exception of thermopenetration which is inexact since the heat is generated within the tissues and not driven in from without. The term diathermy is the commonly accepted one and will be used throughout this text.

History. Diathermy is one of the most recent developments in the effort to modify the electrical current for therapeutic purposes. The first work of note was done by

D'Arsonval in the year 1890. He demonstrated that this type of current had little effect on living tissue other than the production of heat. This is in contradistinction to the action of the galvanic current which is largely chemical or that of the interrupted galvanic, sinusoidal, faradic or static modalities whose main effect upon the body is mechanical in character. Tesla[6] working about the same time as D'Arsonval demonstrated that high potential currents could be used in the body without harm. A number of French and German investigators did valuable work in the application of this current to therapeutics during the first decade of the present century.

Diathermy was first used in this country by Frederick DeKraft in the office of William Benham Snow of New York in the year 1906. A type of apparatus which would give the sustained oscillations, which are essential to a good diathermy current,

[6] Tesla, N. High frequency currents for medical purposes. *Electrical Engineer*, 1891.

was designed by Nagelschmidt[7] in 1907. The first use of diathermy in hospital practice was in St. Bartholomew's Hospital, London in 1909.[8] The real development of apparatus out of which the modern efficient types have been evolved dates back only to 1910 both in this country and in Europe.

The work of De Kraft, Granger, McFee, Price, Sampson, Snow, Titus and Travell did much to standardize diathermy technique in the United States and laid the foundation for its extensive application in the army and in post-war work. In the latter part of 1918 and from 1919 on, treatments by diathermy in the government services alone have amounted to over a million annually. New indications for its use in the treatment of certain pathologies of the heart, lungs, kidneys and brain are rapidly being discovered and it is already proving to be one of the most useful of all therapeutic agents.

[7] In Dresden, September, 1907.

[8] Medical officer to electrical department, St. Bartholomew's Hospital, 1909 was H. L. Jones.

Physics. In this type of current we are dealing with a high voltage and with an amperage relatively high when compared with the other high potential current, static. Since the D'Arsonval current is one which alternates so rapidly as to be called "oscillating" in character it is most easily derived from the ordinary alternating current. Further modifications are necessary if only the direct current is available to operate the apparatus.

Starting then with the alternating current (Fig. 4) which has usually only 110 volts with a 60 cycle per second alternation brought to the machine, quite extensive modifications of it are necessary to develop the true D'Arsonval current. The standard types of machine are provided with what is termed a rheostat, choke coil or auto-transformer, the function of which is to govern the amount of current necessary from that which is supplied by the main. In the second place the voltage must be raised from 110 to many thousands. This is accomplished by

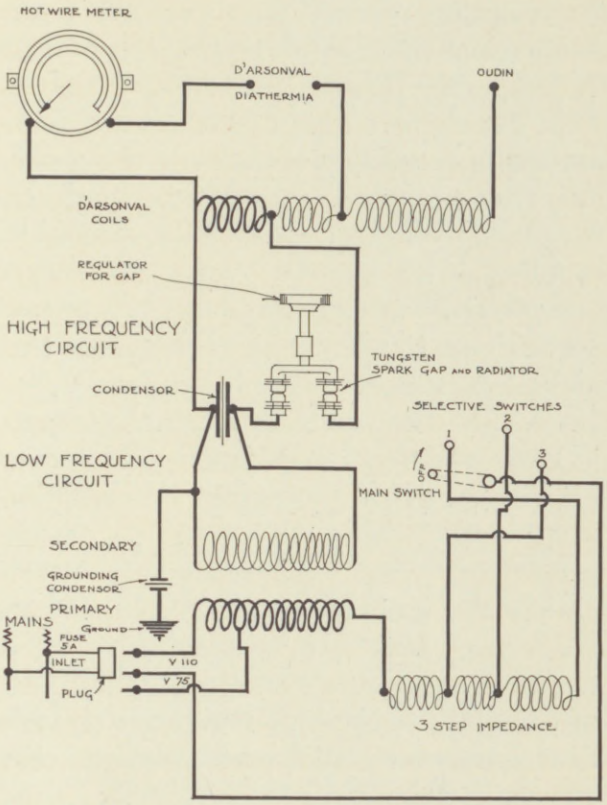


FIG. 4. Diagram of a good type of portable high frequency apparatus.

means of the so-called "step up" transformer usually immersed in oil. During this process the amperage falls as the voltage is raised. This transformer does not affect the alternations or frequency of the current but only its voltage. A second transformer performs the function of raising these alternations to a rapidity which may be over a million per second and should properly be termed oscillations. In the circuit between the first and second transformer are placed two different devices, the condenser and the spark gap.

The condenser is designed to store up sufficient current to excite, by induction, other coils within the machine termed resonators, which when properly tuned, enrich the quality of the current. If the condensers were not working there would not be at any time a sufficient accumulation of energy to excite this resonance or to be discharged with sufficient voltage across the spark gap.

The spark gap is merely a variable resistance which, when placed in the circuit,

forces the current back into the condensers and charges them. The more widely the gap is opened the larger the amount of current which must be stored up in the condensers before it can jump the gap *en masse*. All of this action is instantaneous in a well constructed machine so that there is at the spark gap a continuous stream of sparks. When the spark gap is closed, there is no resistance in the circuit and the condensers are not charged. The same is true to a lesser extent if the spark gap be dirty or corroded in which case the current from the machine will not be smooth or even and may be felt by the patient with what has been termed a "faradic" effect.

The Spark Gap. When using the De-Kraft type of spark gap the mica discs must be constantly removed, cleaned, rearranged and turned so that fresh edges will be nearest to the spark gap rod. It is a good plan to take the micas from the last two or three gaps which are seldom used, and replace them with the micas from the first few gaps

FIG. 5. Front view of new type of spark gap.

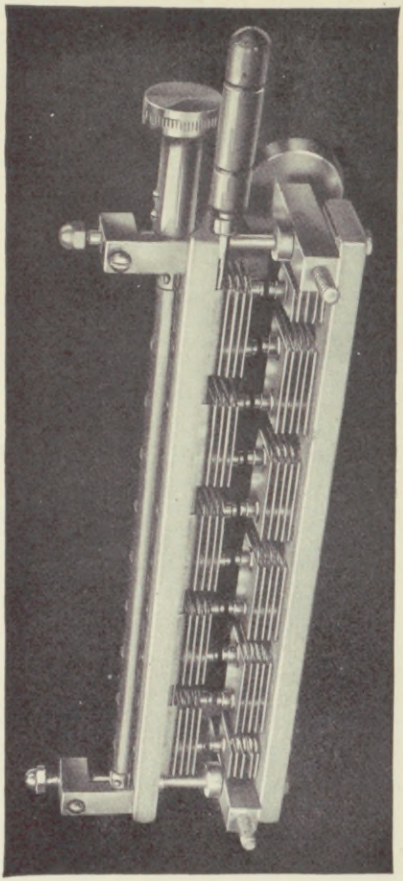


FIG. 6. Back view of new type of spark gap.

which are subject to constant usage. The brass cups should be unscrewed, cleaned and a very thin coating of vaseline left on them. This will facilitate subsequent cleaning. A

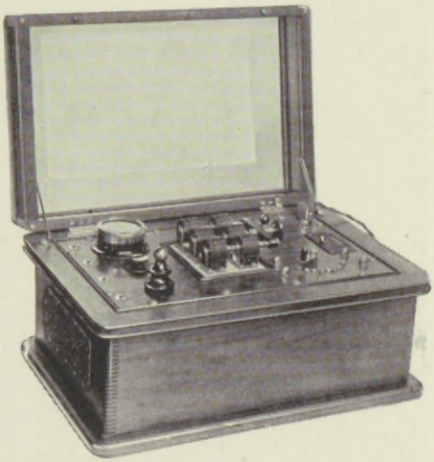


FIG. 7. Improved portable diathermy apparatus with multiple spark gap and three variations of diathermy current.

new variation of this gap has been brought out in which pyrex discs replace the micas. This new type gives much better service. The rod must be kept clean and freshened

with emery paper. With the hooded single target spark gap the rod must be kept clean and the end frequently freshened with filing. A new rod is required at varying intervals because of the shortening so produced. Still further modifications of the spark gap are now being employed with other insulating types of material so graded that finer adjustments of the gap are possible (Figs. 5 and 6). It should be remembered that much of the trouble which develops in a high frequency machine can be traced to the spark gap and the constant care of it will be worth while.

The Milliampere Meter (Fig. 8). This instrument is provided with all the better types of apparatus. It is essential where diathermy is to be used in lungs, brain, heart or kidneys. It consists in the placing of a hot wire in the circuit, expansion of which, produced by the heat developed, moves the meter needle on the scale. It therefore indicates only the total amount of current which is passing through the patient

and does not give a clear idea of the amount of heat he is receiving except when the current density and also the resistance of the tissues through which the current is passing are taken into consideration. The first of

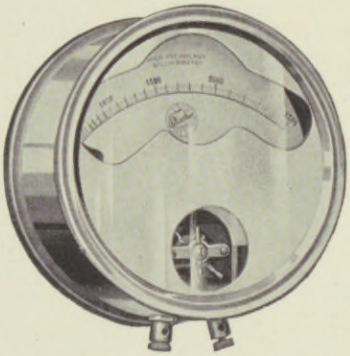


Fig. 8. Milliampere meter.

these factors, that of current density, depends upon the ratio between the total amount of the current and the number of square inches of electrode through which it is applied to the body. If they be different in size, it is the smaller of the two which we must carefully gauge.

For example, if the meter reading shows a current of 1,500 ma. passing and we are using electrodes 3 by 5 inches in size, the patient is receiving a current of 100 ma. per square inch of electrode. This is usually the extreme limit of safety. If there was being applied to him one electrode of this size and one of 2 by 5 inches there would be a current of 150 ma. per square inch which would be too great. On the other hand 4 by 5 inch plates would give a current density of only 75 ma. per square inch which is well within the limits of safety.

The second factor, that of tissue density is of great importance. The same current density for example, 1,500 ma. through a 3 by 5 inch electrode, as just mentioned, will give us a great deal more internal heat when passed laterally through the knee joint than it will through less dense tissue such as the normal lung or through the abdominal cavity. In a consolidated lung we have an intermediate stage of soft tissue density in which the heat developed would be less

than that to the knee and somewhat more than in the normal lung or abdominal cavity, other conditions being equal.

All of these factors then must be taken into consideration in determining both the size of the electrodes to use and the amount of current to employ. It must also be kept constantly in mind that the degree of heat produced varies as the square of the current strength. This means that a relatively small increase in current strength, size of electrodes and tissue density being the same, will produce a relatively greater rise of temperature while to the operator there appears to be only a small increase in the meter reading.

Physiological Effects. It must be apparent that we are dealing here with an absolutely different form of heat from any applied to the body externally and that its effect upon the tissues will be totally different from these other types of external application. As just stated a degree of heat is generated deep within the tissues (Fig. 9)

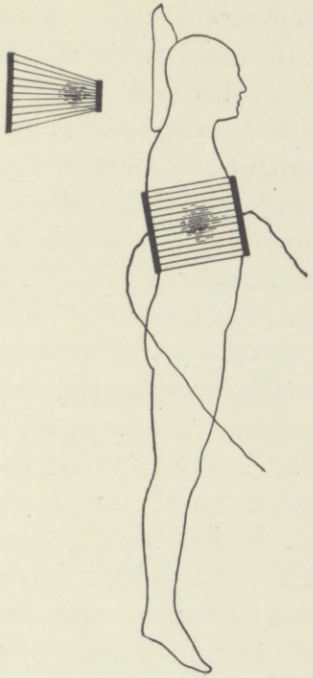


FIG. 9. Shows location of greatest heat in diathermy through the chest and change brought about by the use of electrodes of unequal size.

which is proportionate to the square of the amperage of current used, its density determined by the size of the electrodes and the relative resistance the tissues offer to the passage of the current. It should also be noted that the high frequency current because of its high voltage differs from other currents in the manner in which it passes through the tissues. This high voltage enables it to pass by a direct path from electrode to electrode and it is not greatly affected by the relative resistance of the tissues in the interpolar pathway. That is to say it takes the direct rather than the easiest path. In illustrating how a current of such high voltage may be used in the body without harm when its density is not too great, Major Sampson[9] has compared its effect to water power. When power (voltage) is combined with amperage (volume) as might be illustrated by a stream of water coming from a fire hose under tremendous pressure we have an element

[9] *Op. cit.*

of danger. This stream of water striking the body squarely would be dangerous to life.

If, however, this same volume and pressure of water were run through a spray nozzle such as we have on our garden hose it would issue as a large volume of mist which would be absolutely harmless when sprayed on a person. The effect of the high frequency current is somewhat analagous to this. It will be remembered that this current is oscillating at the extremely rapid rate of about 1,000,000 a second. This to and fro movement is far too rapid to bring about any movement of ions within the tissues. Therefore, it cannot institute any muscle contraction or produce any ionizing effect whatever and there remains only a sedative effect on sensory nerve endings and the development of heat.

Local Effects. In the skin under the electrodes very little effect is produced, other than a mild hyperemia together with a slightly increased activity of the skin glands.

In the deeper part of the pathway of the current we have the main effect which is an acute temporary dilatation of the capillaries. This causes both a thinning of the capillary wall and an opening up of the intercellular spaces in their endothelial walls resulting in a greatly increased outpouring of blood serum rich in repair material. It means also that in a given tissue area there occurs a vast increase in all of the blood elements, erythrocytes, with their contained oxygen, and phagocytes which enhance the local resistance to bacterial invasion. The net result is to double or triple the local repair material and protective forces of the body, also to promote the cellular interchange of gases and fluids upon which metabolism depends.

It must be evident that all glandular activity is greatly augmented by this increase in capillary blood supply. Some confusion has arisen in regard to the effect of this current upon tissues already passively congested, the fear being expressed that diathermy would result in still further conges-

tion. As a matter of fact while the total amount of blood in the area under treatment is increased temporarily, passive congestion is relieved for the following reason: It is in the capillaries that the greatest resistance to the circulation takes place. We have all noticed the slowing up of the blood stream in the frogs' web and the curling up of the red blood-cells in their attempt to squeeze through this narrowest part of the blood stream. Under the affect of diathermic heat the dilatation of the capillaries decreases this resistance and augments the return flow as well as the volume of the blood stream. Hence, previous congestion is not a contra-indication but rather the reverse for the use of diathermy. As has been stated there is no ionic movement in the interpolar pathway and no tendency to muscle contraction. Pain is relieved by the specialized effect upon sensory nerve endings, also mechanically by the relief of passive congestion. Within a very short time after the cessation of the current this capillary dilatation disappears.

A point which should always be kept in mind is that it is the movement of the body fluids which diffuse throughout the body the excess of heat produced and only when the proper current density is employed prevents any destructive effect upon the tissues. In fact it is this same movement of the body fluids which prevents any *external* application of heat from reaching deep lying structures. Reasoning from these facts it is easy to see that caution must be exercised in the use of diathermy in intensive doses where the diffusion of body fluids is sluggish. Such a condition occurs in arteriosclerosis and in large masses of scar tissue. In these conditions the local heat tends to accumulate and it is a safe rule to use only about half the current density that would otherwise be employed. In other words use in such conditions about 50 ma. per square inch.

Systemic Effects. The rise in temperature induced in the body fluids as they pass through the interpolar pathway raises the

general body temperature to some extent. Under varying conditions this increase in body temperature has been found to be between one and one half to two and one half degrees Fahrenheit. There is also as a general rule a lowering of both systolic and diastolic blood-pressure which is more marked when a general diathermy treatment is given such as that in the technique usually called auto-condensation. This fall in blood-pressure has also been found to be quite marked following the average diathermy treatment through the consolidated lung in lobar pneumonia. The higher the blood-pressure and the more it falls into the simple hypertension group the greater will be the fall in pressure. But even in cases where the tension is considerably below normal there is an additional fall noted. In the early phase of our work with pneumonia this was considered to be a contraindication to the application of diathermy, but further experience has lead us to believe that the benefits of the treatment outweigh this

disadvantage. Dr. Boland who has closely observed the treatment by diathermy on more pneumonia patients than perhaps any other worker in the field does not believe that a low blood-pressure is a con-

FIG. 10. Auto-condensation treatment for high blood-pressure.

traindication to this treatment. As would naturally be expected the less the distance between the electrodes and the smaller the amount of current used the less affect will there be upon the blood-pressure. In any event this effect is not invariable because

even in the application of auto-condensation to patients with high blood-pressure we find occasional ones who, although they may feel better generally, do not have any fall in the hypertension (Fig. 10).

Slight stimulation of the general glandular activity of the body follows the systemic application of diathermy and to some extent its local application as well. This stimulation, however is not great enough to justify the claims made by some enthusiasts as to the rejuvenating effects of this current. The employment of too heavy currents often results in a feeling of lassitude and general fatigue especially in the aged.

A series of experiments which have been performed by Cumberbatch, D'Arsonval, Maragliano, Saberton and the writer gives a good conception of the effects of this current on living tissue. The most important of these experiments are the following:

I. The following temperatures were noted by Cumberbatch[10] in a patient holding the

[10] Cumberbatch, E. P. Diathermy. London, 1921.

auto-condensation handles in both hands using 400 ma. for twenty minutes. There was a rise of temperature as follows: front of the wrists 6°, front of the elbow 4°, axilla 2.4°, mouth 2.6°, groin 1.2°, and popliteal space 3°. Fahrenheit is here used. The rise of temperature in the mouth and in the extremities was due to the heating of the blood stream and the maximum temperature was in the wrist where the current density was greatest.

II. In another experiment the same technique was used with 500 ma. to maximum tolerance, which gave a rise of temperature in the front of the wrist of 20°. The flexor side of the arm was 3° to 4° warmer than the extensor side, which increased to 6° when the arms were flexed. With the electrodes over the chest and abdomen no rise of body temperature was secured.

III. D'Arsonval demonstrated that all parts of a saline solution were equally heated. He further showed that in passing diathermy along the hind legs of a rabbit,

the deeper tissues, as well as the skin could be coagulated by strong currents.

IV. Maragliano passed diathermy through the thorax of a dog in which a small electrical lamp had been placed. The lamp became incandescent.

V. A series of our experiments with liver illustrated the conductivity of saline solution to the D'Arsonval current. Strips of liver were cut 6 by 1 by 1 inches. In each case 450 ma. were used for four minutes.

(*a*) Composition metal electrodes twenty-two gauge, four inches long and one inch wide, were wrapped around both ends, the liver placed in a dry dish and the current turned on. The liver was thoroughly cooked through and was especially well done in the center.

(*b*) Both liver and electrodes were placed in the salt solution and the cooking was very much less thorough.

(*c*) One end was raised as before, the other end was placed on the electrode which rested on the bottom of the dish. The liver

was cooked except on and under the electrode.

(*d*) The free electrode was placed over the edge of the dish down into the saline and the results were the same as in (*c*), but with not quite as thorough a cooking. These experiments indicate that the direct application of plates is more efficient than when used through the water, but that a true diathermy may be obtained through saline.

VI. Cumberbatch[11] described a case in which the palms were moistened with saline and the thermometer placed between them. The electrodes were applied to the back of the hands. Fourteen hundred milliamperes for six minutes gave a 7° rise of temperature. It is to be noted here that we have two extra layers of skin with their added resistance and the rise of temperature is therefore greater than it would be in the middle with the same mass of tissue, as for instance in the forearm.

[11] *Op. cit.*

VII. In a large growth on the back of the neck with the indifferent electrode on the chest, an active circular electrode three-quarters of an inch in diameter was placed on the growth. A thermometer was thrust into the growth one inch below the active electrode. The temperature rose to 110°.

VIII. In illustrating the edge effect when two electrodes are placed side by side or end to end, the hottest point is on the skin between them. Two electrodes were so placed on the back of the forearm, the nearest edges parallel and one inch apart. The temperature of the skin under the center of the plates rose 8°, on the edge facing the opposite electrodes, 21°.

IX. Saberton[12] experimented with a dish of egg albumen. Two electrodes were placed in the albumen at opposite ends of the dish. When a heavy current was turned on suddenly the coagulation first appeared immediately beneath the electrodes. When it

[12] Saberton, Claude. Diathermy in medical and surgical practice. New York, 1920.

was turned on slowly the coagulation took place first in the center.

X. Flexible metal electrodes were bound on the opposite sides of a large potato. Fifteen minutes of moderately strong current were applied. The potato was cooked in a diamond-shaped area, broadest in the center and extending toward either electrode.

XI. The temperature of the brain can be raised by diathermy applied through the skull. Cloetta and Waser,[13] showed 1° C. rise, in the lateral ventricle of a dog after diathermy for ten minutes had been applied to the head.

From our clinical experience with this current and from the foregoing experiments it may be concluded:

(1) That we are able by the use of diathermy to develop a deep seated and real heat within the tissues.

(2) That while this heat is sufficient to coagulate protein, there is no danger in its

[13] Cloetta, M. and Waser, E. Bertrage zur kenntnis des fieberansteiges. *Arch. f. exper. Path. u. Pharmakol.*, Leipz., June 25, 1914.

application to approximately normal vascular tissue, because the circulation of the body diffuses the heat.

The amount of heat developed depends upon the resistance of the tissues and the current density. With a given milliamperage, the current density is equal if the electrodes are of the same size. The greatest amount of heat is obtained half way between them, when the current is slowly turned on. If electrodes of unequal size are used the current density, and hence heat production, is greater a short distance below the smaller electrode. Thus we are able to localize the desired heat. In the application of diathermy to the fingers or toes advantage may be taken of its conduction through salt solution. This is especially useful where the fingers are stiffened after severe trauma, infection or arthritis of any type. Where the fingers are flexible the current is best applied by means of the auto-condensation handle and cuff above the wrist.

Apparatus. As is true with most types of instruments, other things being equal, the larger and more expensive pieces of

FIG. 11. A convenient type of portable high frequency apparatus.

apparatus are built to stand up longer under hard usage than are the small portable types. The large machines are therefore to

be preferred for hospital work if some handy means of transporting them about the wards can be devised. For most of our cases, however, both in the wards and in private homes, we must depend upon portable apparatus. We are fortunate in having four or five types of portable apparatus supplied with a meter and capable of delivering a D'Arsonval current of good quality up to at least 2,000 ma. which is all we need in pulmonary work (Figs. 7, 11, 12, 26, 27 and 28).

For several reasons those machines which will give a high meter reading with a comparatively low spark gap are to be preferred. They supply a relatively large amount of heat with the faradic effect reduced to a minimum. An apparatus which does not have to be grounded has an advantage as it is usually not easy to find the means for adequate grounding in all parts of the ward or in homes (Fig. 12).

Before taking a piece of apparatus to a patient's home, a point should be made as to whether alternating or direct current

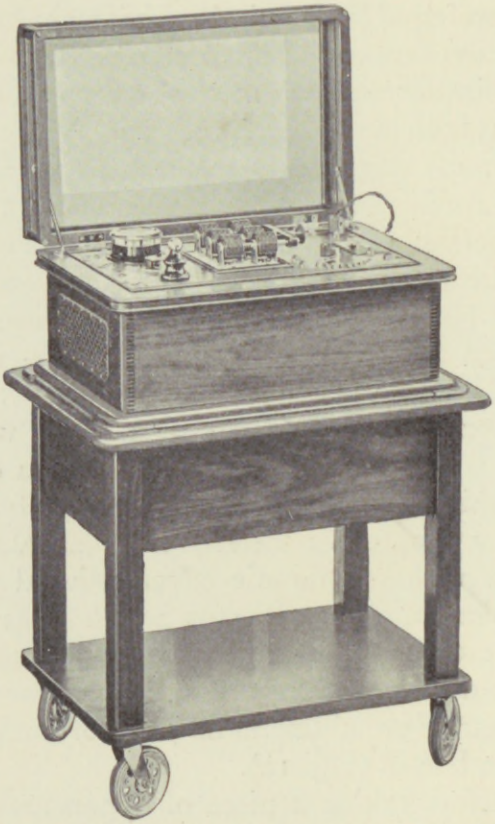


Fig. 12.—Portable high frequency on carrier for ward work.

is available. If the apparatus has been set up and will not function, first examine the wall plug to see that it is fully inserted or if a light socket is used see that the chain

FIG. 13. Portable diathermy with meter.

or switch is on, then see that the insert on the machine is on the correct terminal for the voltage and type of current at hand and that every switch is closed. If the difficulty

still persists examine the spark gap, if necessary taking it apart, cleaning and reassembling it. The use of emery cloth on the gap will often make it work perfectly. It is usually inadvisable to take down the machine further as the manufacturers are providing service in all accessible places.

Electrodes. In all his pneumonia work the author has used the composition 22 gauge flexible metal electrodes and considers them the best for general use. This metal comes in sheets and is supplied by all instrument dealers at a moderate cost per pound. We cut our electrodes in convenient sizes and shapes using as a rule a pair of plates about 4 by 7 inches varying the sizes according to the number of lobes involved and the size of the patient.

The electrodes should be cut out slightly larger than needed after which all edges should be turned sharply back for about a quarter of an inch on three sides and rolled down flat (Fig. 14). A longer flap may be left on one end to which the cord clip may be

FIG. 14. Showing proper preparation of 22 gauge metal diathermy electrodes.

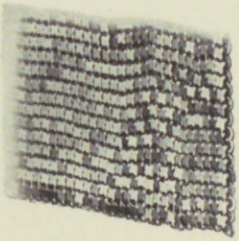


FIG. 15. Mesh electrodes.

FIG. 16. Mesh electrodes.

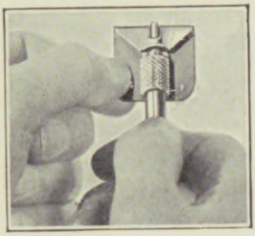


FIG. 17.—Mesh electrode clip.

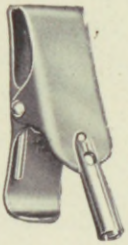


FIG. 18.—Improved diathermy electrode clip.

attached. In treating other areas than the chest these electrodes may be slit down the center of one side or end so that they will overlap and fit such curved surfaces as the point of the shoulder.

In treating the fingers or small joints thin metal, even tin foil is occasionally used. The solid steel disc electrodes are inflexible, will not fit uneven surfaces and are only occasionally useful. Newer types of electrodes which can be made from German silver mesh of flexible chain material are now being manufactured and should prove especially valuable in all pneumonic work (Figs. 15, 16, 17 and 18).

We have at times been compelled to use a lighter metal, considerably thinner and much more flexible than 22 gauge. When of single thickness these plates are easily torn on the edge which may result in a minor burn to the patient. It has been found however, that by doubling this thin metal this disadvantage is largely obviated while at the same time there remains a flexibility

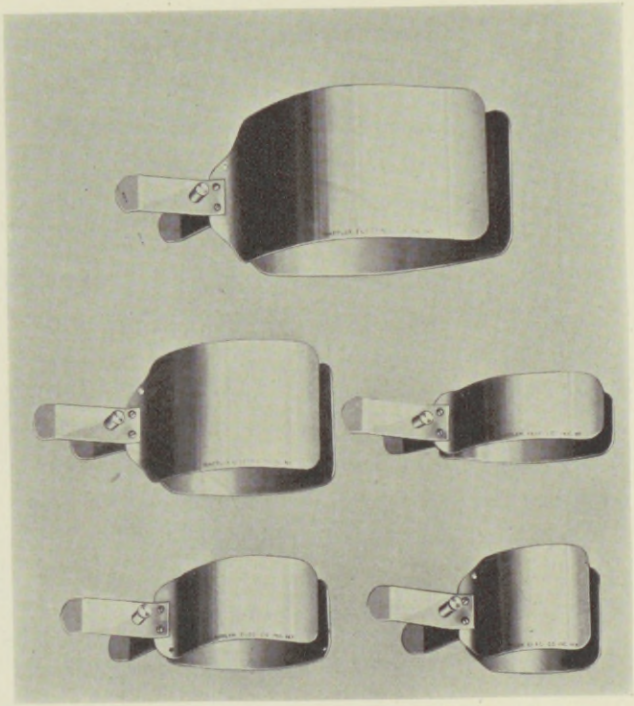


FIG. 19.—Bi-polar self-retaining electrodes for direct diathermy of limbs.

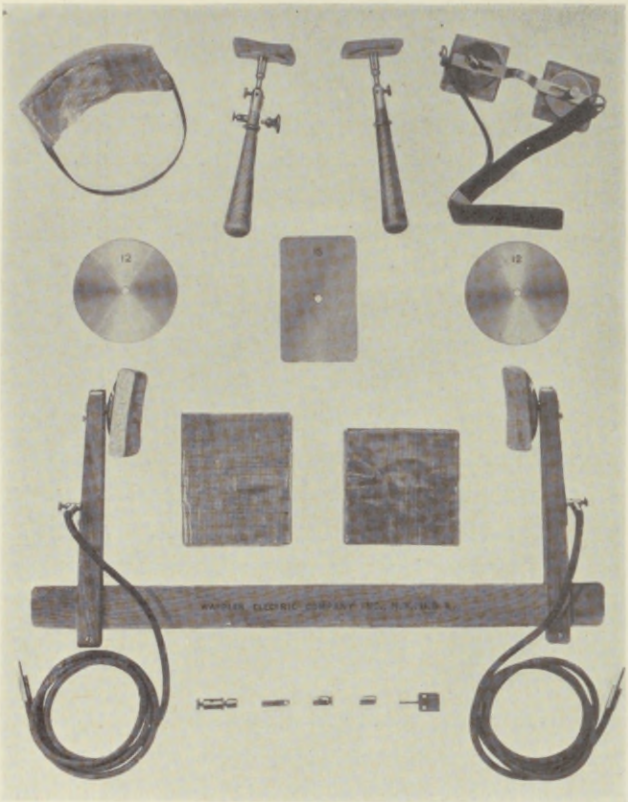


FIG. 20. Self-retaining handle and variety of electrodes for special application.

greater than that of the 22 gauge metal just mentioned.

General Technique. It is important that the patient be made as comfortable as possible and that the part to be treated be well supported. A point often overlooked in a busy practice is that of preparing the patient mentally for his first treatment. Those of us who can remember when we first had the various modalities of electricity applied to us do not need to be reminded of this fact. The patient may fear a shock or the unpleasant sensations of the ordinary electric current. He should be told that he may expect no sensation from diathermy other than a gentle diffuse warmth and that any localized areas of excessive heat or any tingling sensation whatever should be spoken of at once.

Unless this point is emphasized, patients who are anxious to get well quickly will naturally pay but little attention to slight degrees of pain and may receive burns which will interfere with subsequent treatments.

In dealing with patients who are very ill, restless or irrational, particular precautions must be taken to disturb them as little as possible in applying the electrodes and to be especially careful that the electrodes are well lathered, fitting properly and firmly in place. No exposed cords should be left in such a position that they may be torn loose by the patient.

The shaving soap lather is prepared with very hot water and applied freely over the surfaces of the electrodes, which are to be placed in contact with the skin. If the electrodes themselves are first placed in the hot water or are placed face upward under the radiant light, the metal will be sufficiently warmed to avoid the slight chill when applied. The warmed and soaped electrodes are then placed on the skin. The metal cord tips are then attached to their turned back end and bound firmly in place with elastic or cotton webbing bandage (Figs. 21, 22, 23, 24 and 25). The diathermy cord tip may be attached to the

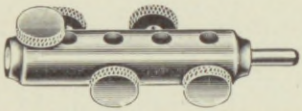


FIG. 21. Multiple cord connecter.

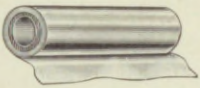


FIG. 22. Elastic bandage.

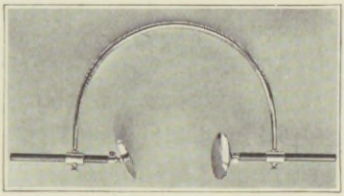


FIG. 23. Electrodes with retaining spring.

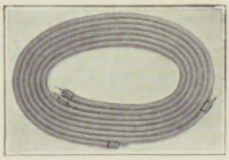


FIG. 24. New type of rubber insulating diathermy cords.

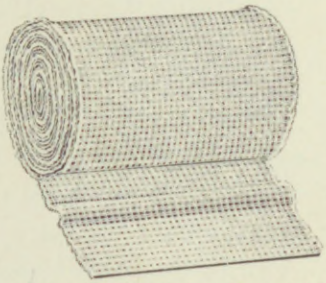


FIG. 25. Elastic bandage which allows for increased size of part during treatment.

middle of the back of the electrodes by adhesive plaster or simply placed on them

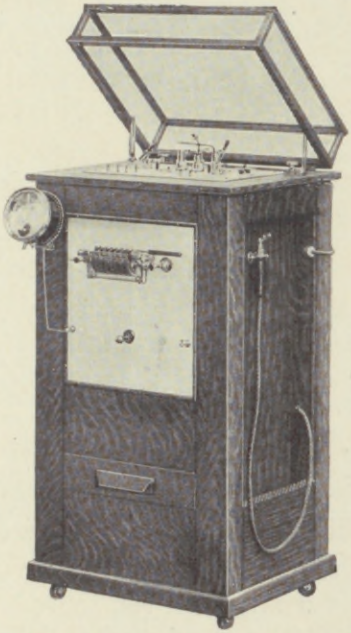


FIG. 26. Cabinet high frequency with attachments.

before they are attached to the patient. A cloth bandage will often act as a wick absorbing a good deal of the soap lather.

This may be prevented by placing thin oil cloth, rubber sheeting or oiled silk over them before binding them. On large flat surfaces such as the abdomen or back the electrodes may be fastened with adhesive plaster or by a bath towel or folded sheet. The electrode upon which the patient is lying in this case need not be attached to the skin but a small cushion or folded towel should be crowded under it to insure good contact.

Occasionally the plate on the chest or abdomen may be held by the patient or assistant. Where the patient is restless particular care must be exercised not only in securely fastening the plates but also in making sure that cords and clips are firmly inserted.

Before turning on the current inspect again carefully all of the switches on the machine and also the cord and electrode attachments. In most cases it is desirable to use from three to five minutes within which to raise the current to maximum and

about half that time to bring it down after the treatment. Sudden changes in current strength, such as those which follow the closing of the knife switch, when the spark gap or rheostat are on more than the first gap and button, may result in disagreeable sensations to the patient because they are unduly stimulating to the nerves. In using any multiple spark gap the following method of slowly raising the current may be used. Start with the rheostat switch on the first button and the spark gap closed. Open the spark gap slowly, first, one and then two notches. After a few seconds close the spark gap one notch and move the rheostat switch to the second button.

This procedure is repeated until the third, fourth or fifth button on the rheostat is reached and the spark gap is at the desired maximum. As stated this procedure should take from three to five minutes for its completion.

A technique commonly used is that of closing the spark gap completely each time

before advancing one button on the rheostat. This brings the meter needle down to zero and completely interrupts the current. The total time taken to reach the maximum is only that consumed after this maximum has been reached on the rheostat while the spark gap is being rapidly widened, and it does not seem as efficient a method as that just outlined.

In the use of the single spark gap of any type it is usually possible to set the rheostat switch to the desired maximum and slowly to open the spark gap until the desired amount of current has been reached. If for any reason a stimulative effect is desired the current may be raised and lowered abruptly to obtain it. When in the use of opposed plates it is desired to localize the heat nearer to one of the two body surfaces a smaller electrode is used at that point. The current density and therefore the heat production is greatest beneath the smaller electrode. The greater the disproportion between the two plates the closer to the

smaller electrode will the point of greatest heat production be located. When electrodes of equal size are used then the location of the greatest thermal effect is midway between them.

It will be remembered that, other factors being equal, the more dense the tissue in the pathway of the current, the greater will be the heat produced. Relatively large amounts of current are needed through the chest and abdomen under ordinary circumstances. Moreover, since the amount of heat varies as the square of the current in any given density of tissue, a relatively slight increase in the milliampere meter reading will indicate a marked rise in internal temperature. It is for this reason that some patients seem extremely sensitive to a slight increase in current strength. When diathermy is applied through the chest or abdomen we use fairly large plates and a rather heavy current. In that case there is almost always a fall in systolic and diastolic blood-pressure fairly comparable to that obtained by the

auto-condensation technique. This fact must be kept in mind in treating patients with hypotension. In treating a consolidated lung with diathermy this effect is usually quite marked. In pneumonia cases we do not now believe this fall in blood-pressure to be a contraindication in the use of diathermy because of the other pronounced beneficial effects we are able to obtain by its use. In computing the dosage of the D'Arsonval current which should be used in a given case, quite a few factors have to be considered.

In tissues supplied by a normal circulation and sensory nervous mechanism it is safe to employ 100 ma. of current for each square inch of the electrode used. When the electrodes are of unequal size it is the smaller one upon which this dosage is based. Occasionally this maximum current may be exceeded especially in very vascular tissue where the resistance to the current is low. Generally the patient's sensations are a reasonably good guide as to the maximum

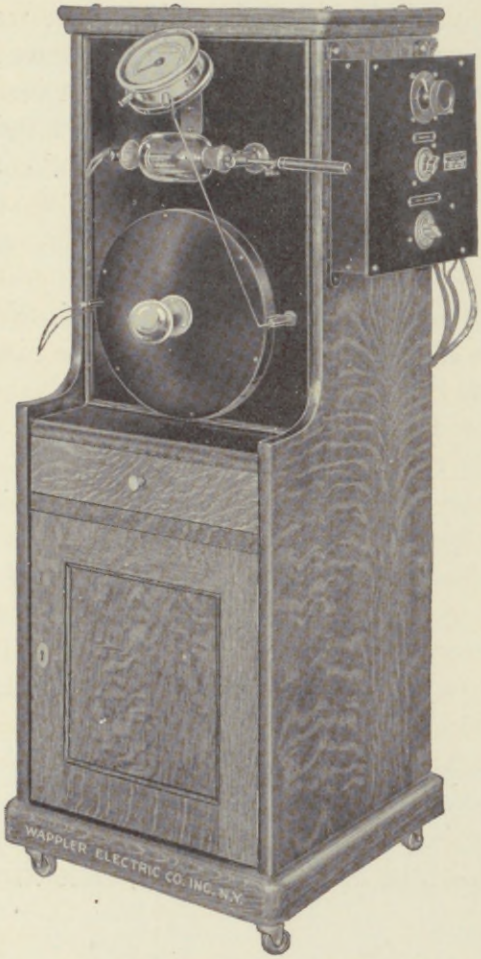


FIG. 27. A standard type of office diathermy machine.

current desirable. When, however, we are treating anesthetic areas added precaution is necessary regarding the contact between the electrode and the skin, the sufficiency of lather and the total amount of current used. These precautions of course, apply with special emphasis to patients acutely ill, toxic or unconscious.

Patients suffering from arteriosclerosis must also be treated with extreme caution. It has been stated that diathermic heat was diffused throughout the body by the blood and lymph. Where a condition of vascular inelasticity is present this heat diffusion is necessarily impaired, and therefore there is danger of an undue accumulation of local heat in the tissues. A dusky erythema under the electrodes is often seen in this condition. It is a good rule to reduce the strength of the current nearly 50 per cent in all types of treatments given to arteriosclerotics.

When opposed plates are used it is essential so to place them that they are equidistant at all points, *i.e.*, that they are

as nearly parallel as the contour of the part will permit, for if care is not taken in this regard an undue amount of current will pass between the nearer portions of the electrodes. This usually means deflecting the current largely through the skin and subcutaneous tissue so that the more central area we desire to reach is not affected by the current. There may develop at the point where the electrodes are in close proximity, a current density sufficient to induce a burn. As an illustration of this point, in the treatment of the knee joint the oblong electrodes are commonly placed on the inner and outer side of the knee with the patient's leg in extension. If, after they are bound and completely covered, the patient bends his knee slightly, the lower anterior corners of the two plates will be brought close together with the effect just stated.

Generally, the patient will be aware of an unusual degree of heat and call attention to the fact. It is a safe rule to follow, that whenever excessive heat is complained of in

any one point or a faradic sensation is produced, the current should be turned slowly and completely off. Any sudden change in the current is dangerous to the patient. Electrodes should be reëxamined, more soap lather inserted beneath with finger or brush, the electrode pressed gently down upon the skin and the bandage reapplied. The current should then be turned on and brought up to the maximum in not less than a minute. It is perhaps unnecessary to state that skin abrasions of any kind while they do not cause as much trouble as in the use of the galvanic current, make it advisable that electrodes should not be placed directly over them.

Many physicians and patients have questioned the advisability of going outdoors within a few minutes after a diathermy treatment. There is no reason why this should not be done. The skin does not receive much of the heat effect and there is therefore but slight perspiration. The heat subsides very soon after the current is

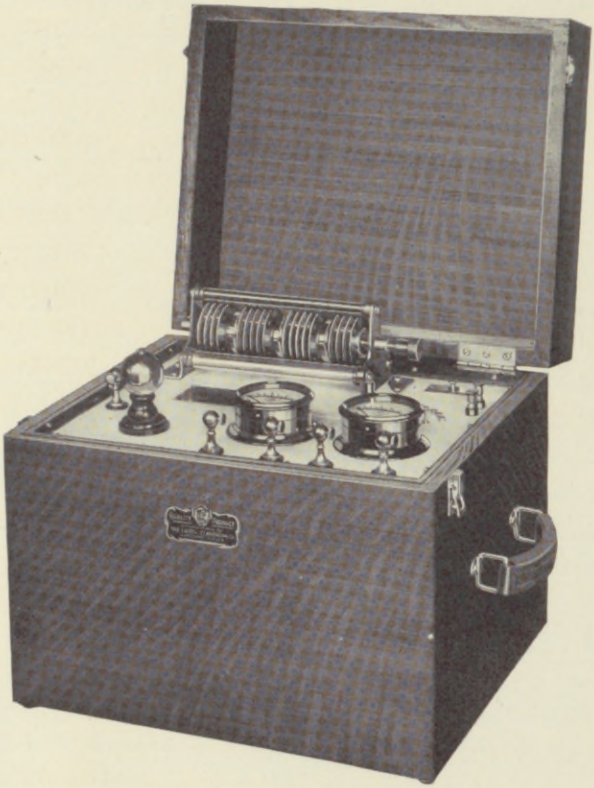


FIG. 28. Another type of portable machine with multiple spark gap.

turned off and even in the treatment of a bronchitis or similar condition there is no reason why a patient should not go outdoors as soon as he would ordinarily be ready to do so.

SPECIAL REGIONAL TECHNIQUE

Knee Joint. Opposed and laterally placed electrodes should be kept parallel but placed slightly nearer the anterior than the posterior surface of the joint (Fig. 29). This is because the popliteal space is much more sensitive than the front of the knee. Care must be taken as before mentioned to have the patient slightly flex the knee before the electrodes are applied and that the knee be not further flexed after the electrodes are in position. In injuries to the patella or patella ligament an anteroposterior direction may be used. In this case the anterior electrode should be cut from the corners toward the center in order to fit properly the contour of the patella. With sufficient lather under it, it is of no moment if the newly cut edges overlap

FIG. 29. Diathermy of the knee through self-retaining handle.

slightly. Some prefer to divide the total treatment time by "cross firing" the joint using both anteroposterior and lateral directions.

FIG. 30. Double cuff diathermy applied to periarticular structures of the knee joint.

An additional method of reaching the joint surface is fully to flex the knee placing both electrodes on the anterior surface, one above and one below the joint. In the

treatment of the internal lateral ligament use a small internal and large external electrode. From 800 to 1,200 ma. are sufficient because of the density of the tissues. Involvement of the periarticular tissues may be reached by the double cuff method with a long and fairly narrow electrode encircling the lower thigh and upper leg (Fig. 30). This method does not reach the inside of the joint efficiently. Effusion into the joint should be aspirated if there is any reason to believe it is hemorrhagic in character, after which diathermy may be used. This condition does not yield readily to diathermy alone.

Hip Joint. An anteroposterior direction of the current is usually best. A slightly smaller electrode bent to fit in the groin may be used anteriorly. The maximum current is limited only by the size of this electrode and the patient's tolerance.

Heart. Anteroposterior electrodes about 5 by 7 inches in size are used in treating cardiac affections. Most simple myocardial

conditions may be greatly helped by the application of diathermy. These include some of the conditions due to involvement of the bundle of His. It is difficult to see where any benefit can be derived in structural lesions of the heart valves, except where improvement of the condition of the myocardium will enable the heart better to carry its load. No direct effect upon the valvular pathology can be expected.

There is no question however, but that diathermy through the heart will improve the coronary circulation and minimize the effect of toxins on its muscular structure. A current of absolute steadiness derived from an even current supply and applied through a machine with a clean spark gap is absolutely essential. From 500 to 800 ma. is the maximum current strength that should be used and nearly double the usual time should be consumed in raising and lowering the current strength. There is undoubtedly after cardiac diathermy a decrease in muscle tone persisting for a short

time after the treatment, similar to that obtained and too often disregarded, in the body cabinet, electric light bath. For this

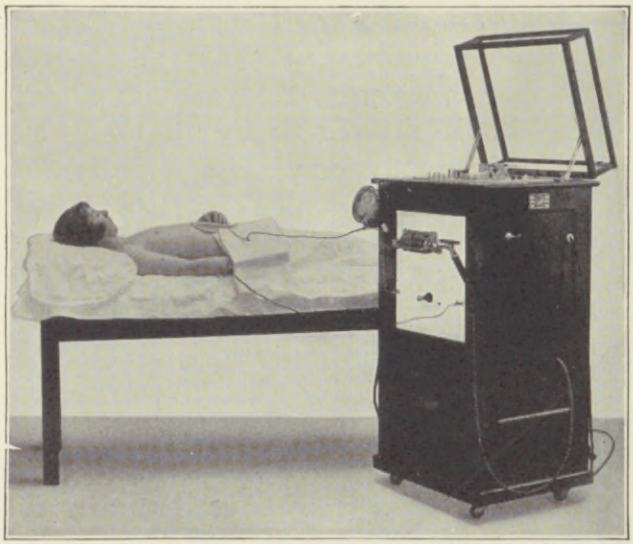


FIG. 31. Abdominal diathermy.

reason the patient's activity during the first few hours after the treatment should be distinctly restricted. Rest in the horizon-

tal position for at least an hour is especially desirable (Fig. 31).

Lungs. In treating a single lobe, plates of the size just given for applications to the heart are sufficient. The patient may lie on the posterior plate which, by means of a folded towel, sheet or small cushion placed under it, is pressed firmly to the back (Fig. 1). The anterior plate may be gently held on the chest, strapped on with adhesive or held by an encircling towel or sheet or secured by a light sand bag. From 800 to 2,000 ma. of current may be employed. The growing tendency is to use the lesser degrees of current. When it is desired to treat more than one lobe, electrodes of sufficient size to cover the area involved are used and because of the decreased current density produced, larger currents up to 2,000 ma. may be employed. In treating both lungs it is better to apply the diathermy to first one and then the other. In treating bronchitis, electrodes about 7 inches square may be used directly over the affected area with

the current strength of from 1,000 to 1,500 ma. Diathermy should not be used when there is cavity formation in the lungs with the evident danger of instituting hemorrhage.

Brain. Diathermy has been successfully used in the treatment of a number of cerebral conditions. The electrodes may be applied anteroposteriorly on forehead and occiput, about 3 by 5 inches in size, or they may be used laterally through the parietal region. With the employment of sufficient lather the hair offers no obstacle to the application of the plates. The cautions just cited as to the steadiness of current and the careful grading of its rise and fall apply with especial emphasis to treatment of the brain. Moreover, because of the resistance of the double thickness of the skull, lower amounts of current should be employed. Regardless of the size of the electrodes not over 500 ma. should ever be used through the brain. To accelerate the absorption of the clot after hemiplegia and to improve the nutrition of

surrounding neurons that may have received pressure-injury without destruction, this current has a special value.

In those conditions when general cerebral degeneration sets in due to arteriosclerosis, this current is a rival to galvanism in its affect on improving the nutrition of brain cells. Occasionally remarkably good results have followed its careful application. Every patient receiving cerebral diathermy should be constantly and carefully watched. They should be told to report the slightest feeling of nausea or vertigo, and because these symptoms at times appear with but slight warning, they should be under uninterrupted observation. A retaining handle by means of which both electrodes may be firmly applied is very useful in this technique (Fig. 20).

Spine. A method commonly used in the application of diathermy to the spine is the placing of two long narrow electrodes on either side of the spinous process. It does not seem that any thermal effect upon the spinal

cord itself or the vertebral articulations is possible by this method. The erector spinae muscles also could be but slightly affected with this position of the electrodes. The greater portion of the current would naturally pass through the skin and subcutaneous tissue between the near edges of the plates. If it be the deeper lying structures which we desire to reach, some means of direct or through and through application of diathermy must be secured.

There are several methods by means of which this is possible. The patient may be placed prone upon the auto-condensation cushion (Fig. 32) and a single electrode about 3 inches wide and long enough to cover the affected part of the spine may be applied directly over the spinous process and held on with adhesive plaster. In this case there is of course, a marked disproportion between the very large anterior electrode and the posterior one over the spine. This should localize the heat in the region within which the spinal column lies. A still smaller elec-

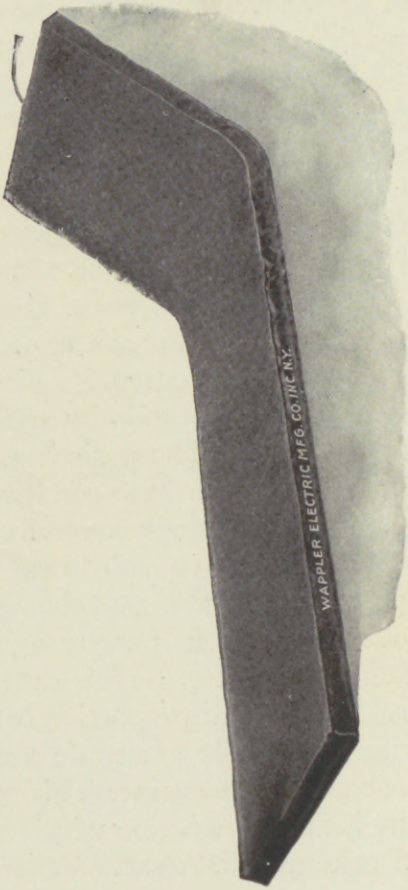


FIG. 32. Auto-condensation cushion.

trode may be used over the sacroiliac and sacrolumbar joints when they are primarily affected.

FIG. 33. Auto-condensation by means of chair.

Cavity Applications. For most cavity work the active electrode consists of the same glass vacuum or non-vacuum electrode

usually applied from the Oudin current (Fig. 34) and an indifferent surface electrode placed on any convenient skin area according to the individual indications.

Rectal. The prostate may be reached by means of the rectal electrode applied to the anterior wall, the other a small surface electrode placed well forward on the perineum or over the symphysis. It is possible to treat various pathologies of the pelvic region in unmarried women by the use of the rectal and superpubic electrodes.

Vaginal. The special glass electrode for this work is prepared with K-Y or similar lubrication and inserted as for treatments with the monopolar current. The surface indifferent electrode is then placed on the lower back or abdomen according to the directions in which it is desired to localize the heat. It is a common procedure to alternate between anterior and posterior plate at succeeding treatments. Under certain conditions especially in thin individuals the

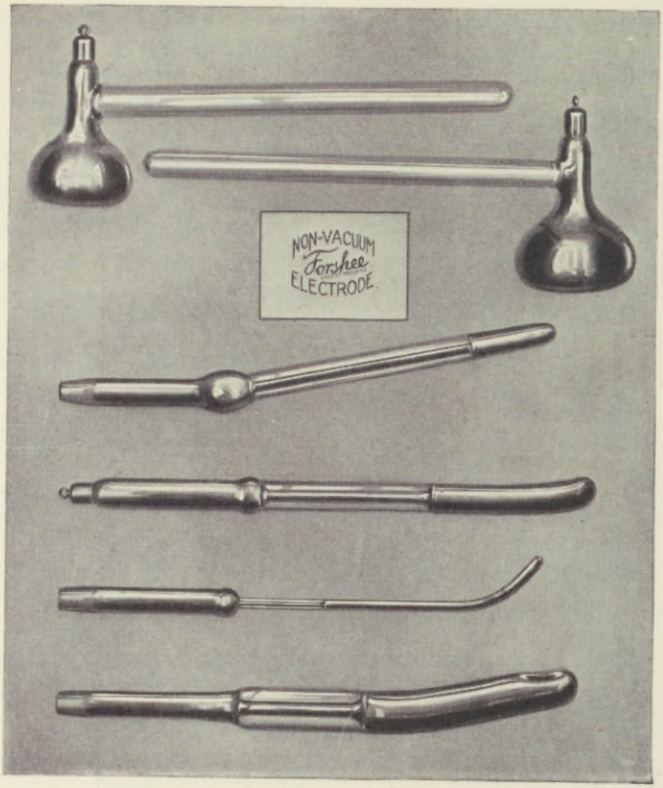


FIG. 34. Set of surface and cavity non-vacuum condenser electrodes used in modified diathermy.

through and through anteroposterior plates are nearly as efficient.

It is important when using diathermy for pelvic inflammatory conditions to rule out the possibility of walled-in pus as will be mentioned among the general contraindications for the use of this modality. All of the laboratory tests which are an aid in diagnosis should be carefully employed and one is not justified in the unscientific use of diathermy in the hope of obtaining symptomatic relief. Pregnancy, normal or ectopic, should also be excluded for certain before employing diathermy through the pelvis.

Several foreign workers have reported exceptional results in the treatment of gonorrhea in the female by the use of prolonged and intensive treatments. This organism was reported as destroyed by a degree of heat which the patients were able to tolerate for an hour at a time.

There is another technique sometimes called "modified" diathermy which is better controlled from the standpoint of sharp

localization of heat effect and which is very easy to apply. The patient is placed prone on the cushion which is attached to one D'Arsonval terminal. To the other terminal is attached a cable and a non-vacuum or vacuum surface condenser electrode. This movable surface electrode is then applied to the part to be treated exactly as if it were attached to the Oudin or Tesla current. In this manner the diathermic effect is made intense by the small amount of surface of the movable electrode which must be kept in motion when any large amount of current is employed. In this way it is somewhat easier to concentrate upon the erector spinae muscles or the sacroiliac joints or any other definite area which it is desired to reach.

Extremities. In the treatment of the *toes* for arthritis, fractures or other indications it is a rather difficult problem to secure an adequate application of diathermy. The experiments already quoted have demonstrated that a real diathermy may be

obtained by passing the current through salt solution and this offers practically the only method we have at our command to effect the toes. The patient is placed prone on the treatment table with the affected foot extending over the end of it. A table or stand 5 or 6 inches lower than the table is then placed under the foot. A fairly deep non-conducting receptacle is then partially filled with saline and a metal electrode attached to one D'Arsonval terminal placed on the bottom of the container. The other electrode may then be placed encircling the patient's instep or the ankle. In treating the toes it is necessary to employ quite a mild current strength and to have them partly immersed in the solution. To reach the metatarsophalangeal joints or the distal part of the foot itself the toes should be entirely immersed in the saline.

The *metatarsal* region may be readily treated in a direct manner by means of small electrodes perhaps 2 by 4 inches placed one on the sole and one on the dor-

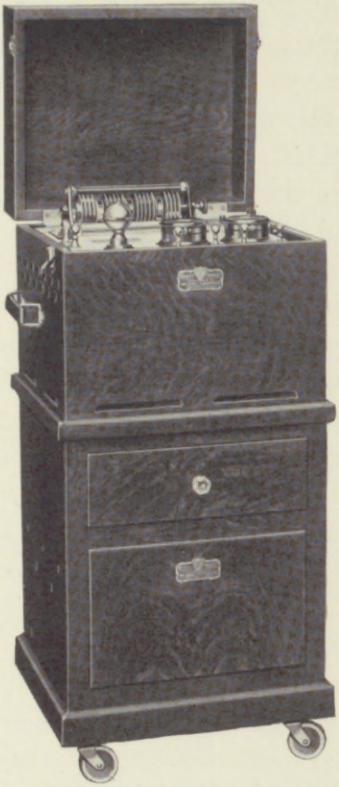


FIG. 35. Diathermy apparatus with carrier for ward work.

sum of the foot in such a manner that the affected part lies directly in the pathway of the current. For treatment of the os calcis itself or periostitis of this bone the lower plate may be placed directly over the heel. Here again the method of slitting electrodes down from the corners to enable them to fit snugly over a rounded surface is of great value. To reach the internal or external lateral ligaments, the midtarsal or the ankle joint, the placing of the plates laterally is very satisfactory. Plates of unequal size are used of course for sharp thermal localization, on one or the other of the lateral ligaments. As a rule lateral plates are indicated and are easy to apply to the leg. When it is desired to localize the treatment upon the Achilles tendon and its sheath lateral plates are used, which while parallel, are brought nearer the posterior than the anterior aspect of the lower leg. By this means we obtain somewhat of an edge effect between the two plates which will localize the heat in the tendon sheath as desired.

In treating the *fingers* a technique practically similar to that used for the toes is employed. With one electrode encircling the wrist or forearm, the other is placed in the container as before. This method is particularly satisfactory in that it is entirely within the control of the patient. When all of the fingers are immersed an even and slight degree of warmth is felt in the proximal end of all of the fingers. Moderate currents of 500 to 600 ma. are as a rule sufficient. The patient may then use his fingers like rheostats, lifting first one and then the other above the saline until he is concentrating all the current in the affected finger. If then the current density is too great he may reinsert one of the fingers thus decreasing the degree of the heat to tolerance.

In using this method the patient may be safely left alone during practically the entire treatment. If the fingers retain sufficient flexibility and power to hold the auto-condensation handle easily, then treatment of the hand and wrist is best given by this

means and an electrode around the forearm. The metacarpal or carpal bones may also be reached by small, directly opposed plates using mild degrees of current. The elbow may be treated by anteroposterior plates or by the double cuff method in which a pair of long narrow electrodes entirely encircle the joint above and below it.

This cuff method is used a great deal in some clinics. It will be easily seen that most of the current must pass through the soft tissues between the near edges of the metallic plates and will not reach to any extent the internal part of the joint. In treatment therefore of the soft tissues this method is efficient and applied with facility, but the direct through and through technique is always to be preferred where it is possible to employ it in the treatment of joint surfaces. It is probably true that by increasing the distance between the cuff electrodes and increasing the current strength to tolerance as well, a larger proportion of the current

will actually pass through the joint structures.

There is another method of applying this current which has been termed a "movable direct" technique. In it two non-vacuum or vacuum surface condenser electrodes are attached, one to each D'Arsonval terminal by means of the usually employed flexible cords. The skin is then powdered and the operator holding one electrode in either hand moves them so that they are exactly opposite each other on the patient's skin, and continues to move them slowly as one would in the ordinary Tesla or Oudin technique.

There are a number of conditions in which it is desirable to localize the thermal effect practically at the surface of the body. In this situation no disproportion in the size of the electrodes would accomplish the desired effect since the smallest electrode which could then be used, with any appreciable current strength, would still localize and make the point of greatest heat at some

little depth in the tissues. Our method of obtaining a distinctly surface heat is to

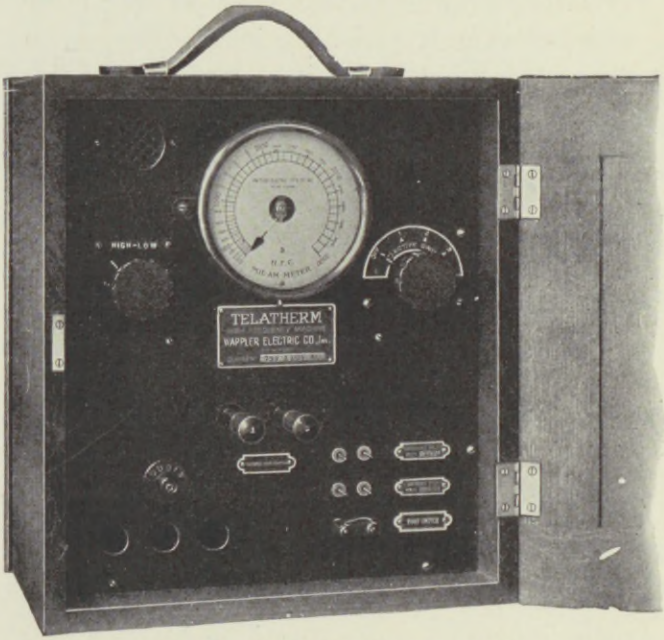


Fig. 36. Portable diathermy outfit.

place the patient upon the auto-condensation cushion or chair, have the operator similarly placed or hold a large non-vacuum

surface electrode in one hand. The operator may then place the tips of several fingers directly on the affected area after which an assistant turns on the desired amount of current. The operator then lifts one or two finger tips, concentrating the heat under that finger localized exactly on the affected part. This method is useful in the treatment of the gums following dental trauma, over the exit of the facial nerve or at the supra or infraorbital foramen and in other similar situations. Another method of raising the surface temperature by electrodes closely placed on the skin has already been mentioned.

There are several methods of treating the *middle ear*. A metal handle may be strapped to the patient's palms or cuff electrodes placed around his wrists, then with his little fingers in the external auditory canals a gentle through and through current may be used. In several bilateral conditions occurring in the upper extremities one auto-condensation handle may be held in each

of the patient's hands and the current raised to tolerance. Here the current density is greatest in the wrists because of the smallness of the cross surface to this point, and the entire arm, shoulder and upper thorax are affected by the current. It is not possible to give in detail all of the various modifications that have been applied to the D'Arsonval current for treatment purposes. Those that have proven most efficient have been outlined. A thorough knowledge of the physics, physiological effect and technical principles involved, will enable the physician to modify his own technique still further to suit particular needs as they arise.

GENERAL DIATHERMY OR AUTO-CONDENSATION

In this technique the patient is placed seated in the auto-condensation chair (Fig. 33) or lying supine on the auto-condensation cushion or mattress. The small folding covered wooden electrodes are not very efficient in this form of treatment. The chair

or cushion is then attached to one D'Arsonval terminal and the steel or non-vacuum cylinder electrode, held firmly in both hands, is attached to the other. In using the mattress it is a good plan to place a small pillow or cushion under the hands and forearms of the patient thus keeping them free from the body. The patient should be cautioned to retain his grasp upon the handle.

This treatment is used mainly for the relief of hypertension for which it is in most cases quite efficient. There is an undoubted stimulation to glandular metabolism throughout the body especially effecting elimination. There are a few patients suffering from hypertension who do not respond to this treatment. It is quite usual however, in these conditions to have them report a distinct general benefit from its use. Nervous tension is allayed, sleep made more profound and their feeling of well being enhanced as a rule. A current of between 600 and 800 ma. used for some twenty to forty minutes

is generally sufficient. Sometimes heavier amounts of current pushed to tolerance will obtain results where lesser amounts fail. Care should be taken not to give more current than will produce a slightly cramped feeling in the wrists. Another caution which should always be emphasized is against the lowering of high blood-pressure too quickly particularly in the aged. There is undoubtedly in these cases a certain amount of hypertension necessary in order to bring nourishment particularly to the brain through thickened capillary and arteriole walls, and many times the mistake has been made of lowering this pressure too fast and too far. Once it is judged that the hypertension has been lowered to the point which is normal and necessary for that patient (it may still be considerably above what is generally calculated as normal) the treatments should be given with decreasing frequency. The blood-pressure may be kept within normal limits, often by one or two treatments a month once this point has been reached.

PRECAUTIONS

Before leaving the subject of medical diathermy it might be well to summarize a few of the factors which are liable to interfere with the desired result if they are not constantly kept in mind.

1. *The outlets* should be divided into several circuits each one plainly numbered in the fuse boxes and fused as heavily as safety will permit. Much unnecessary search for the defective fuse is thus avoided.

2. *The spark gap* should be kept clean. In no other way can a smooth current be obtained.

3. *Electrodes* of a wide variety of sizes and shapes should be at hand rolled smooth and ready for use.

4. A good quality of shaving soap lather should be used and worked up with a brush.

5. *The patient* should be prepared mentally for treatment. Caution him to report tingling or burning sensations. Make him

comfortable, and support the part to be treated.

6. *Electrodes* must be snugly and evenly applied, equidistant at all points even when deliberately applied closely for "edge" effect. Have them of sufficient size so that there is not given over 100 ma. of current per square inch of the *smaller* electrode.

7. *Particular caution* should be used in treating abraided or anesthetic areas in patients who are restless or unconscious.

8. *The ordinarily indicated current strength* must be decreased by 50 per cent in patients with arteriosclerosis especially in the treatment of dense areas such as the knee. Similar precautions should be used in masses of scar tissue because of their subnormal vascularity.

9. *Take sufficient time in raising and lowering the current.* Five minutes for the former and two or three for the latter procedure. Double this time in treatments of the brain and heart.

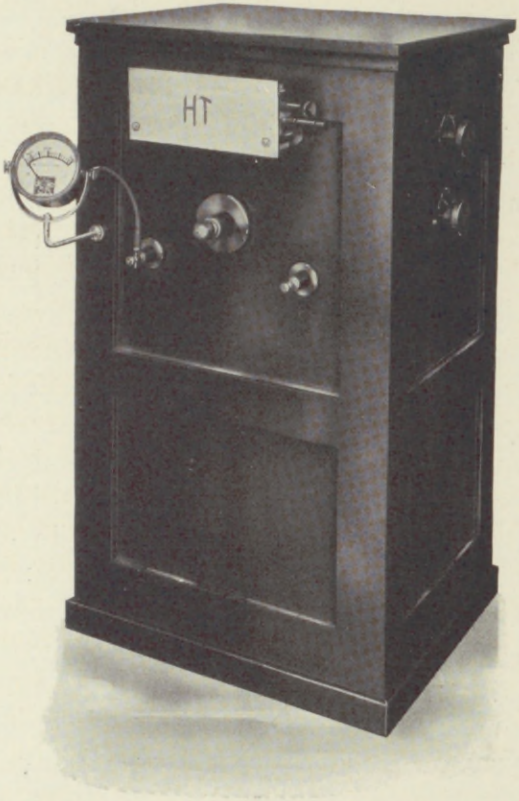


FIG. 37. High frequency machine of standard office type.

CONTRAINDICATIONS

The real contraindications to the use of diathermy are very few and this is one of the reasons for the rapidly widening use of diathermy in therapeutics.

In inflammatory conditions in which there is walled-in pus, diathermy should be avoided because the drainage from that area would be increased by its use, which would have a tendency to disseminate the pus throughout the system. This restriction in the use of diathermy does not obtain when adequate drainage has been secured, because with the increasingly active blood supply a corresponding increase in the number of phagocytes is brought about.

Wherever capillary or arteriole dilatation would increase the danger of hemorrhage diathermy is likewise contraindicated. Fresh contused and incised wounds, pulmonary tuberculosis with cavity formation and gastric and duodenal ulcers fall in this group. Pelvic diathermy should be avoided during pregnancy and menstruation.

In several texts, phlebitis is mentioned as a condition in which diathermy should not be used. It would seem to the writer that this contraindication is more theoretical than practical and in three cases in which it has been used by him there was a distinct lessening of the pain and inflammation with no untoward results.

CHAPTER III

SURGICAL DIATHERMY

Surgical diathermy sometimes called "endothermy" is the destruction of living tissues by heat arising and concentrated within them. The heat effect is sharply localized and raised to the point of coagulation or dessication. The term "diathermic cauterization" which has sometimes been applied to this form of treatment is not quite exact, as in cauterization heat is conveyed to the tissues by conduction while in this, as in other forms of diathermy it arises within the tissues themselves. This type of destruction of tissue is not to be confused with galvanic cauterization which is chemical in nature following the concentration of caustic ions at one of the poles.

Surgical diathermy is finding a place in the modern operating room where its advantages *in selected cases* are rapidly being

recognized. It is of course, particularly in malignancy that it finds a wide field of usefulness. Among the chief advantages of this method over other operative procedures the following have been mentioned:

(1) The *danger of postoperative infection* or the spreading of already present infection to uninvolved areas or throughout the body, *is eliminated in the proper use of surgical diathermy*, because the intense degree of heat developed absolutely sterilizes the tissue in which it is localized.

(2) The *likelihood of metastasis* in the treatment of carcinoma and other types of malignancy is very greatly diminished, in fact with a proper technique it is practically nil. This is because, as will later be described, the periphery of the growth is first treated and the lymphatics and blood-vessels are completely sealed and destroyed as the treatment proceeds. This of course is not true with the use of the knife no matter how rapid the operation or well considered the technique may be.

(3) *In advanced cases of malignancy and in other tumors which may be otherwise inoperable*, such as those involving the orbit and antrum this procedure offers at present the only possible method for their removal.

(4) *That this method of removing masses of tissue is practically without hemorrhage* is a factor that has considerable value in many cases. There are many conditions such as the removal of cancers of the tongue in which danger of hemorrhage is real and constant.

(5) *In conditions where prolonged anesthesia is necessary* when other operative measures are used, surgical diathermy offers an especial advantage because of the rapidity of the operation. A great deal of time is saved since the necessity of tying off small vessels is obviated.

Generally speaking surgical diathermy is not difficult and can be mastered by the average physician in somewhat less time than the surgical technique which it parallels.

(6) *Recovery time* is as a rule *diminished*, probably in large measure due to the free-

dom from infection which follows the use of this method. Postoperative adhesions are not commonly formed.

So much for the special advantages offered by surgical diathermy. There are clearly a number of disadvantages to be considered and in the selection of the proper procedure in any given case the disadvantages of this method, as well as the advantages must be taken into account. No broad statement can be made claiming special efficiency for surgical diathermy over the use of the knife, radium or *x*-ray. A fair statement to make is that each individual case presents problems of its own and that if all of the methods of attack, particularly where malignancy is concerned, are available, better work can be done by their proper selection than if the surgeon has not at hand all possible kinds of treatment.

Among the disadvantages of the use of surgical diathermy which also must be taken into consideration are these:

(1) The tissues which it is desired to reach must be fairly accessible, *i.e.*, not deeply buried beneath normal tissue.

(2) Intra-abdominal and intrathoracic new growths would be most difficult to deal with by surgical diathermy.

(3) It is not possible for the operator to lay bare important structures overlying his field by blunt dissection. He must therefore avoid working in close proximity to large vessels or must ligate them before proceeding.

(4) The fact that normal tissue must be destroyed along with malignant tissue in the immediate vicinity of the electrode is often a distinct handicap in operating by this method.

(5) A severe or fatal hemorrhage may easily be caused if the area desiccated extends to the wall of a large vessel.

(6) The formation of keloids in operations of this character is fairly common, especially when a large area of skin surface is involved.

To William L. Clark[14] of Philadelphia, George Wyeth[15] of New York, T. Howard Plank of Chicago, William McFee[16] of Haverhill and others we are largely indebted for the development of the technique of surgical diathermy. As soon as it is thoroughly understood this method of tissue destruction and removal is certain to attain wide popularity among surgeons. It is evident that it cannot be successfully employed except by a physician who is also well grounded in surgical technique. A well-built apparatus is essential for good work. The best modern types are providing several modifications of the current as to frequency and voltage so that still better work is possible in auto-condensation, medical dia-

[14] Clark, William L. Hemorrhoids and anal fissures with special reference to the desiccation method of treatment. *Am. J. Electrotherap. and Radiol.*, June, 1921.

[15] Wyeth, George A. Endothermy in accessible malignancy and pre-cancerous conditions. *Am. J. Electrotherap. and Radiol.*, May, 1923.

[16] McFee, William D. Electrocoagulation and allied therapeutic methods. *Am. J. Electrotherap. and Radiol.*, November, 1922.

thermy, and surgical diathermy. This development of apparatus will greatly increase the usefulness of this procedure to the surgeon.

Keeping pace with this improvement in apparatus is a constant refinement in the construction of electrodes, making them applicable for all sorts of special localizing work, especially as regards their insulation and the general convenience of their use. These active electrodes consist, as a rule, of an insulated handle containing a metal core to the end of which are inserted knives, buttons or one or more needles. There is an increasing tendency to use single needles in this work. The indifferent electrode may be a large flexible composition metal plate, mesh or pad electrode which should be covered with soap lather and applied in the same general way as for medical diathermy. Special care must be taken that the electrode is large enough properly to decrease the current density, and, when the patient is anesthetized, to secure good contact. In a prolonged operation the reinsertion of

soap lather under this electrode may be necessary.

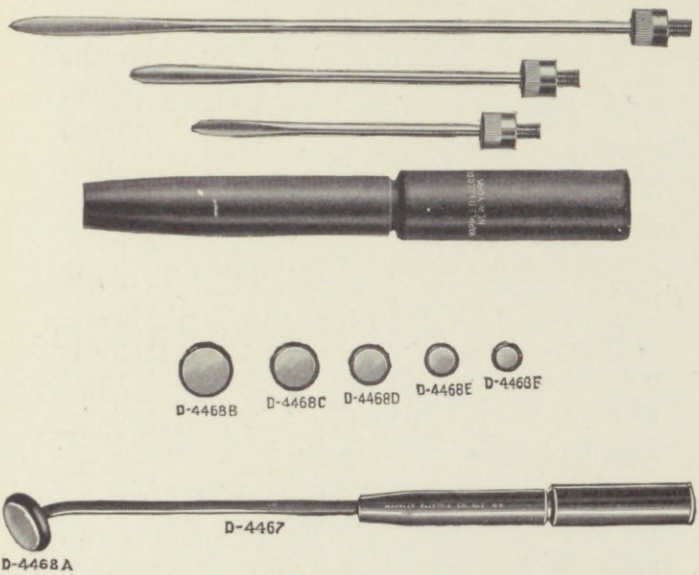


FIG. 38. Types of surgical diathermy electrodes with protective handle.

In most operations by means of surgical diathermy a general anesthetic is required.

Small tumors however, may often be removed under local anesthesia, which as a rule is all that is required in the treatment of tonsils. After the completion of the operation the skin under the indifferent electrode should be examined, dried and powdered. The apparatus and electrodes must be examined and prepared with the same care as for medical diathermy. The patient and the field of operation should be prepared as for any other surgical procedure of equal magnitude (Fig. 38).

It has been the rule to employ currents of some 500 to 2,000 ma. In the better types of modern apparatus which give a relatively high frequency in comparison to the voltage, currents up to 4,000 ma. may be used. When the apparatus and electrodes are in readiness and the patient under a complete local or general anesthesia, as the case requires, the needle, knife or button is thrust into the mass and the current turned on (Figs. 39 and 42). In most operations a single needle is used and the periphery of the growth is first

treated, each needle insertion made a slight distance from the preceding one until the whole periphery of the mass has been treated.

The current from the needle point may be tested against a key or other metal instrument and the rheostat or spark gap set to the desired amount, after which it may be controlled by the knife switch on the machine or better yet, by a foot switch (Figs. 40 and 41). The current is of course turned on completely to the desired amount and not increased slowly as is the case with medical diathermy. A blanching of the area immediately surrounding the needle first occurs after which bubbles appear in a very few seconds. At this point the current should be turned off as otherwise sparks will jump across the dessicated tissue to the surrounding normal tissue. Undue stimulation of nerves is brought about if this is allowed to occur. Treatments of extreme brevity with repeated insertion of the needle or other form of the active electrode, rather than the attempt to extend the area of the coagulation

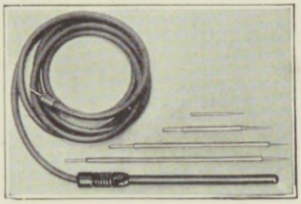


FIG. 39. Surgical diathermy electrodes.

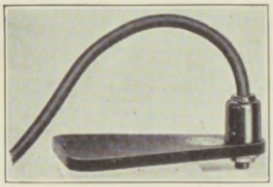


FIG. 40. Surgical diathermy electrodes and foot switches.

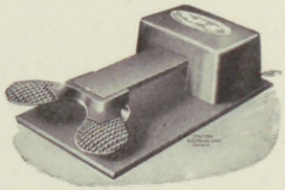


FIG. 41. Surgical diathermy electrodes and foot switches.

by prolonging the time during which the current is applied, is the indicated procedure.

The tissues will be found to be coagulated to a depth roughly equal to the diameter of the electrode and in cross-section approximately half its diameter beyond the edge of the electrode when buttons or knives are used. In the employment of a needle or needles both the depth and cross-section of the coagulation is much greater by this method of calculation. Slightly more time is necessary to coagulate vascular areas. In operating upon large masses of tissue more time is required and it is occasionally necessary to prevent the sudden drying of the tumor mass by steadily dropping salt solution along the electrode. Whether or not the mass should be left *in situ* to be dressed surgically and allowed later to slough off, or whether it should be removed and the base curetted, depends largely upon the individual indications in the case.

The Tonsils. Use of surgical diathermy is increasingly employed in the reduction

or removal of tonsils. The advantages and disadvantages of this procedure in general have been fully discussed and most of them apply to the treatment of tonsils. This is an office procedure under local anesthesia and has much to commend it. We are often confronted with a case in which, because of absorbed toxins, tonsillectomy is urgently needed, but which must be delayed until the acute inflammatory stage has passed. *Acute inflammatory condition is not a contra-indication to immediate attack by the electro-coagulation method.*

There has been perfected an excellent technique for the treatment of various tonsillar conditions by this method. Pre-operative sterilization is unnecessary. Both the tonsils and peritonsillar tissues are anesthetized. During the process the tonsils are heated to a temperature far above that necessary to kill all organisms. The fact that the blood-vessels are sealed in the process enables us to treat patients who have hemophilia, in this manner. The apparatus

should be capable of delivering from 1,000 to 2,000 ma. of current. Several of the new types which deliver extremely high frequency and low voltage are particularly useful in this work. They should be provided with a foot switch so as to be more completely under the operator's control. The insulated rubber handle previously described is the most convenient form of active electrode to use.

A pliable needle of sufficient length can be used to reach the tonsil easily. The indifferent electrode may be placed behind the shoulder but it is still more convenient to have the patient simply hold the auto-condensation handle attached to the other D'Arsonval terminal. With the patient seated in such a manner that the light falls as desired, the tongue is then depressed with a wooden or glass tongue depressor. If necessary an assistant may retract the anterior pillar by means of a blunt hook or other convenient retractor.

The needle can be insulated with fine rubber tubing extending nearly to the point. If

a machine is available delivering the type of current just described a very small milliamperage is usually sufficient for the operation. To reduce hypertrophied tonsils the needle may be placed against the tonsil

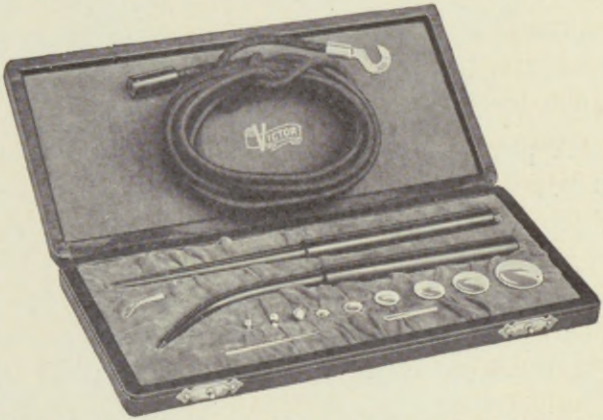


FIG. 42. Folding case with complete surgical diathermy electrodes.

and the current turned on. Here only the slightest blanching of the tissue is indicated when the current is removed and the needle applied to a new area. This is done until the entire tonsil has been evenly and

thoroughly treated. In the destruction of tonsillar tissue currents of from 400 to 600 ma. are used, and the needle is inserted to the depth of one-quarter of an inch each time. In this case a slightly more pronounced blanching should be obtained which takes a somewhat longer time than the treatment of the tonsil's surface as just described. Only a very few seconds are required with each needle insertion and the entire operation is a matter of only a very few minutes.

In a week or ten days the tonsil will usually slough away and does not require any particular attention in the meantime. If for any reason surface sterilization is indicated ultraviolet applications by the water-cooled lamp through a tonsillar applicator may be employed. Particular care should be taken against any attempt forcibly to remove the dessicated tissue. More than one treatment is seldom required. The patient should be warned that after the affect of the local anesthetic has worn off

there may be considerable after-pain. With the employment of the proper technique, however, this should not be much, if any, greater than follows the surgical removal of the tonsils.

I would not consider that I had fairly presented this subject if I did not refer to a recent article.[17] Novak reports the treatment of some hundred cases by this method and states that in these cases the postoperative pain was very great and that the patients experienced difficulty in swallowing, and in speech, also that the palate often became edematous. He used the needle electrode in but one case. In the others he used a button electrode with a current of from 400 to 1,500 ma. and a duration as great in some cases as fifty seconds. It is not stated whether this type of apparatus gave the desired extremely high frequency and low voltage quality of current which has been mentioned. It is thought that such a current

[17] Novak, Jr., Frank J.: The electrocoagulation method of treating diseased tonsils. *J. Am. M. Assn.*, June 23, 1923.

used after the technique just described would without doubt greatly lessen the unpleasant postoperative sequelae which Novak encountered. As Novak[17] himself says: "This method offers theoretically so many advantages over operative procedures as to be worthy of extensive trial."

CHAPTER IV

DETAILED CASE HISTORIES

When the effect of a new type of treatment on the progress of a disease is being described detailed case histories are necessary. They teach many facts not easy to bring out in any other manner. The attempt has been made in this chapter to set forth in detail, cases that were as nearly as possible typical in every way. Those selected embrace each type of lobar pneumonia together with streptococcus infection.

Those types which were the most numerous in our series are represented by two cases each, while in the types that were less numerous only one case history is given. The time at which diathermy was given the patient is indicated as far as possible in order that its immediate as well as accumulative

effect may be brought out. There were a few case records that show more marked changes in the temperature and pulse readings than those given, but they are not included for the reason that it is the average or constant effect of the treatment which it is desired to emphasize.

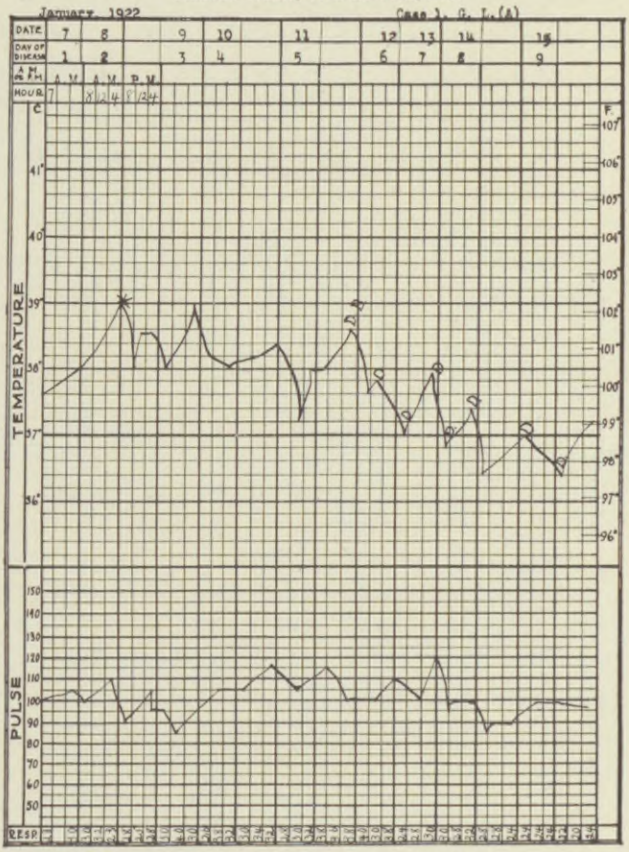
These case reports are all from the U. S. Marine Hospital No. 21, N. Y., and were entirely the work of the hospital staff. They represent as great detail as it was possible to secure in the midst of a busy hospital routine. There are many more records which could have been included but not without overburdening the reader with this particular phase of the subject.

DETAILED TYPICAL CASE REPORTS ON DIATHERMY IN THE TREATMENT OF PNEUMONIA FROM U. S. MARINE HOSPITAL, NO. 21, N. Y.[18]

STREPTOCOCCUS PNEUMONIA

CASE 1. G. L., aged thirty-nine years, was a merchant seaman.

[18] The following case reports are transcribed from the records as they appear on file in the U. S. Marine Hospital, No. 21. N. Y.



*—Diagnosis: lobar streptococcus; D. B.—Diathermy begun; D.—Diathermy.

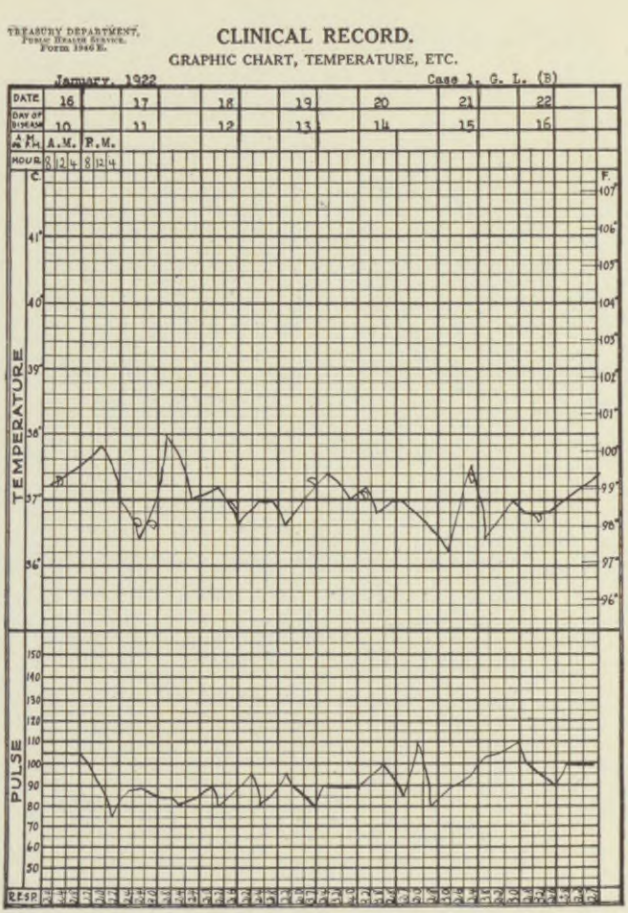
Family History: One brother had died of tuberculosis, otherwise negative.

Past History: Negative.

Present Illness: The patient was admitted to the U. S. Marine Hospital, No. 21, N. Y., on January 7, 1922. Two days before entering the hospital while working in a refrigerator car, the patient began to cough and had severe pain in the left side. During the evening of the same day, the patient had a chill which was followed by a rise in temperature, a dull headache, frequent cough with little expectoration and a severe pain on coughing or on taking a deep breath, at the left base. The pain was referred to the left axillary region. These symptoms increased to the extent to cause the patient to come to the hospital.

Physical Examination: A fairly well-developed and well-nourished adult male about thirty-nine years of age who has paroxysms of coughing with severe pains in left side.

Head: Tonsils were slightly enlarged and congested.


TREASURY DEPARTMENT,
PUBLIC HEALTH SERVICE.
Form 1940 E.
CLINICAL RECORD.
GRAPHIC CHART, TEMPERATURE, ETC.
January, 1922
Case 1, C. L. (B)
DATE
DAY OF DISEASE
A.M. P.M.
HOUR
TEMPERATURE
PULSE
RESP
C.
F.

D.—Diathermy.

Thorax: Heart—normal. The lung expansion was decreased on left side. Fremitus was increased over the upper left lobe. Crepitant râles over the whole of the left lung. Breath sounds increased throughout the left lung with bronchovesicular breathing in the axillary region. Percussion note showed there was a large area of dullness in the left axillary region. The right lung has a few scattered coarse râles otherwise negative. Physical examination otherwise negative.

Laboratory Findings:

Urine, January 8, 1922:

Color	amber
Reaction	acid
Albumin	two plus
Sugar	negative
Pus	one plus
Epithelia	one plus
Specific Gravity	1,012

Wassermann, January 10, 1922: Negative.

Sputum, January 12, 1922: No Pneumococci present. Streptococci present.

X-ray, January 11, 1922: Radiological examination of the chest shows the whole left lung dense except a small area at the outer face. The heart displaced to the right. The right lung not normally translucent, possibly fluid in the left chest. Fluoroscopic examination shows fluid clear.

Diagnosis: Lobar pneumonia, probably complicated with pulmonary tuberculosis.

X-ray plate No. 6145, February 3: The right lung shows peribronchial infiltration and general mottling.

The left lung shows upper lobe with greatly decreased radiability. The whole picture is one of encysted pus or fluid in the upper left chest.

X-ray plate No. 6210, February 20: Both lungs show fibrosis and mottling. Left lung shows area of decreased radiability over second and third rib in front and at base. Fluoroscopy shows absence of diaphragmatic movement on left side.

Diathermy: The treatment was begun on the fifth day of the disease. Two treat-

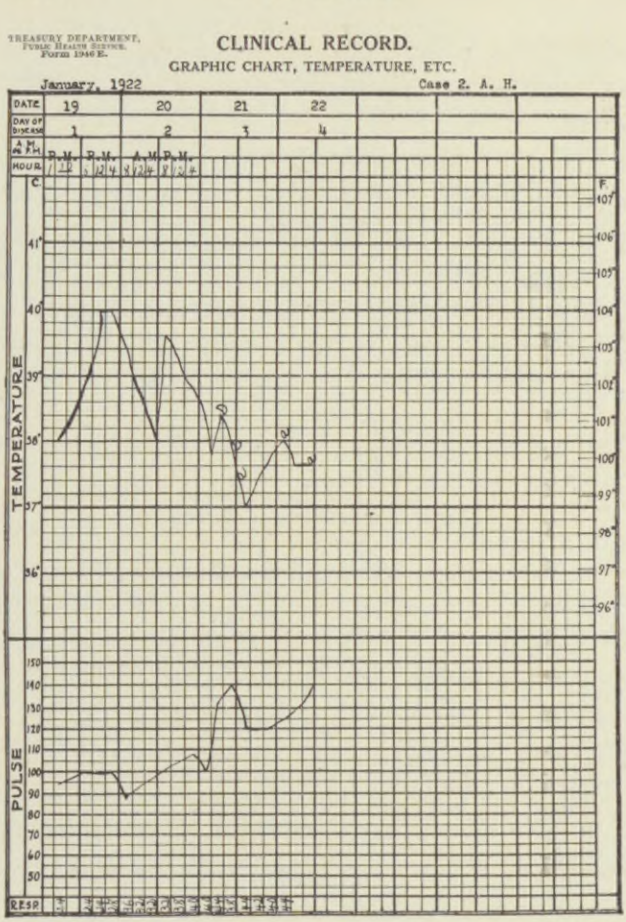
ments were given daily for six days—2,000 ma. for twenty minutes, followed by six daily treatments. The patient received complete relief from pleuritic pain. Cyanosis which at first was marked, disappeared and he received from two to four hours of restful sleep. The temperature fell steadily by lysis and he made an uninterrupted recovery.

CASE 2. A. H., aged thirty-seven, was a merchant seamen.

Family History: Negative.

Past History: Negative.

Present Illness: The patient was admitted to the U. S. Marine Hospital, No. 21. N. Y. January 19, 1922. Two days before he entered the hospital the patient was taken with a severe chill, headache, pains in the extremities and the back. When the chill began to pass away the temperature began to rise. The patient felt some better on the morning following the chill, but during the afternoon felt much worse and a cough began to develop. On the day the patient entered the hospital a pain had developed



D.—Diathermy; a.—Axilla.

at the base of the left lung posteriorly which radiated to the angle of scapula. When entering the hospital patient's temperature was 38° which rose to 40° C. within seven hours.

Physical Examination, January 19, 1922: A well-developed and well-nourished adult, male,thirty-seven years of age, acutely ill.

Head: Pharynx congested. Otherwise normal.

Thorax: Heart—normal. The expansion of the left lung was decreased at the base. Fremitus equal. Percussion—just below the angle of the left scapula there is a spot about the size of the palm of the hand which is dull. Over this area bronchovesicular breathing is heard with fine crepitant râles. Whispered voice sounds are increased over this area. Coarse bubbling râles were heard over the large bronchi, especially on the left side. Breath sounds harsh through the entire right lung. Physical examination otherwise negative.

Diagnosis: Lobar pneumonia.

Physical Examination, January 21, 1922: The patient's general condition was much worse. Pulse was 136, and thready, respiration was markedly increased and labored. Examination of chest shows a well developed pneumonia at right base and signs of pleurisy with effusion at left base.

Diagnosis, January 22, 1922: Lobar pneumonia in the right lung. Pleurisy with effusion in the left.

Patient developed a hemorrhagic rash which began on the back and the upper extremities and extended down to the abdomen. General condition on this date was critical.

Laboratory Findings:

Urine, January 20, 1922:

Color	amber
Specific gravity	1027
Reaction	acid
Albumin	one plus
Sugar	negative
Pus	one plus
Casts	none
Blood	negative

White Blood Count, January 20, 1922:
White cell count. . . 46,000
Differential count. 82 per cent polys.

Blood Culture, January 22, 1922: After eighteen hours incubation showed streptococcus veridans.

Diagnosis: (*a*) Lobar pneumonia, right base.

(*b*) Pleurisy with effusion.

(*c*) Septicemia (streptococcus veridans).

Diathermy: Although patient's condition was obviously desperate diathermy was applied on the third day in which he received two treatments of 2,000 ma. for twenty minutes. His temporary improvement was so great that for a time it was thought possible he might recover but he died the next day. The autopsy and blood culture demonstrated the hopelessness of the case.

Result: Death, January 22, 1922, 8 P.M.

Autopsy, January 23, 1922: At the autopsy there was found a lobar pneumonia on the right, a central pneumonia at the left

base. Also there was a pleurisy with effusion found at the left base. There was an exudate about one-eighth inch thickness which covered the lower left lung.

TYPE I: PNEUMONIA WITHOUT SERUM

CASE 29. A. M. aged twenty-four, was a Portuguese seaman.

Past History: Negative.

Family History: Negative.

History: Admitted April 19, 1923. One day before admission the patient was taken sick on board ship with chill, cough and pains in the right chest, and temperature. The temperature on admission was 36.2° C. Three hours later it was 40° C.

Physical Examination: Negative except for chest. Heart was apparently normal. The respiration was rapid with respiratory grunt. Dullness on the right lower side and impaired resonance on the left lower. Weak breath sounds on the right lower base; few râles at the right lower base. Increased

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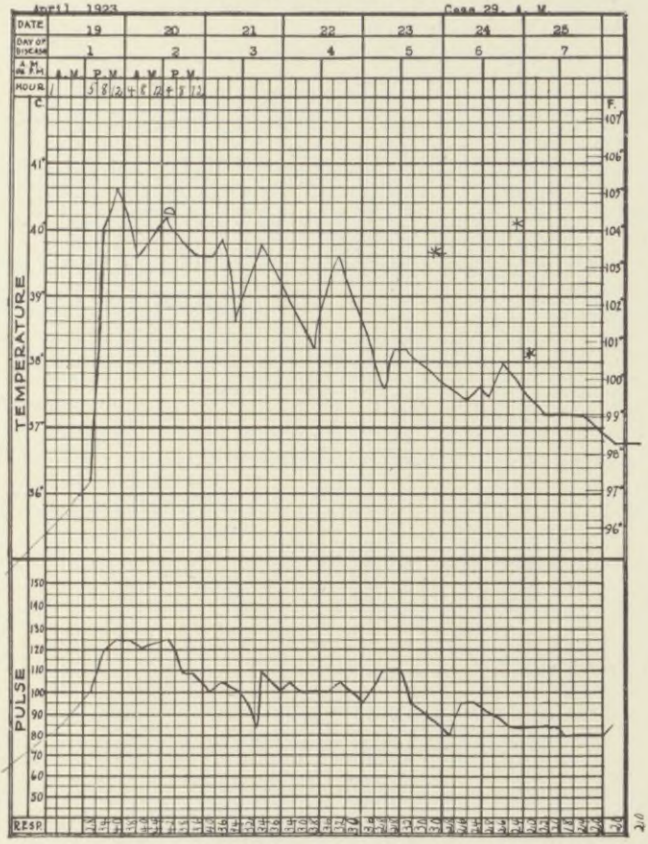
Form 1966 E.

CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC.



D.—Diathermy; *—Asleep.

whispered voice-sounds. Diagnosis: Pneumonia, right lower lobe.

Laboratory Findings: Shows a homogeneous shadow occupying the right base.

Urine: Negative.

Wassermann: Negative.

Sputum: Pneumococcus. Type I.

X-ray Examination, April 20, 1923: With the exception of the right axilla. Cardiac shadow is not displaced. Rest of the lung fields are fairly clear. Roentgen inference: Pneumonitis of the right lower lobe.

Diathermy:

	Before			Treatment		After		
Date	*B.P.*	*Pulse*	*Resp.*	*M.A.*	*Time*	*B.P.*	*Pulse*	*Resp.*
4–20–23	118/66	120	32	1600	20 min.	118/58	104	30
21	118/70	100	30	1600	20 min.	106/62	94	30
22	108/70	90	28	1600	20 min.	114/86	90	28
23	120/98	84	26	1600	20 min.	108/66	80	26
24	120/80	68	24	1600	20 min.	112/60	68	24

Note: Some subjective improvement following each treatment, with less pain following coughing and deep inspiration. Temperature fell by lysis and diathermy was discontinued, by the next day tempera-

ture had reached normal. Diathermy was started on the second day of the disease.

Result: Recovered.

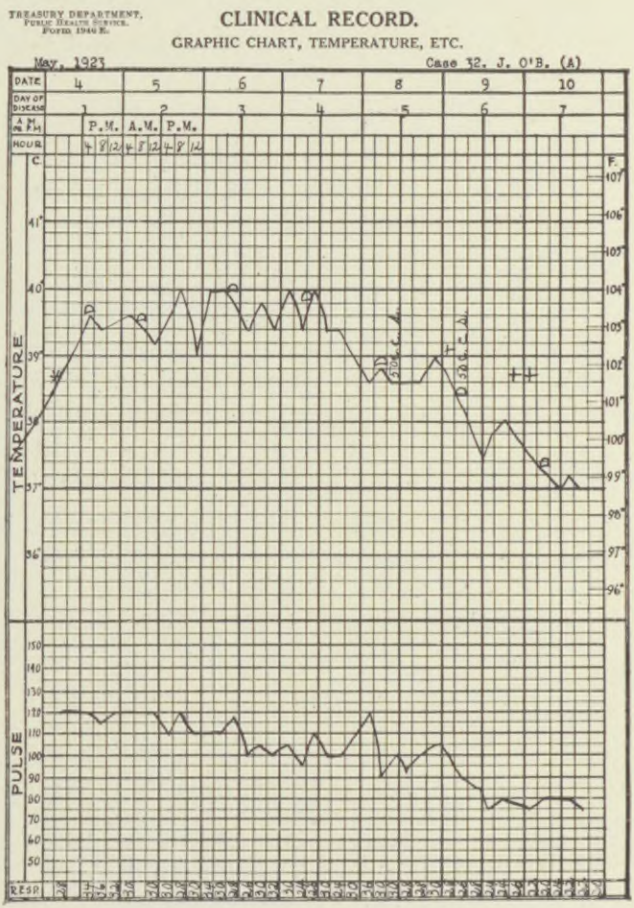
WITH SERUM

CASE 32. J. O'B., aged twenty-five was a merchant seaman.

Past and Family History: Negative.

History: Patient was taken sick on the day before admission to the hospital with a severe chill which was followed by a rise in temperature and a moderate cough which caused some pain in the lower right chest. The day of admission to the hospital the cough was worse and the pain in the lower right chest was more severe. Temperature remained elevated. Sputum was blood streaked. Temperature on admission was 39° C.

Physical Examination: Showed a well developed lobar pneumonia of the right lower lobe. Abdomen was slightly distended: no masses or tenderness. Examination otherwise was negative.



*—Admission 3 P.M.; D.—Diathermy; 50 c.c.s.—50 c.c. serum; +—Asleep.

Laboratory Findings:

X-ray: Chest with the bedside unit shows an almost homogeneous shadow occupying the region of the lower right lobe. Roentgen inference: Pneumonitis of the right lower lobe.

Urine: Negative.

Wassermann: Negative.

Leucocyte Count: 22, 100.

Differential Count: PM. 90 per cent trans., 2 per cent, LM. 3 per cent, SM. 5 per cent.,

Sputum: Type for pneumococci showed Type 1.

Diathermy:

	Before			Treatment	After			
Date	*B.P.*	*Pulse*	*Resp.*	*M.A.*	*B.P.*	*Pulse*	*Resp.*	*Time*
5–4	110/58	120	32	1600	108/58	118	30	30 min.
5–5	108/56	124	34	1500	106/54	128	31	30 min.
5–6	102/50	108	30	1600	102/48	106	30	30 min.
5–7	108/60	120	30	1700	106/52	116	30	30 min.
5–8	102/52	94	28	1700	118/84	96	28	30 min.
5–9	102/56	88	26	1650	100/56	88	28	30 min.
5–10	?	?	?	1600	?	?	?	30 min.

Each treatment was given for thirty minutes; the treatments were started on the

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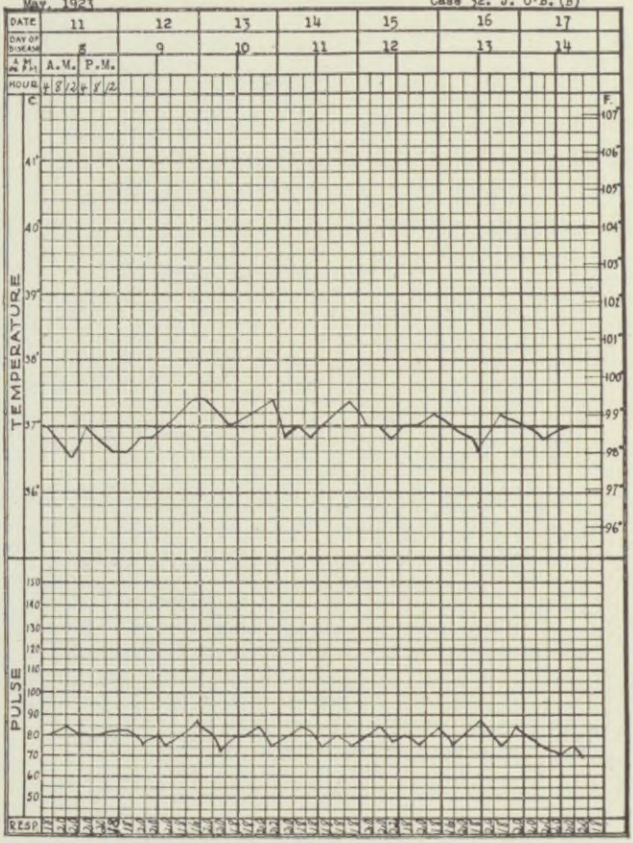
CLINICAL RECORD.

GRAPHIC CHART. TEMPERATURE, ETC

May, 1923 — Case 32. J. O'B. (B)



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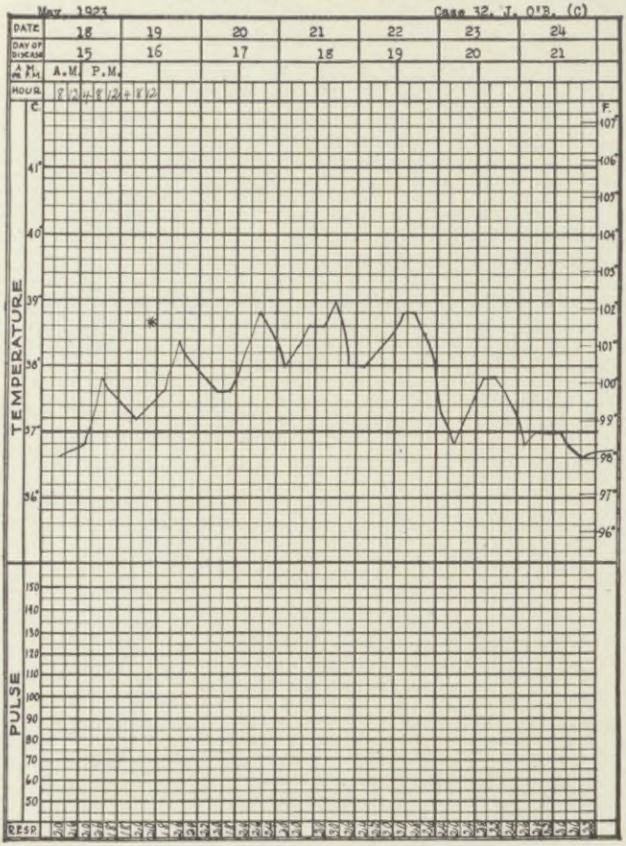
Form 1946 E.

CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC.



*—Asleep. The rise in temperature is due to serum sickness.

second day of the disease. The patient stated that he felt more comfortable following each treatment.

This patient received 50 c.c. of anti-pneumococcus serum on the sixth and seventh days of the disease. On the ninth day following the administration of the serum the patient had a marked rise in temperature, a serum rash and a poly-arthritis. The arthritis involved the smaller joints to a greater extent than the larger joints. It is Dr. Boland's opinion that diathermy did good in this case as the patient had a restful sleep following each treatment, the pleuritic pain was relieved and the cough was less and with more ease.

Result: Recovery.

TYPE II: PNEUMONIA

CASE 15. J. B. T., aged fifty-nine, was a coast guard.

Past and Family History: Negative.

History: Patient was taken sick during the night of November 6, 1922 with severe

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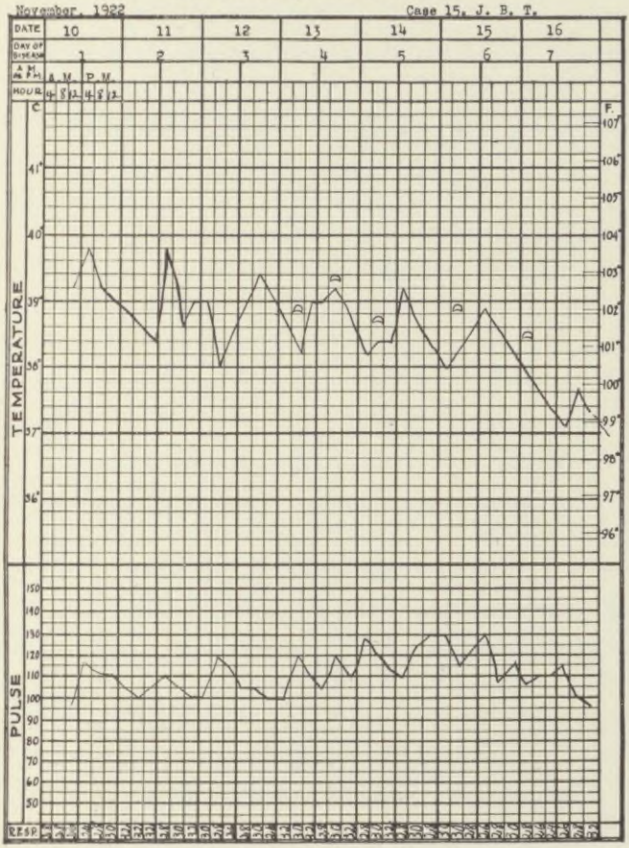
CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC



D.—Diathermy.

pains throughout the body and especially of the extensor muscles of back and lower extremities. The following day he began to cough but did not raise any substance from the lungs. Patient remained in bed for two days after which he went back to work for one day. The following day he was admitted to the hospital complaining of pains in the lower right chest which were aggravated by deep breathing and coughing. The cough was more severe than on the previous days and his sputum was blood streaked.

Physical Signs: Shape—long and narrow chest. Mobility—fair.

Inspection: Lagging at the right base.

Palpation: Increased fremitus over all of right chest both anterior and posterior. Left—normal.

Percussion: Right lung—impaired from the second dorsal spine to base and from the fifth rib to the base with absolute dullness at base posteriorly. Left lung—impaired from apex to second rib and from apex to fourth dorsal spine.

Auscultation: Right lung—Bronchovesicular breathing throughout. Vocal fremitus increased throughout. Fine crepitant râles from the fifth rib to the base and from the third dorsal spine to the base. Left lung—breath sounds harsh.

Laboratory Findings:

Urine: Showed a slight trace of albumin and a few pus cells.

Leucocyte Count: 15,800.

Sputum: Showed Type II pneumococci.

Wassermann: Negative.

Radiographic Report: Apices cloudy. Heart-dropped type. Consolidation of the right middle and lower lobes.

Diagnosis: Lobar pneumonia—middle and lower right lobes.

Diathermy: Was begun on November 12, 1922: 1,800 ma. was given for one hour each day from November 13th to November 20th. Temperature fell by lysis. Recovery was uninterrupted with a long convalescence.

TYPE III: PNEUMONIA

CASE 17. T. A., aged thirty, was a merchant seaman.

Past and Family History: Negative.

History: Patient was admitted December 20, 1922. Four days before admission patient was taken with a headache, slight temperature, loss of appetite and a feeling of general malaise. The following day the patient was confined to bed with the above symptoms, a cough and slight pains in the chest and back. These symptoms persisted with localizing of pain in lower right chest until date of admission. Temperature on admission 38.4° C. Pulse 120. Respiration 28.

Physical Signs:

Heart: Enlarged slightly downward and to the right. Heart sounds soft and regular.

Lungs:

Inspection: Shape—normal. Mobility decreased at the right base.

Palpation: Fremitus increased over the right lower lobe.

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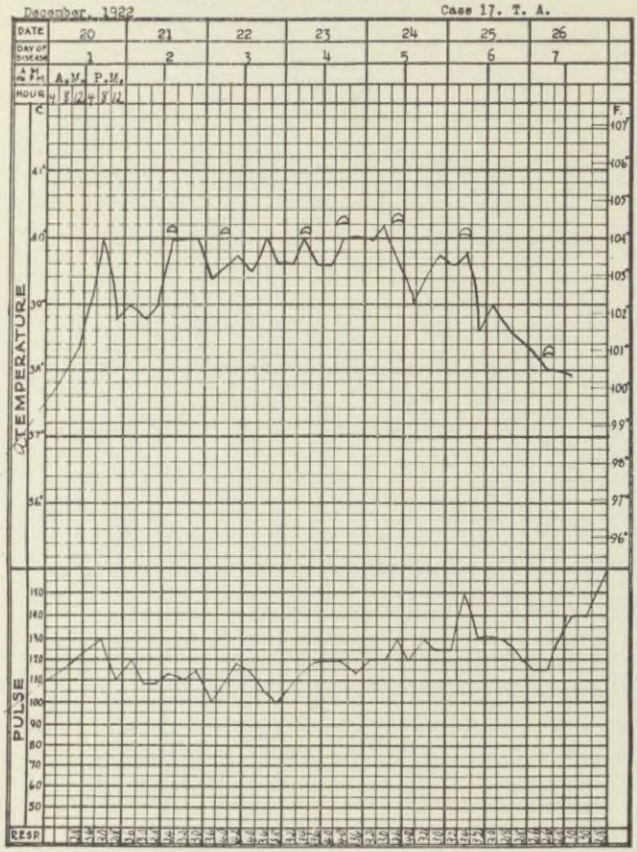
Form 1046 E.

CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC

December, 1922 Case 17. T. A.



A.—Admission; D.—Diathermy.

Percussion: Right lung—dull over entire right lower lobe anteriorly and posteriorly. Left lung resonant throughout.

Auscultation: Right lung breath sounds almost absent over the right lower lobe, whispered and spoken breath sounds increased. Left lung negative.

Laboratory Findings:

Urine: Trace of albumin, few pus cells, and a few hyaline and granular casts.

Leucocyte Count, December 21, 1922: 21,100.

Sputum, December 22, 1922: Type III pneumococci.

Wassermann: Negative.

Radiographic Report, December 20, 1922: Showed consolidation of right lower lobe.

Physical Examination, December 24, 1922: Showed pneumonic process had extended to the right middle and left lower lobes. Temperature—104.3° F. Pulse 154. Respiration 42. Temperature, pulse and respiration remained elevated until 12 mid-

night, December 27th at which time the temperature began to fall by lysis.

Diathermy:

		Time		Before		After
Date	*B.P.*	*Pulse*	*M.A.*	*Time,*	*B.P.*	*Pulse*
12–21–22	150/70	140	2,200	30 min.	144/70	136
22	152/74	115	2,200	30 min.	148/72	105
23	150/70	120	2,000	30 min.	144/70	120
		130	2,000	30 min		120
24	154/72	140	1,800	20 min.	150/70	140
26		150	1,800	20 min.		
		160	1,800	20 min.		140
27		140	1,800	20 min.		160
28		120	2,000	30 min.		135
			2,000	30 min.		115

Diathermy discontinued December 28th and patient made an uninterrupted recovery.

Diagnosis: Lobar pneumonia—right middle and lower lobe and left lower lobe.

TYPE IV: PNEUMONIA

CASE 3. W. S., aged nineteen, was a merchant seaman.

Family History: Negative.

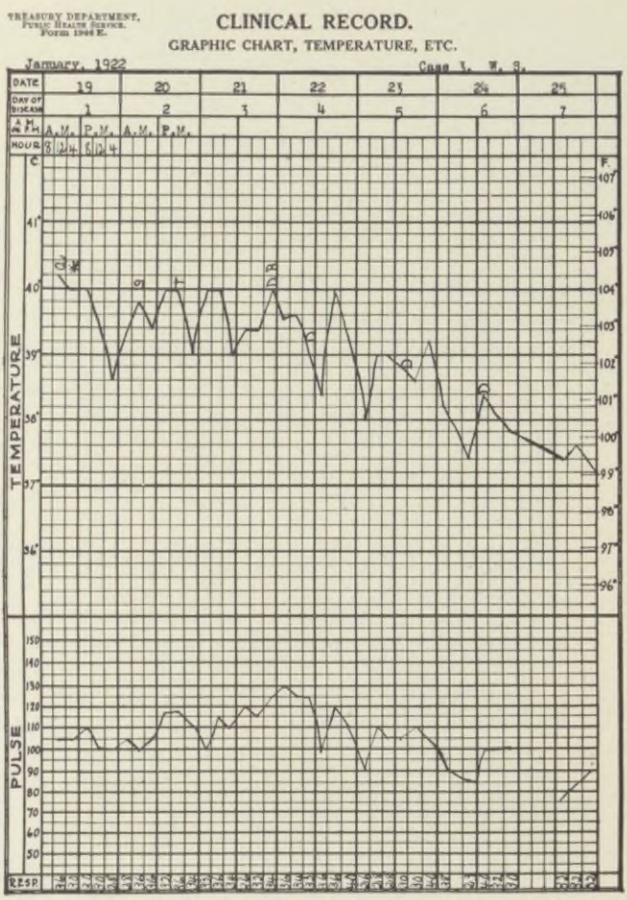
Past History: Negative.

Present Illness: Patient was admitted to U. S. Marine Hospital, No. 21, N. Y., January 19, 1922. On the day before entering the hospital the patient was taken with a sudden chill and headache, pains in the extremities. Following the chill there was a rise of temperature. During the night patient developed a cough, with slight pains in the left chest. The following morning the patient's cough grew worse and he had a severe pain at the base of the left lung which radiated to the left shoulder. On entering the hospital the patient's temperature was 40° C. Pulse 105. Respiration 36.

Physical Examination, January 19, 1922: Well-developed and well-nourished adult, male about twenty years of age, acutely ill.

Head: Pharynx—markedly congested. Tonsils enlarged and red, but with no patches.

Thorax: Heart—normal. Lungs—expansion decreased at left base, percussion note dull over an area about the size of the palm



A.*—Admission after sponge; S.—Sponge; +—Diagnosis: lobar pneumonia; D. B.—Diathermy begun; D.—Diathermy.

of the hand just below the angle of the left scapular. Fremitus increased.

Auscultation: There is distinct broncho-vesicular breathing over an area of dullness with a few fine crepitant râles. Whispered voice sounds increased.

Abdomen: Slightly distended, but soft and tympanitic. Physical examination otherwise negative.

Physical Examination, January 20, 1922: Examination at this date showed a clear cut lobar pneumonia of the left lower lobe.

Laboratory Findings:

Urine, January 20, 1922:

Color	amber
Specific Gravity	1,012
Reaction	acid
Albumin	one plus
Pus	nene
Epithelia	none
Casts	none

Leucocyte Count, January 20, 1922:

White cell count..... 28,600

Differential count... 78 per cent polys.

Sputum, January 23, 1922: Pneumococci found—Type IV.

Wassermann, January 27, 1922: Negative.

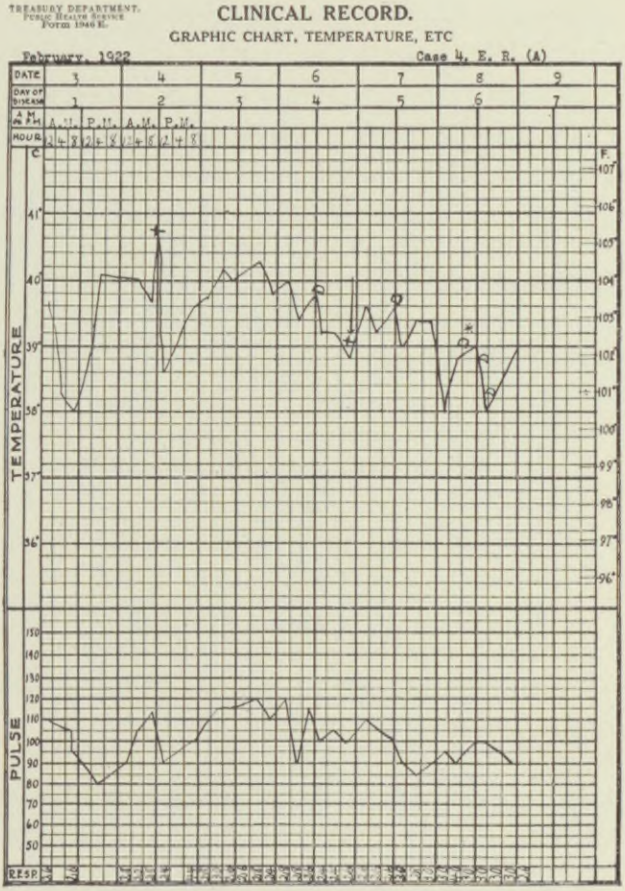
Diagnosis: lobar pneumonia, lower left lobe.

Diathermy: Treatment started on the third day, twice daily of 2,000 ma. for twenty minutes. Improvement in patient's condition was marked after each of the first few treatments when it remained satisfactory. Temperature fell by lysis and he made a satisfactory recovery.

CASE 4. E. R., aged twenty-six, was a merchant seaman.

Present History, February 2: Complained of frontal headache, weakness, severe pain on left chest. Duration one day, hurt to breathe or cough. Restless. (Mustard plaster and aspirin 10 q. 4 h. ammonium carbonate and codeine, p. r. n.)

Examination: Throat—negative. Chest, left base posteriorly loud friction rub. Harsh respiration over both lungs posteriorly. Otherwise negative.



+—Diagnosis: Pneumonia left lung; D.—Diathermy; +←—Right lung affected; *—Condition desperate, "filling up."

Diagnosis, February 4: Lobar pneumonia —left lobe (upper post): Bronchial breathing, whispered pectoriloquy and dullness almost flatness. Pneumonia lobar spine and ice cap. Sputum taken. Diathermy started. Pain less since diathermy.

February 5: Chest the same. Tincture of digitalis mn. 15 q.i.d. Stopped aspirin.

Diathermy, February 6: Started caffein-sodium, benzoate q. 4 h.

February 7: Diathermy (2). Left chest, no real bronchial breathing. Less harshness but still dullness almost flat in affected area. *Right* middle lobe post. Showed bronchial breathing, whispered pectoriloquy and almost flatness (lobar involvement of right).

Diagnosis, February 8: Double pneumonia: Pneumococcus—Type IV.

Diathermy (2). Right chest shows in area involved no real bronchial breathing. Respiration still harsh and due to percussion. Many coarse râles in both sides of chest posteriorly in areas affected.

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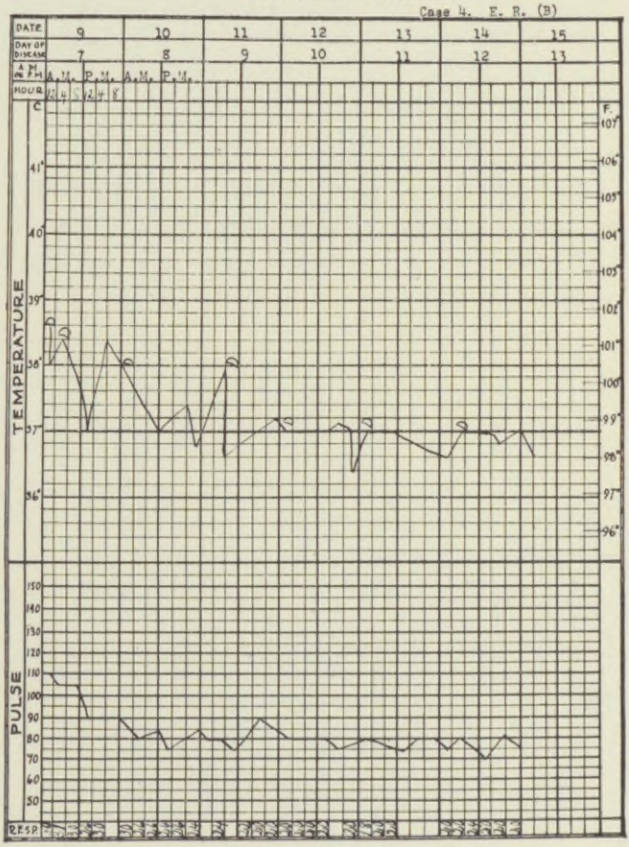
Form 1916 E.

CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC.

Case 4. E. R. (B)



D.—Diathermy.

February 9: Diathermy (2). Left lung showed fewer râles still coarse in quality.

Right lung shows many coarse râles and small area of bronchial breathing at inferior angle of scapula. Percussion—dull with pain markedly less.

Treatment: Diathermy was started on the third day of the disease: 2,000 ma. were used for twenty minutes. Eleven treatments were given in all. The left lung was rapidly improving when the right became involved. Both then were treated for a time, finally only the right. On the sixth day of the disease after the right lung became involved the patient's condition seemed hopeless, he appeared to be "filling up." Two diathermy treatments, three hours apart, brought great relief and he began to improve at once and made a complete recovery.

PNEUMONIA OF UNDETERMINED TYPE

CASE 8. A. B., aged thirty-one, was a merchant seaman admitted February 23, 1922.

Examination: Chest showed throughout harsh respiration. No definite changes in tactile or vocal fremitus on auscultation. Scattered râles throughout chest. Pulse, 96. Respiration, 36. Heart sounds—fair quality but not distinctly heard because of harsh respiration near precordium. Dyspneic and slightly cyanotic. Medication, gargle and cough mixture of ammonium carbonate and codeine.

February 24: Chest, same.

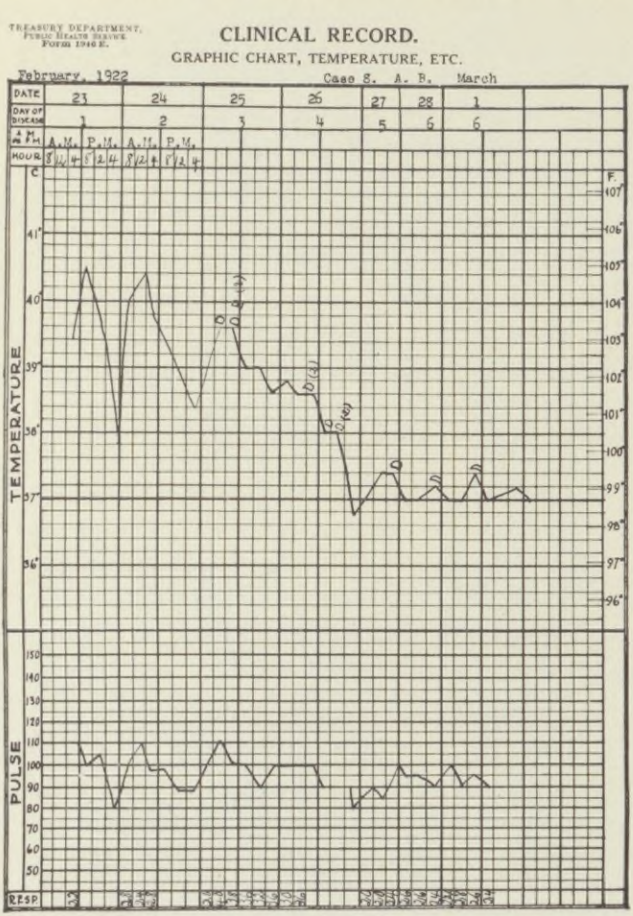
February 25: Developed dullness in right base and bronchial breathing. Cyanosis more marked. Respiration rapid, 40 and shallow. Pulse, 112. Rales at right base anteriorly.

Diagnosis: Lobar pneumonia. No virulent pneumococci: 2 diathermy treatments daily started. Tincture digitalis mn. 15 q. 4 h.

Laboratory Findings:

Leucocytes: 10,000 hemoglobin, 75 per cent.

Sputum, February 26: Unsatisfactory for typing. Heart enlarged to left one and a



D.—Diathermy; D. B. (2)—Diathermy (2) begun.

half inches apex beat. Sixth interspace, mitral systolic murmur at apex transmitted toward axilla. Patient restless, irrational at times. Got out of bed four times at night. Morphine ¼ gr., atropine 1/150 p. r. n. for restlessness.

February 27: Right base still shows dullness. Many coarse râles both anteriorly and posteriorly. Patient complained of pain in the right base. Expiration is prolonged throughout the entire chest. Patient still irrational. Morphine and atropine p. r. n.

March 1: Medium râles anteriorly and posteriorly at the right base and some harshness. No whispered pectoriloquy and no bronchial breathing, no change in percussion note. Cardiac condition as above. Rational. General condition improved. Coughing less and less cyanotic.

Treatment: Diathermy was started on the third day of the disease. He received fourteen treatments—twice daily at first—of 2,000 ma. for twenty minutes. Diathermy

seemed to help his condition very much. Temperature fell by lysis and he made a rapid recovery.

CASE 11. M. K. aged twenty-two was a merchant seaman, admitted March 22, 1922.

Examination: Walked into the hospital. Complained of pain in right lower chest especially in the axillary region, dullness at the right base, lack of breath-sounds and voice-sounds, some pain in the right upper quadrant of the abdomen and in the epigastrium.

Medication. Mustard plaster to the right side of the chest. Aspirin gr. 10 q. 4 hrs.

Diagnosis, March 23, 1922: Breathing rapidly. Lobar pneumonia. Diathermy ordered twice daily. Ammonium carbonate and codeine 5 c.c. p. r. n.

March 24, 1922: Right base: Shows dullness, increased vocal fremitus and almost bronchial breathing in the posterior part. Stop aspirin. Started tincture of digitalis minims 15 q. 4 hrs.

March 25, 1922: Had fair night. Still coughing. Pain in the chest is less; practically no pain in the abdomen.

March 27, 1922: Is feeling more comfortable. Right base still shows dullness and bronchial breathing. Friction rub in the left base. Coughed considerably during night.

March 28, 1922: Chest signs the same as the previous day.

March 29, 1922: Coughing considerably, less after treatment.

March 30, 1922: Coughing considerably. Right base still shows dullness and bronchial breathing at the extreme base.

March 31, 1922: Stop tincture of digitalis. Stop ammonium carbonate and codeine. Start Stokes' expectorant. 5 c.c. p. r. n.

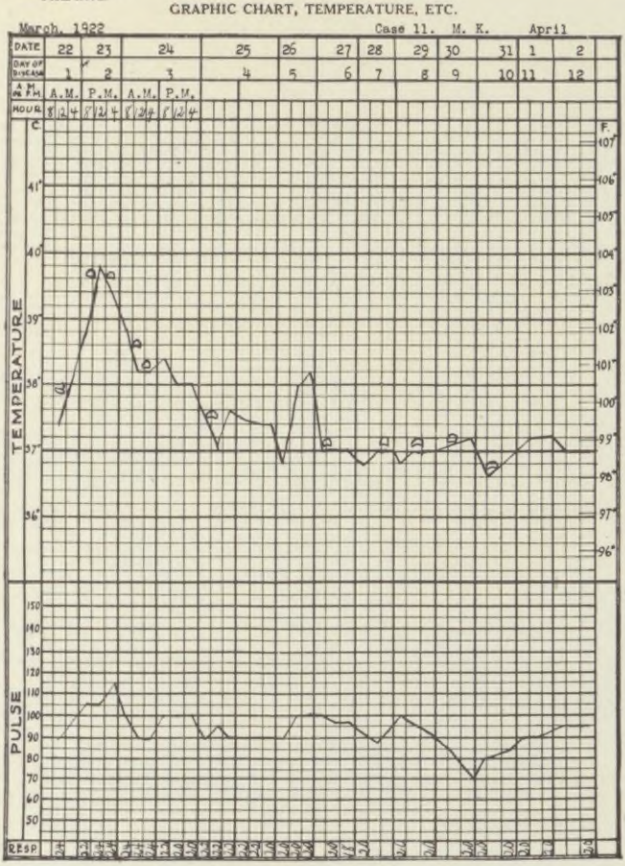
April 1, 1922: Right base—dullness and a few medium râles. A few high pitched râles in the right apex. A few medium râles in the left base. Diathermy discontinued.

Dobells' gargle q. 4 hrs. Strychnine sulphate gr. $\frac{1}{60}$ t.i.d.

TREASURY DEPARTMENT
Public Health Service
Form 1946 E.

CLINICAL RECORD.

GRAPHIC CHART, TEMPERATURE, ETC.



A.—Admission; D.—Diathermy.

Laboratory Findings:

Urine, March 23, 1922: Sp. gr. 1,025 acid reaction. albumin—negative, sugar—negative.

X-ray of chest, March 24, 1922: Peribronchial infiltration and light mottling of left lung. Heavier mottling of the right apex and decreased radiability of the lower lobes. Suggests tuberculosis process with consolidation or thickened pleura at the right base.

Sputum: Unsatisfactory for typing. (Undetermined.)

Treatment: Diathermy started twice daily on the second day of the disease. Ten treatments were given of 2,000 ma. for twenty minutes. Improvement marked for several hours after each treatment. Temperature started down immediately by lysis and reached normal on the fourth day with a slight subsequent rise. Recovery, uninterrupted.

CHAPTER V

SUMMARY OF TOTAL CASE REPORTS

The points regarding each case necessary to show the effect of diathermy on pneumonia concern the patient's age, the type of the organism, the amount of pulmonary area involved and the day of the disease on which diathermy was first given. Only those complications which were apt to produce distinct modifications in the usual course of the disease were recorded.

These facts give an idea of the progress of the cases and of their comparison with the controls. Practically all of the cases occurred in the Marine Hospital and were worked out in the same detail as the case histories given in the previous chapter.

In the column headed "temporary or symptomatic results" the results were noted by the medical officer in charge of the case. This type of case did not lend itself well to the making of graphs to indicate group averages in the result obtained.

SUMMARY OF THE TREATMENT OF ALL BY DIATHERMY, AND CONTROLS

TREATED

No.	*Name*	*Age*	*Lobes*	*Type*	*Day**	*Treatments*	*Amount*
1	G. L.	39	2	Strep.	5	18	2,000
2	A. H.	37	4	Strep.	3	2	2,000
3	W. S.	19	1	IV	4	11	2,000
4	E. R.	26	2	IV	3	11	2,000
5	G. S.	32	3	IV	3	21	2,000
6	J. R.	37	2	IV	4	33	2,000
7	O. Y.	28	1	Undet.	2	8	2,000
8	A. B.	31	1	Undet.	3	14	2,000
9	W. M.	52	2	Undet.	3	10	2,000
Spring, 1922							
10	J. J.	52	2	Undet.	3	18	2,000
11	M. K.	22	1	Undet.	2	10	2,000
12	G. L.	32	4	Strep.	7	8	1,800
13	R. W.	33	3	IV	4	3	1,800
14	A. N.	40	3	IV	7	10	1,800
15	J. B. T.	50	2	II	3	8	1,800
16	E. K.	32	Entire left	III	4	3	1,600
17	T. A.	30	3	III	6	9	2,000
18	M. V.	27	1	IV	3	4	2,000
19	A. H.	19	Entire left	IV	3	3	1,300
Fall, 1922							
20	A. G.	34	2	I	3	4	1,800
21	J. T.	50	2	II	6	6	1,500
22	E. A.	24	1	Undet.	4	4	1,800
23	G. T.	30	5	IV	3	5	1,800
24	E. D.	39	2	IV	6	2	1,800

* Indicates day of disease in which diathermy was first started.

CASES OF LOBAR PNEUMONIA—TREATED U. S. MARINE HOSPITAL NO. 21, N. Y.

CASES

Time	*Temp. fall*	*Effect*	*Complications*	*Terminus*
20	Lysis	Immed. relief	Pul. T. B.	Recovery
20	Lysis	Seemed impr.	Empyema-strep. septicemia	Death
20	Lysis	Much impr.	None	Recovery
20	Lysis	Much impr.	Another lobe	Recovery
20	Lysis	Less pain	One relapse	Recovery
20	Lysis	Much impr.	Prolonged "septic" temp.	Recovery
20	Lysis	Much impr.	Mitral systol	Recovery
20	Lysis	Much impr.	Mitral systol	Recovery
20	Lysis	Felt better	None	Recovery
20	Lysis	Greatly impr.	None	Recovery
20	Lysis	Temp. norm. 4th day	Otitis media	Recovery
20	None	Temp. impr.	Bronchial asthma	Death
20	Lysis	Marked impr.	Pyuria	Recovery
20	Lysis	Marked impr.	None	Recovery
60	Lysis	Some impr.	None	Recovery
30	None	No benefit uncomfort. slight temp.	Scoliosis Wassermann 4+	Death
30	Lysis	Some impr.	None	Recovery
30	Partial crisis	Subjective impr.	Major oper. 1 wk. prev.	Recovery
20	None	Treat. discon. temp. impr.	Hypotension	Death
50	Lysis	Subj. impr.		Recovery
25	Lysis	Subj. impr.		Recovery
50	Lysis	Subj. impr.		Recovery
25	None	Subj. impr.		Death
20	Lysis	Impr.		Recovery

SUMMARY OF THE TREATMENT OF ALL BY DIATHERMY, AND CONTROLS

TREATED

No.	*Name*	*Age*	*Lobes*	*Type*	*Day**	*Treat-ments*	*Amount*
25	H. S.	32	5	Undet.	3	3	1,800
26	S. A.	20	1	IV	4	2	1,600
27	J. L.	36	1	I	3	5	1,600
28	O. M.	24	3	Undet.	3	6	1,500
29	A. M.	24	1	I	3	3	1,600
30	J. C.	55	2	IV	4	3	1,300
31	G. B.	37	1	Undet.	7	4	1,700
32	J. O. B.	25	1	I	3	7	1,600
33	W. B.	20	1	IV	3	5	1,700
34[19]	G. G. Dr. Bacon Dr. Comfort	42	1	Undet.	1	17	1,200
35[19]	Dr. K. Dr.W.B.Snow	51	4	III	5	6	1,500
36[19]	A. A. Dr. Freeman Dr. Brophy	40	4	Undet.	10	31	1,000

CASES TREATED BY DR. HENRY V. BROESER,

37	C. B. Dr. Kerdasha Dr. Pyle	39	1	IV	4	6	2,000
38	F. K. Dr. Kline	29	2	II	3	10	1,500
39	V. G. Dr. Spath	35	1	Undet.	6	11	2,000
40	A. B. Dr. Spalding	33	2	Undet.	6	8	1,800
41	P. W. Dr. Opdyke	26	1	Undet.	5	7	2,000
42	A. E. Dr. Londrigan	42	2	Undet.	4	8	1,800
43	A. W. Dr. Spath	24	1	IV	3	7	1,500
44	L. F. Dr. Pindar Dr. Pyle	72	2	IV	3	8	2,000
45	S. B. Dr. Spath	12	2	Undet.	6	4	1,600
46	A. R. Dr. Wolf	22	3	Undet.	7	4	2,000
47	E. A. Dr. Londrigan Dr. Neimeyer	7	1	Undet.	5	3	1,400
48	A. M. Dr. Neimeyer	6	1	Undet.	6	5	1,400

[19] Cases 34, 35, 36, were of a severe type in adults fairly comparable but were not Marine

CASES OF LOBAR PNEUMONIA—TREATED U. S. MARINE HOSPITAL NO. 21 N. Y.

CASES

Time	*Temp. fall*	*Effect*	*Complications*	*Terminus*
20	None	B. P. lowered		Death
20	Lysis	Impr.		Recovery
20	Lysis	Some impr.		Recovery
20	Lysis	No change		Recovery
20	Lysis	No change		Recovery
15	Lysis	No change		Death
20	Lysis	Impr.		Recovery
20	Lysis	Felt better		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Felt better		Recovery
	Lysis	Much impr.	Very cyanotic	Recovery
25	Lysis	Carried thru. several crit. times	Hiccoughs, otitis media	Recovery

HOBOKEN, N. J.

20	Lysis	Great impr.	None	Recovery
20	Lysis	Felt better	Otitis media	Recovery
20	Lysis	Impr.	Empyema	Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Relief	Extreme distension	Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Relief		Recovery
20	Lysis		Chronic nephritis myocarditis	Recovery
20	Lysis	Impr. cy. dis.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Great relief		Recovery
20	Lysis	Impr.	Glycosuria	Recovery

to the others and are therefore included in the mortality tables, Hospital cases.

CASES TREATED BY DR. BROESER

No.	*Name*	*Age*	*Lobes*	*Type*	*Day**	*Treat-ments*	*Amount*
49	Dr. Greenfield	4	1	Undet.	8	5	1,400
	D. S. Dr. Neimeyer						
50	E. M. Dr. Spath	2½	3	Undet.	6	5	900
51	S. E.	17	1	Undet.	4	4	2,000
52	Mrs. B.	65	1	Undet.	5	6	1,700
53	V. M.	55	1	Undet.	6	6	2,000
54	L. V.	24	2	Undet.	4	5	2,000
55	J. B.	45	1	Undet.	6	6	2,000
56	J. K.	11	1	Undet.	5	7	1,400
57	M. M.	23	1	Undet.	7	5	2,000
58	Mrs. A.	34	3	Undet.	5	4	1,600
59	F. H.	48	1	Undet.	4	4	1,800
60	J. S.	8	3	Undet.	6	5	1,400
61	R. D.	15	1	Undet.	6	4	1,500
62	F. V.	21	1	Undet.	5	7	2,000
63	Mrs. F.	50	1	Undet.	4	5	1,700
64	Mrs. D.	40	1	Undet.	6	6	1,600
65	E. D.	47	1	Undet.	7	5	2,000
66	L. H. Dr. Natrass	72	3	Undet.	7	11	1,000
67	L. K.	6	3	Undet.	5	4	1,400

HOBOKEN, N. J. *(Continued)*

Time	*Temper.*	*fall Effect*	*Complications*	*Terminus*
20	Lysis	Impr.	Delirium	Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	Lysis	Impr.		Recovery
20	None	Temp. impr.	Chronic heart & kidney disease	Death
20	Lysis	Impr.		Recovery

CONTROLS 1922—1923

No.	*Name*	*Age*	*Lobes*	*Type*	*Day**	*Treat-ments*	*Amount*
1	O. T.	30	1	Undet.			
2	L. L.	25	2	Undet.			
3	E. R.	26	3	Undet.			
4	F. S.	54	2	IV			
5	F. R.	70	1	Undet.			
6	A. V.	22	1	IV			
7	A. R.	41	2	Undet.			
8	E. DeF.	23	2	Uudet.			
9	E. D.	49	3	II			
10	R. S.	22	2	Undet.			
11	E. S.	21	1	Strep.			
12	N. R.	46	2	IV			
13	J. T.	19	1	Undet.			
14	J. D.	56	2	IV			
15	W. M.	40	4	Strep.			
16	J. M.	21	1	IV			
17	G. M.	35	1	Undet.			
18	J. O.	50	1	IV			
19	A. O.	42	3	II			
20	J. D.	38	2	IV			
21	L. S.	34	4	II			

U. S. MARINE HOSPITAL

Time	*Temp. fall*	*Effect*	*Complications*	*Terminus*
	Crisis			Recovery
			On 6th day	Death
				Recovery
				Death
				Death
				Recovery
				Death
			Empyema	Death
				Death
				Recovery
				Recovery
				Recovery
				Recovery
				Recovery
				Death
				Recovery
				Recovery
				Recovery
				Death
				Recovery
				Death

CHAPTER VI

BRONCHOPNEUMONIA

The results of our treatment of bronchopneumonia have not been as clear cut as

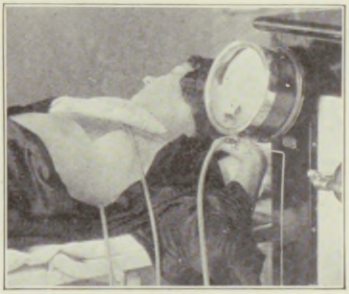


FIG. 43. Use of mesh electrode in treatment of bronchopneumonia through upper chest.

in lobar pneumonia. This is undoubtedly largely because no cases were lost either among those treated by diathermy or the controls.

The symptomatic relief which the patients who were treated by diathermy received was similar to that obtained in the treatment of lobar pneumonia. There was immediate subjective improvement following each treatment. The temperature came down somewhat more rapidly than in the controls and the period of convalescence was apparently shortened. There is every indication, therefore, that in the application of diathermy to bronchopneumonia, we have an agent of value.

Technique. Electrodes slightly larger than those used for the application to a single lobe should be selected. They will vary in size according to the degree of the involvement. We use electrodes averaging seven inches square. Particularly in the case of an emaciated patient, the flat German silver mesh is a convenient material to select. In the use of these or the flexible solid plate electrodes, the preparation is the same. The patient rests on a posterior plate and the anterior one is placed cen-

trally on his upper chest. Both are covered with a heavy warm shaving soap lather, and clipped to the diathermy cords. When electrodes of this size are used it is safe to employ any desired amount of current up to 2,000 or even 2,200 ma. The current should be raised and lowered with the same care as in the treatment of lobar pneumonia. The earlier treatment is instituted, the better will be the results obtained. Treatments may safely be given twice a day or even more often as the needs of the case indicate.

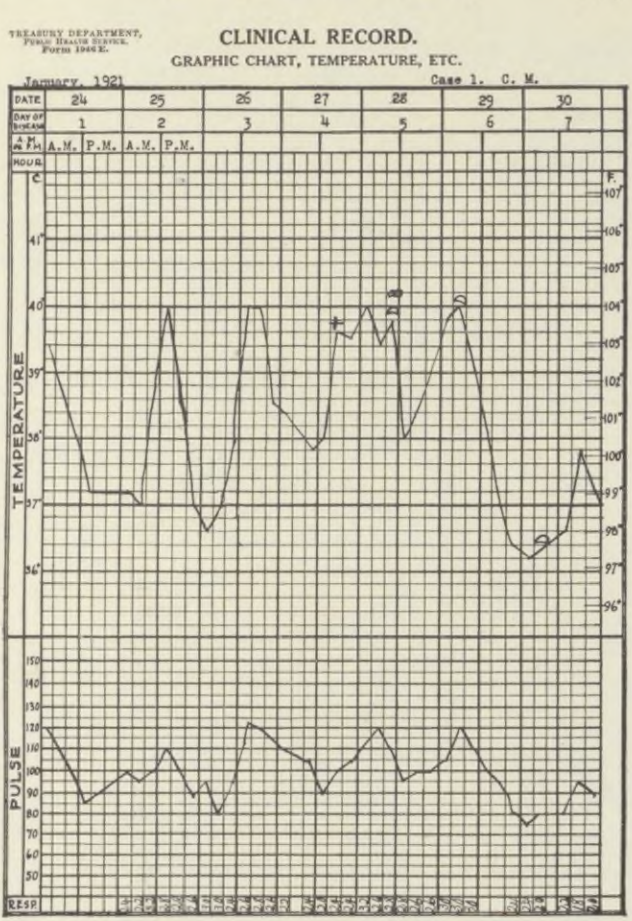
DETAILED CASE HISTORY

CASE I. C. M., aged twenty-four, was a merchant seaman.

Family History: Negative.

Past History: Negative except for primary infection of syphilis.

Present Illness: Patient was admitted to the U. S. Marine Hospital, No. 21, N. Y., January 24, 1922. Three days before entering the hospital after being exposed to damp cold weather the patient developed a slight



+—Diagnosis: Bronchopneumonia; D. B.—Diathermy begun; D.—Diathermy.

sore throat, headache and slight pains in the extremities. The day before entering the hospital the patient's throat was much worse and his temperature was elevated. The day the patient entered the hospital he had a severe headache, sore throat, pains in extremities and back and a slight pain in right chest on deep inspiration. On entering the hospital his temperature was 39.2° C. Pulse 112, respiration 24.

Physical Examination, January 24, 1922: Well developed and nourished adult male about twenty-five years of age, moderately ill.

Head: Pharynx congested. Tonsils slightly enlarged and red.

Thorax: Heart—normal. Lungs: To and fro friction rub at left base posteriorly, few fine crepitant râles heard at angle of left scapula. Otherwise negative. Temperature was normal on the morning of the 25th. At 8 P. M. January 25th, temperature 40° C., January 26th A. M. temperature normal, P. M. went back to 40° C. January 27th at 4 A. M. temperature 38° C. At noon 39.2° C. At

8 P. M. 40° C. January 27th examination of the chest showed that there was an area just below right scapula about the size of the palm of the hand, over which the percussion note was dull. Over this area there was bronchovesicular breathing with numerous fine crepitant râles. At middle of body of scapula there was an area about the size of a dollar over which percussion note was dull. Over this area there was bronchovesicular breathing and fine crepitant râles.

Diagnosis: Bronchopneumonia.

Laboratory Findings:

Urine, January 25, 1922:

Color	amber
Reaction	acid
Specific gravity	1007
Albumin	trace
Sugar	negative
Blood	negative
Casts	negative
Pus	one plus

January 25, 1922: Blood smear for malaria negative.

January 27, 1922: Blood smear for malaria negative.

Wassermann, January 27, 1922: Four plus.

Urine, February 1, 1922: Negative.

X-ray, January 28, 1922: Radiological examination of the chest shows increased density of lower lobes of right lung with an abnormal arching of right diaphragm. The whole suggests resolving pneumonia, lobar.

Diagnosis: Bronchopneumonia.

Treatment: Treatment by diathermy was begun on the fifth day of the disease, the day following the diagnosis. There was an immediate and pronounced drop in temperature which however, resembled several previous falls. The chart suggests malaria, but two successive smears were negative. The patient felt very great relief from the treatment. After the second treatment there was no further rise in temperature. Five treatments of 2,000 ma. were given for twenty minutes each. Patient recovered.

SUMMARY OF CASES TREATED AND CONTROLS

Name	*Age*	*Diagnosis*	*Type*	*Day*	*No.*	*Amount*	*Time*	*Temporary Results*	*Complications*	*Results*
C. M.	24	Broncho.		5	6	2,000	20 Min.	Marked drop in temp.	Wassermann 44	Recovery
N. S.	39	Post flu. broncho.		2	21	1,200	20 Min.	Critically ill 9 days Treat. made her more comfort.	Persistant hic-cough, post-flu	Recovery
C. W.	61	Broncho.	IV	3	3	1,600	20 Min.	Improved	None	Recovery

UNTREATED CONTROLS

H. W.	41	Broncho.	Recovery
H. S.	43	Broncho.	Recovery
J. N.	27	Broncho.	Recovery
F. O.	25	Broncho.	Recovery
E. C.	21	Broncho.	Recovery
L. L.	64	Broncho.	Recovery

CHAPTER VII

CONCLUSIONS

It has been the author's object both in his preliminary paper on this subject and in this book to use every care not to exaggerate the results obtained in treating pneumonia with diathermy. He would prefer that his co-workers find his statements too conservative rather than that the reverse should be true. The opinions expressed in regard to the results of the treatment of the symptoms and general condition of the patient, are as far as possible the combined opinions of the other physicians who have used this treatment as well as the author's own. The effects of the diathermic treatment on different phases of the patients' condition were as follows:

Pulse Rate. In many but not all of the cases there was a slight retardation of the

pulse rate. Wherever the pulse was especially rapid and thready this change was most noticeable. On the other hand in those cases in which the rate was not rapid considering the patient's condition, there was little if any lessening of the rate, in fact it was occasionally increased. Where the pulse rate was irregular or intermittent its improvement in quality was as a rule quite evident. In *Case* 17 (page 144) for instance the average pulse retardation in nine treatments was five per minute and this was fairly representative of the effect of the treatment on the pulse rate in all cases.

Respiration. During and after the treatment there was on the average a slight slowing of the respiratory rate. This change, however, was not wholly constant, and, as has just been mentioned in regard to the pulse, was more in evidence when the respiratory rate was highest. It was in the character of the respirations that the largest amount of change was discernible. In the early stages of the disease or whenever

pleuritic pain induced the typical expiratory grunt, the improvement in its character was remarkable. There was almost no exception to this rule. This result was undoubtedly due either to slightly increased aeration and improved circulation in the affected lung, to the alleviation of the pleuritic pain, or possibly to both these causes. This pronounced symptomatic relief was also in a large measure responsible for the several hours sleep which in most cases immediately followed the treatment. There were only a few cases, most of these in the late stages of the disease and not suffering from pain, that complained of only slight discomfort from the treatment. This was undoubtedly in part due to the fact that these patients did not wish to be disturbed for any reason and they were so few in number that they constituted the exceptions that prove the rule.

Cyanosis. We have in this symptom a guide to the efficiency with which the right ventricle of the heart is sustaining its increased load and also to the decreased

general aeration of the blood. The alleviation of no other symptom was more uniformly successful than in the case of cyanosis. In our first case the disappearance of the cyanosis occurred within about two minutes after the current had reached its maximum and was complete enough to be one of the most interesting effects of this test treatment. In our experience it can be stated that this symptom is always diminished and nearly always eliminated when diathermy is used in proper dosage.

Temperature. Perhaps the most certain and unvarying effect in the treatment of pneumonia by diathermy is the change in the temperature reading. A glance through the chapter summarizing all of our cases will show that only once or twice in this entire series did the temperature drop even faintly resemble the usual fall in the crisis. In only two or three of our patients did the temperature again reach a point as high as it had been before diathermy was applied. Clearer proof of the fact that diathermy

does have a real influence on the disease could not be brought forward than this change in the ordinary temperature chart. In fact in the first few cases we had under treatment, we would not have been certain that we were dealing with lobar pneumonia had not our *x*-rays and laboratory reports confirmed our clinical findings. The phrase "the temperature immediately began to come down by lysis" appears over and over again in our case histories. In many instances this fall in the temperature began on the third or even the second day of the disease, thus making it a still more striking phenomenon. It would almost seem as though the brief but intensive heat localized in the affected area accomplished what the body was trying to do in raising the systemic temperature, thereby making such rise to some extent unnecessary. The drain upon the bodily reserve which such sustained high temperature produces is therefore greatly lessened when diathermy is given early.

More important than all, the distinct shock or critical period through which the patient passes when the usual abrupt fall in temperature occurs is entirely avoided. This appears to us to be a noteworthy point. Such systemic rise of temperature as occurs during the treatment disappears immediately after the current is turned off and has neither a temporary nor a permanent ill effect of any kind upon the progress of the disease.

Extension of the Disease. Involvement of additional lobes by the pneumonic process occurred quite a few times in our series of cases. It cannot be readily determined what this percentage should be. It is probably a fair statement to make that there was no change in the proportion of relapses among the treated cases from that which might be expected among untreated cases. Following additional lobular involvement however, the patient's general condition was improved by the treatment in an exactly similar manner as in the first attack.

In fact, since these relapses often place the patient in a precarious condition, the relief which the treatments afforded often seemed even more striking.

A problem which remains to be worked out is the result obtained after treating the unaffected lobes by diathermy. This was not done in any of our cases. If this was made part of our routine in a sufficiently large group we might then fairly judge as to whether it were possible by means of diathermy to cut down the number of relapses. It is reasonable to suppose that this result might be achieved because in several cases where the physical signs pointed to the beginning of additional involvement this process apparently subsided under treatment.

Blood-pressure. The blood-pressure both systolic and diastolic sustained a slight fall without a single exception after the treatment. Only occasionally when the pressure was rather high was this fall marked and as a rule it did not persist until the next day. Indeed in a number of cases

with low blood-pressure it had risen to above the previous figure before the next treatment. It was at first considered that even a slight lowering of arterial pressure was an untoward symptom in patients with weakness and hypotension. Careful study however, revealed the fact that the benefits derived from the treatment far outweighed this disadvantage and the definite conclusion was reached that diathermy was indicated in all cases regardless of the amount of blood-pressure.

Rate of Resolution. From every point of view it seems logical that the deep-seated heat produced by diathermy should have a clear cut effect in hastening resolution. On the average this has been true with our group. In two or three cases there was a protracted convalescence in spite of continuous treatment. One of these cases was complicated with a beginning of pulmonary tuberculosis. For others we have no explanation. It was not always possible to obtain repeated *x*-rays in our group but in a num-

ber of instances a rather rapid resolution was clearly demonstrated. In one case within two days after the temperature became normal careful physical examination could elicit no sequellae of disease in the lungs. It was unfortunate that an *x*-ray of this chest could not have been taken at that time, as it does seem beyond reason to believe that the lung became clear that quickly. Altogether it seems to be well established that resolution is hastened by means of diathermy.

Complications. Persistent hiccough occurred in two cases in Norwich, Conn. treated by Mr. Houghton under the direction of Drs. Freeman and Brophy. Both cases resisted the ordinary means of control until the physicians in charge considered the condition serious. Because of the well known antispasmodic effect of diathermy on muscle tissue this treatment was applied through the region of the diaphragm and in both instances it proved both favorable and prompt in its results.

In patients in whom a weakened myocardium may make it impossible under ordinary circumstances for the right side of the heart to carry for long its increased load, cardiac diathermy is very useful. Its effect in improving the coronary circulation will help to tone up the heart whenever there is sufficient time within which to accomplish this. In valvular lesions of the heart very little good can be accomplished by means of diathermy.

In renal insufficiency some very interesting work has lately been done which tends to show that direct diathermy applied to the kidneys will, in many instances, greatly improve function and lessen the amount of albumin passed through them. It is the writer's opinion that when acute or chronic nephritis is present in a patient with pneumonia the kidneys should be treated as well as the lungs.

The results of the treatment on the various symptomatic phases of the disease above outlined would seem to be pretty

well established. In the opinion of those of the profession who have applied the treatments these favorable effects are sufficient in themselves to justify the use of diathermy in pneumonia, without regard to the effect on the mortality which is the next subject to be discussed. Certainly it is not too much to assume that the reduction of temperature, the lessening of the load upon the heart, and the diminution of pain, all of which the treatments bring to the patient, may in themselves mark the turning point toward recovery. There are many cases in which for some time it is impossible to state what the outcome will be, so evenly balanced are the attacking and resistive forces. It is in cases of this kind that this treatment would seem to be especially valuable.

EFFECT ON MORTALITY

Our hospital cases, both those treated by diathermy and the controls, were all adults. As has been mentioned these cases extend

over several different epidemics each of which, as is usually the case, had a different average mortality. One of the most vicious epidemics in the history of the hospital occurred in the early winter months of 1923, at which time most of the deaths both in the treated cases and in the controls occurred. It is also important to note that of all the cases admitted to the hospital during this time, a good many more were treated with diathermy than were used as controls. This point is stressed because it has occurred several times that when a new form of treatment has been used in a number of consecutive cases of pneumonia with very good results, a comparison with other cases occurring at the same time in which that treatment was not used would have shown an equally low mortality.

It is believed that we had a rather unusual opportunity for making a fair comparison with controls because each group was made up almost entirely of merchant seamen. Their average age, about thirty-five

years, was the same in the two groups. Another very important factor beside age, namely, previous indulgence in alcohol, was as nearly as we could judge the same in both groups. A large majority of the men both those on whom diathermy was used and the controls were taken ill on shipboard, and in many cases had little or no medicinal care until they were admitted to the hospital. With an average age of thirty-five years and the usual life lead by men of this occupation we would expect a fairly high mortality rate.

The mortality in pneumonia in general is lowest in children and while varying considerably as to type we have a general average of some 20 per cent at twenty years of age. It has been stated on high authority that this rate increases about 10 per cent per decade thereafter, hence at the age of thirty-five we would have an average mortality of about 35 per cent. It is a well-known fact that as a general rule cases of pneumonia admitted to hospitals have a

higher mortality than those treated at home. The more serious the case, the greater is the demand for hospital care and the net result is that in spite of superior advantages and treatment more of the hospital cases die. Considering further the affect of alcohol and of the conditions on shipboard under which a large majority of these men became ill it would seem that a fair figure for the expected mortality would be at least 40 per cent. This is substantiated by the fact that the mortality in our control group of twenty-one cases was 42.9 per cent.

The group of cases arising under the same conditions and treated in exactly the same manner as the controls, except that they were given diathermy, comprised a group of thirty-six cases and sustained a mortality of 19.4 per cent. When to this group is added the other cases treated outside of the hospital we have a total of sixty-seven cases in which diathermy was used. In this total, eight deaths occurred or a mortality

of 11.9 per cent. Several of these cases were in children in whom a lower death rate was to be expected. If these be disregarded in order to obtain a fair comparison with the mortality of the controls who were all adults, the rate would be about 14 per cent. It is difficult to see how this reduction in mortality can be explained upon any other basis than that of the effect of diathermy in this disease. Based upon his experience gained so far the author feels certain that this general average mortality in all cases treated by this technique of about 14 per cent, will, in the future, be still further reduced. The results of our study indicate also the value of the time factor in instituting the treatment, and we have every reason to believe that when diathermy is applied very early in a case of pneumonia there will be a still greater reduction in the mortality.

A detailed comparison of the hospital cases receiving diathermy and the control group according to the type of the disease is of interest:

HOSPITAL CASES TREATED BY DIATHERMY
TOTAL 36

Type	*No.*	*Recovered*	*Died*	*Mortality*
				Per cent
I	4[20]	4	0	0
II	2	2	0	0
III	3	2	1	33
IV	13	10	3	23
Undet.	11	10	1	9
Strep.	3	1	2	66
	36	29	7	19.4

HOSPITAL CONTROLS UNTREATED BY DIATHERMY
TOTAL 21

Type	*No.*	*Recovered*	*Died*	*Mortality*
				Per cent
I	0	0	0	0
II	3	0	3	100
III	0	0	0	0
IV	7	6	1	14.29
Undet.	9	5	4	44.4
Strep.	2	1	1	50
	21	12	9	42.9

[20] Type 1, one of these cases received serum.

The list of cases supplied by Dr. Henry Broeser were treated in several different hospitals in and around Hoboken and a good many of them were house patients. These cases were handled by him and his associates, twelve different practitioners, whose unbiased opinion of the results as they saw them have been of service to us in estimating the value of the treatment. This group comprised thirty-one cases with a mortality of just slightly over 3 per cent. As the detailed case histories show that many of these cases were severe in type this is a very commendable result. Even taking into consideration that seven of the patients were children, the mortality would be but slightly over 4 per cent if the adults alone were considered. As a rule treatment was not instituted in this group before the fourth day. Only three received their first treatment on the third day.

A careful study of the eight cases out of the sixty-seven treated by diathermy which

had a lethal outcome, brings out some very interesting facts.

CASE 2. A. H. had four lobes involved with a streptococcal infection. He received his first treatment on the third day. This case was obviously in a desperate condition upon admission to the hospital. He received two diathermic treatments after each of which he showed pronounced temporary symptomatic improvement. This was so marked that for a time Major Bryan thought that he had a chance to recover. The next day he became steadily worse and finally died. An eighteen-hour blood incubation showed that he had developed a streptococcus veridans septicemia. The autopsy findings showed four lobes completely consolidated. There was also a well-developed empyema with a thick exudative membrane almost completely covering one pleura.

CASE 12. G. L. had four lobes involved. The organism was streptococcus. He was not received for treatment until the seventh day. He received two treatments daily for

four days. After the first four or five treatments there was a transitory favorable effect upon the symptoms. This patient had been affected with bronchial asthma since he was two years of age. This complication not only persisted until his death, but was contributory to it.

CASE 19. In A. H. there was involvement of the entire left lung by pneumococcus—Type IV. Treatment began on the third day. He received three treatments after each of which he felt better. On the fifth day because of low blood-pressure, treatment was ordered discontinued and he died the following day. This is just the type of case in which in the light of our subsequent experience, treatment by diathermy should have been intensified, given perhaps every three hours, as we have since seen many patients in an apparently similar condition come through under such intensification of the treatment.

CASE 23. In G. T. the entire lungs, all five lobes, were involved in the pneumonic process: Pneumococcus type IV. He received

five treatments altogether, with practically no effect upon the symptoms. Autopsy showed in addition to the pulmonary involvement an acute purulent pleurisy on the left side.

CASE 30. J. C. was fifty-five years of age. Two lobes were involved with the organism—Type IV. He was first treated on the fourth day of the disease. There was a slight drop in temperature and a slight temporary symptomatic relief, which quickly disappeared.

CASE 66. L. H. was seventy-two years of age. He had a history of previous pulmonary hemorrhages with nephritis for several years. Respiratory rate 48, delirious and cyanotic when treatment was first started on the seventh day of the disease. He received six treatments which could not be satisfactorily given because of mustard plaster blisters. Autopsy showed diffuse general edema of both lungs in the uninvolved area.

By the summing up of these cases it will be seen that cases 2–12–23–25 and 66

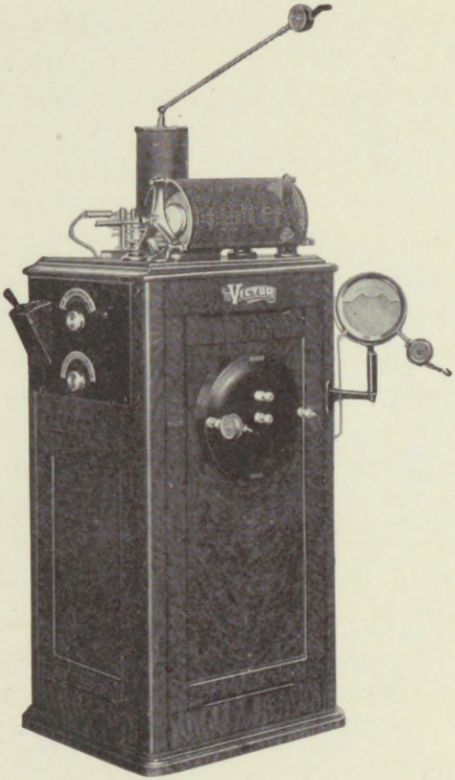


FIG. 44. A type of large office high-frequency apparatus.

offered practically no hope from the first, so that there was lost out of this entire group of sixty-seven, only three cases which had a reasonable chance of recovery. The members of the staff of the Marine Hospital No. 21 who were present at the autopsies were free to state that these men would have died in spite of any possible type of treatment. The most significant fact which this study brings out is that *not a single case* among all of those outlined in this book nor among any others that have come to the author's attention *has died when diathermy was given before the third day.* Again the reader is reminded that this does not necessarily mean that in the future there may not be cases that terminate fatally even though treated thus early, but it should emphasize the value of early and intensive treatment.

CONCLUSIONS

The author has attempted to present a description of the immediate symptomatic

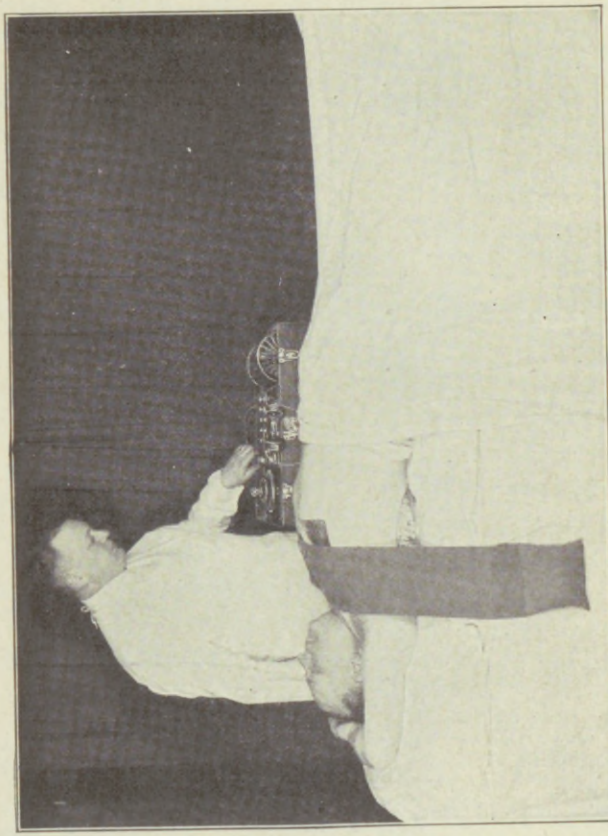


FIG. 45. Illustrating technique of treating lobar pneumonia with portable apparatus.

improvement in the patient's condition which occurred not only in nearly every case but in almost every treatment in the entire series amounting to about nine hundred altogether. These symptomatic changes were a lessening of the cyanosis and the respiratory pain with a slight lowering of pulse and respiratory rate. A reduction in the temperature comes by lysis, entirely eliminating that critical period which follows its abrupt fall. General relief was experienced by the patients for a duration of several hours during which sleep was usually obtained. Dr. Bryan stated that in his opinion this relief was greater than that which he was able to achieve by the administration of opiates. Such symptomatic relief is surely in itself a result sufficient to justify the use of diathermy in this disease.

It is well in conclusion to emphasize again the absolute harmlessness of diathermy when properly applied to pneumonia patients. To one of our patients who was at the point of death with a double lung

involvement we gave to one lung a diathermy treatment of considerably higher milliamperage than the average used. He reached the autopsy table in less than an hour after this treatment was stopped. A careful examination at that time showed not the slightest trace of any injury from the treatment. No certain or even probable contraindications to the use of diathermy in pneumonia have as yet come to light. In view of this fact and of almost certain symptomatic relief which its employment brings to the patient are we not justified in extending its use?

The fact that our case reports are few in number makes it necessary that we guard carefully the conclusions we draw from our mortality figures. Disregarding all of the very favorable reports from cases treated outside of the hospital we have yet a reduction in the death rate of 55 per cent in favor of the group who received diathermy over that of the controls. Surely this figure is not without significance.

INDEX

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PHYSICAL RECONSTRUCTION AND ORTHOPEDICS

BY

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