HIGH FREQUENCY PRACTICE

FOR PRACTITIONERS AND STUDENTS

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ILLUSTRATED WITH NINETY-FIVE ENGRAVINGS.

SECOND EDITION

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DEDICATED

To my preceptor and lifelong friend,
FRANK E. BLISS, M.D.

FOREWORD.

WITH increasing knowledge of the laws governing physiological function of many organs of the human body, physicians are placing more confidence in the methods which conserve these functions.

The empiric polypharmacy of the last century is now being replaced by safe and sound methods in the use of certain drugs which have been found to be efficient in meeting definite indications. The therapy of today is based on more accurate diagnosis and greater conceptions of the condition of the human organism, its physiology and etiologic pathology, and calls for the recognition of other important forms of therapy. It is the supreme duty of the physician to employ the best agents at hand to meet the existing condition, whether they be drugs, surgery, diet, climate, serums, vaccines, light, heat, electricity, radium, roentgen rays or other physical measures.

The indiscriminate use of drugs, overzealous surgery and discredit of physical therapy have been fruitful in bringing criticism upon the profession.

While electricity as an agent in the treatment of disease, not unlike drugs, has been and is employed by unskilled hands and outrageous claims made for its efficacy in this or that condition, it has come into our professional life as one of the many important modalities of our armamentarium, and he who ignores or berates its possibilities in many perverted conditions of the organism, is, to say the least, derelict in the duty he owes to himself as a physician and to those who are submitted to his charge and keeping.

The employment of drugs should be based upon their physiological indications and no less should be every application of electricity. Nothing could be more destructive to rational therapeutics than the carrying away of the physician by very interesting results secured by high-frequency currents. Electrical modalities assist in rounding out the physician's armamentarium, but let us not thru enthusiasm possess ourselves with the idea that the entire field of medicine revolves about the art of physiotherapy.

In the application of high-frequency currents to diseased or perverted conditions of the human organism mentioned in these pages, it has been the endeavor of the writer to give a physiological reason for their use. In a few instances their use has been recommended when, without known pathology, they have been proven beneficial.

It is well known that impressions are more easily fixed in the mind if made thru several senses and to that end many details of technic are visualized by means of diagrams, cuts and halftone illustrations.

The methods of treatment given in this volume. while in the main are founded on personal experience of the writer, reference has been made to all available literature upon the subject.

No bibliography is appended because it is impossible to state the source from which emanated many of the facts herein enumerated. I am especially indebted to the members of the American and Western Electro-therapeutic Associations, whose writings have been consulted and many paragraphs directly quoted.

It is hoped that the information contained in this volume will prove an incentive to the use of less empirical and more scientific methods in the application of high-frequency currents.

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PREFACE TO SECOND EDITION

THAT there is an increasing interest in high frequency therapy being taken by the profession is proven by the exhaustion in a few months of the first edition of this work.

New methods in technic are rapidly being developed through the experience of different operators. The methods of treatment outlined in these pages are employed by the writer. This does not mean that others may not obtain as good if not better results from some other method.

The changes made from the first edition of the work are few with the exception of Chapter V, which has been entirely rewritten and many points in blood pressure interpretation added. The treatment of cardiovascular diseases has been extended.

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WHAT IS ELECTRICITY?

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WHAT IS ELECTRICITY?

Atoms and Electrons.—Centuries ago it was discovered that the world and the matter of which it consists were in motion, and until quite recently were we content to believe an atom to be the smallest hypothetical subdivision of matter. Now, however, the existence of the atom no longer rests upon a hypothesis. According to Hull, "The atom is a real object of definite shape and size. We know what it is made of. We know its weight in grams. We know its exact speed when it flies about a gas, and, lastly, we know its exact position when it forms a part of a solid body."

The roentgen ray and the ultra-microscope, together with other modern scientific instruments, are means by which man is enabled to penetrate the mysterious composition of the atom and obtain a view of what may be life itself.

Scientists of today tell us that the atom is composed of minute particles of matter called electrons and that an electron consists of an electrical charge.

There are two kinds of electrons, positive and negative. The nucleus of the atom is composed of positive electrons and approximates one-half its atomic weight and about 1/100,000 part of the atom in size. The balance of the atom is made up of space and negative electrons which revolve about the nucleus in regular orbits not unlike the planets of the celestial system in their revolution about the sun—the nucleus representing the sun and the negative electrons the planets.

The electrons of the atoms of any substance are sufficiently far apart to enable the electrons of other substances to pass thru the atom without coming in contact with the electrons of the atom through which they pass.

An atom of hydrogen, the lightest of all gasses, contains 1000 electrons. The number of electrons constituting an atom of any substance is in direct proportion to the atomic weight of the substance. An atom of radium, with an atomic weight of 226, contains, therefore, 226,000 electrons.

Some idea of the size of an electron may be had by the fact that one gram of radium ejects thirty-seven billion atoms of helium per second, which, even at this rate of decay, requires over 3000 years to become entirely consumed.

According to C. G. Darwin, if we imagine an atom magnified 10 million times a million diameters the nucleus will appear to have a diameter of about 1½ inches; the innermost electrons will appear to be following an orbit about ten feet from the nucleus while the outermost ones will appear to be one-half to two-thirds of a mile distant.

The physical features of electrons are their small volume and extreme speed. It requires a great disturbing power to break up atoms of most substances and to start the electrons, but when once detached little force is required to keep them moving. Moving electrons produce visible as well as invisible rays. If a target of high atomic weight be placed in a vacuum of high degree and in the path of moving electrons, the electrons are deflected and x-rays are manifest. The production of x-rays depends upon the separation of electrons from the atom, giving them high rate of speed, concentrating them on a small area and stopping them suddenly. Alpha and beta particles may be deflected by a magnet, but gamma particles move in a straight line and are only deflected by contact with a positive nucleus of high atomic weight. At the point of deflection or stoppage of electrons great heat is produced, sufficient to melt ordinary metal. This is the reason for choosing for x-ray targets metals of high melting points such as tungsten and platinum. However, any known substance may be melted by proper concentration of electrons. The atoms of every substance, regardless of their position or characteristics, are made up of electrons. The number and movement of electrons in relation one to another within the atom characterize the substance. An atom of gold differs from an atom of iron only in the number and the manner in which the electrons are grouped. An atom of mercury contains but few more electrons than an atom of gold. If it were practical to remove these few excess electrons from the mercury atom, gold might be produced and the dream of the alchemists come true.

It is possible to count electrons as they emanate from radium as helium. It is possible and more or less probable that helium was the first existing element from which all matter was transmuted, and as all matter is more or less radio-active or constantly returning to helium, we may dare presume that from helium we came and unto helium may return.

Electricity has been defined in many ways, the one most common being that it is a force of nature develoded or generated by chemism, magnetism or friction, but today the theory accepted by most physicists is that electricity is a SUBSTANCE composed of moving electrons and made manifest to us by its magnetic, thermal and chemical effects.

It is not known whether the electric current coming from a primary cell is due to chemical action on the elements of the cell or whether the flow of electrons causes the chemical changes in the electrolyte. It is the belief of the writer that the flow of electrons causes the chemical changes in the electrolyte of the primary cell.

Radioactivity.—Radioactivity is the property possessed by a substance of emitting rays capable of penetrating opaque substances. When an atom explodes it emits alpha particles and becomes another element.

An enormous amount of energy must have been expended in the formation of radium, as it gives off an enormous amount of energy in its disintregation. It is said that during the disintegration of one gram of radium there is as much heat given off as in the burning of 1000 pounds of coal.

The first radioactive substance was discovered in 1896 by Henry Becquerel. From that day to this thirty-three more radioactive elements have been discovered. There is probably no substance but what is more or less radioactive during its disintegration. Each radioactive element has a definite rate of transmutation, therefore a definite period of existence.

The earth and all matter therein are continuously being bombarded by the electrons from the sun. There is nothing but what undergoes disintegration and consequent transmutation into atoms of matter entirely foreign to those now existing. The marble walls of our public buildings will crumble into atoms of dust, and the electrons of the dust atoms will be set free to join the innumerable caravan whose journey ends in new matter.

For convenience man has divided all material substances into two groups, the animate and inanimate. In our minds the animate is associated with motion, growth and function of reproduction and the inanimate with material not possessed by these attributes. This division of matter may be entirely wrong and the so-called scientific facts of today be discarded theories of tomorrow. Those who believe that the electron is the base of all fundamental matter cannot be blamed for believing that the electron is life itself. It has been proven to be always in motion; it may be capable of growth and reproduction and thus fulfill the requirements of life as we understand it. To say the least, it is the prime cause of all life and energy. In accordance with our present understanding of the function of electrons the existence of inanimate matter is impossible. The electron or the possible spark of life exists in all matter.

Energy.—In the movement of electrons energy is displayed. Everything in existence is composed of electrons, therefore possesses potential energy, and the extent of that energy is measured by its capacity to do work or transfer its power from one form to another. It is impossible for man to *create* energy, but he has discovered methods of transferring it from one form to another. All energy tends to return to its original form. Heat transfers water into steam, the expansion of steam produces power, while it in turn passes back into heat; and in all the transfers of which human ingenuity is capable not one electron is lost.

In transferring mechanical energy into electrical energy a dynamo is employed. A dynamo creates no electricity; it simply separates the electrons of the atom by agitation and pushes them apart, when they fly to the point of greatest attraction through the route of least resistance.

The water of Lake Erie possesses potential energy, and when it falls over Niagara its potential energy is transferred into mechanical energy, and this energy is again transferred by the turbine wheel to the dynamo which transfers it into electrical energy. The electrons composing the mists of Niagara possess the same potential energy as those which pass the turbine wheel.

The electrons set free by the dynamos of Niagara flow through the copper wires as does water through a pipe to the many points of distribution where they are again transferred into light, heat and power from which they escape to form atoms of new matter. All forms of energy can be traced back to an electrical source. Light, heat and power are all one and the same.

Human Mechanism.—From an electro-physiological standpoint the human body is the most delicate, intricate and wonderful apparatus of which we have conception. Within its structure are contained electric generators, converters, vibrators, rheostats, condensers, resonators, inductances, transformers, conductors, insulators, collecting and dispersing electrodes. It develops electro-motor-force producing volts, amperes, coulombs and watts. The skin presents a resistance of thousands of ohms. The body is full of primary cells connected in series and in multiple and develops continuous alternating, sinusoidal, static, inductive and oscillatory currents. Its electrolytes contain anions and cathions. Its diathermic apparatus converts mechanical energy into heat. The body as a whole exhibits a polarity which is usually positive but may be changed to negative by surrounding objects, etc. It receives electrical charges and disperses them.

It has electric circuits open and closed. It not only possesses every device known to electrical science but many details of construction and activity which we do not understand.

Body Currents.—Man's body currents are direct and continuous only to a degree. It is likely that a large proportion of them are inductive. Counting the distance from origin to destination the rate of flow is about 120 feet per second. The reduction of rate of flow from that of the ordinary electric current is due to the many condensers and rheostats existing in the body. While body currents may flow through almost any tissue of the body it is well known that the nerves are the all-important conductors. In tracing any nerve from its origin to its termination many obstacles, such as synapses, ganglions and pathological switches, are interposed and delay the current flow.

The human body may lose its electrical charge by being grounded, but it will reestablish its charge in a very short time, thus demonstrating the presence of electrical generators. A portion of the body may lose its charge while the remainder retains it, showing that the body contains many generators.

Whether the chemical changes going on within the body induce electric currents or the ever-present electrons produce the chemical changes is not a settled matter with physiologists, but the electrical theory is fast becoming the accepted one.

When a normal tissue takes on pathological change it becomes an insulator of body currents. The body currents being the main factor in nutrition it is logical that tissues deprived of these currents will take on degeneration.

The voltage of body currents is very low, something like 5 millivolts. It would seem that if we were able to detect the obstruction to body currents in time and the deficiency be supplied from an outside force pathological changes might be averted.

It has been demonstrated that in fatigue of animal or vegetable tissues the polarity of the currents was reversed. Even metalic substances are subject to reversal of polarity and consequent fatigue. Normal nerve will react to the cathodal closing of a direct current, but when the motor nerve supply is cut off by injury or pathological changes the polarity is changed and the nerve reacts only to anodal closing.

Stimulation of all tissues from any source—vibration, light, heat or electricity—increases body currents. It is impossible to stimulate any tissue of the body without inducing currents in those tissues, and these induced currents have their physiological and pathological effects.

A high-frequency current induces hyperemia without evident electrolytic action, and at the same time changes take place which increase nutrition. Whether these marvelous transformations are due to electrical, mechanical or chemical effects is not entirely clear, but it is the consensus of opinion of the leading physiologists of today that they are electrical.

Primary Cell.—Any two dissimilar metals when placed in contact with each other cause a flow of electrons from the metal of higher to that of lower potential If the two metals be separated and then connected by a conducting medium there will be a flow of electrons through it. If the medium contains salts in solution a separation of the basic radical from the acid radical will take place. A primary cell consisting of copper and zinc elements in an electrolyte of a solution of hydrochloric acid and water will illustrate the changes which take place due to the movement of electrons through the solution. The negatively charged chlorine seeks the positive pole, and the positively charged hydrogen seeks the negative pole. Faraday named these charged particles ions. Those carrying a positive charge which they give up at the negative pole or cathode are called cations and those with a negative charge anions, in accordance with the direction in which they move. During the passage of the current of electricity the solution or electrolyte is decomposed and the resulting ions take their places at the poles in accordance with their charge. It is quite probable that the chlorin of the hydrogen chloride is displaced by a positive electron converting it into an atom of hydrogen.

We have been taught that the electrical current is the result of the chemical action of the electrolyte upon the elements of the cell, but it is far more intelligible to assume that the electric current passing from one element to the other causes the chemical change in the electrolyte.

The primary cell in electrical phenomena is analogous to the animal cell. Baines and Robertson, who have spent years in electro-physiological research, have arrived at the conclusion that the electrical phenomena dominate the entire process of reproduction: "During the stage of functional activity, and before reproductive demands bring this to a halt, we find that the nucleus is still the center of life of the cytoplasm, and that any portion of that cytoplasm which becomes separated from the body of the cell, dies, even though it be surrounded by a richly chemical medium from which the remaining protoplasm of the cell body continues to derive its life. The hyaloplasm apparently, therefore, performs two distinct functions. It forms a compound barrier through which pass into the cell only those elements from the lymph which are essential to its working life and specific to its functional activities. But by virtue of its lipoid elements it maintains a constant equilibrium between the electrical potential within the cell and that of the neighboring cells and of the lymph, highly charged as it is with electrolytes, by which it is environed. So long as massive toxic influences are not brought within its area this electrical equilibrium is maintained, but this protection from toxic agents can be overcome; the hyaloplasm fails in this function of barrier, and electrical and chemical diffusion result and the cell is doomed."

After years of research in Electro-physiology Baines has arrived at the following conclusions:

(1) Everything living, whether animal or vegetable, has a well-defined electrical system.

(2) Broadly speaking, the edible part of a fruit or vegetable is the positive element, or that part which yields a positive galvanometric reaction.

(3) Dry earth is a bad conductor of electricity, and therefore water is required as an electrolyte as well as being necessary in the formation of protoplasm, etc.

(4) Every tree, shrub, plant, fruit, vegetable, tuber and seed is an electrical cell, differing from cells made by human agency in that it cannot be polarized or discharged so long as it remains structurally perfect.

(5) The skin, peel, rind or jacket of fruits and vegetables is of the nature of an insulating substance primarily designed for the conservation of their electrical energy.

(6) The electro-motive force of them all is the same, the current varying in accordance with Ohm's law.

(7) Plants grown in pots or removed from the earth and placed in other receptacles differ materially in their electrical constitution from those grown in the earth.

(8) If a suitable electrolyte, other than water, is mixed with the soil it is possible to grow plants with much less moisture.

(9) Growth may be stimulated by means of a continuous current of electricity of low potential and proper sign.

LIGHT.

Light is usually defined as the propagation of vibrations or undulations in ether. Newton believed that light consisted of particles of material or corpuscles sent off in all directions from luminous bodies. His theory which held for over a hundred years was displaced about one hundred years ago by the wave theory. The theory of today held by many physicists is that light is due to the frequency and undulatory movement of electrons. Thus we are gradually returning to the Newtonian theory.

We know that particles are deflected from the anode of the x-ray tube and that their penetrating qualities are due to their extreme speed. This characteristic "time-speed" is called by Einstein the "fourth dimension." It is reasonable to assume that the sun's rays are composed of an actual substance. The extreme speed of 186,000 miles per second gives to light its penetrating character. The electrons of sunlight possess weight and exert a certain amount of pressure upon the earth. Particles of light coming from less powerful bodies than the sun are deflected by the powerful pressure of the electrons composing the sun's rays.

The source of light has been one of the mysteries of science for ages. The discoveries of Maxwell and Hertz, that light is simply electrical vibration caused scientists to look for the electric charges which caused the vibration. Bohr says: "Light is given off when the electron is suddenly changed from its normal motion, by jumping from one atom to another or from one orbit to another about the same atom."

The human eye is capable of response only to certain limitations of light frequencies (or wave lengths), generally supposed to be from 400 to 700 billion per second. Lower frequencies which lie beyond the visible spectrum are known as infra-red. The lowest known at the present time are called Hertzian waves. At the opposite end of the visible spectrum the frequencies are too rapid and short for the human retina to respond. These frequencies are known as ultra-violet; the next higher are known as x-rays, while the highest are gamma rays of radium. While all frequencies are more or less chemical in effects, the most energetic are found at the highest frequency end of the spectrum. The visible part of the spectrum according to Langley is only 19 per cent of the total spectrum energy. When we consider that 81 per cent of the sun's rays are invisible we must realize how little we know concerning the total energy of the sun spectrum.

Physiology.—Light energy causes contraction of protoplasm and increases the oxygenating power of the blood. The high-frequencies of ultra-violet of sunlight are absorbed by the oxygen and nitrogen as well as the particles of material in the air. Sunlight in the pure air of the mountain regions is rich in actinic rays, which accounts for its health-giving properties. The smoke and dust which hover over cities practically shut out all ultra-violet rays. Window glass will filter out ultraviolet rays, which to a certain extent accounts for the poor health of those whose lives are spent in closed rooms.

Robertson says: "Every cell in the plant, every cell in the animal body requires light, and it requires light frequencies of very definite wave length which will determine the resonance of its own molecules and thereafter activate them in accordance with that specific resonance. That is why the plant and the animal tissues alike are provided with so marvelous a complex of light screens, pigments and dyes."

The activity of all living matter, animal or vegetable, depends upon the frequency of light electrons in determining the chemical changes necessary to its existence. As chemical changes are due to electrical activity it can be understood that without electricity there is no life.

Every cell being made up of electrons must, therefore, consist of positive and negative charges. When the cell is in a normal state a perfect electrical equilibrium is maintained. In other words, the potential is such that the electrical phenonenon we call life is maintained. Whenever the dialectric of the cell is ruptured the integrity of the cellular substance is destroyed, the process of decomposition sets in. Physiologists no longer look upon a living cell as a mass of protoplasm endowed with a particular function due to chemical activity. The modern view of the living cell is that it contains a highly organized and complex system not unlike that of the atom, and is governed by the same law which controls the universe. Physiologists are fast becoming converted to the theory of the body being electrically controlled and electrically driven.

This is the truth of today. Who dares to prophesy what the future will bring forth?

CHAPTER II.

High-Frequency Currents

CHAPTER II.

HIGH-FREQUENCY CURRENTS.

Definition. Source. Change of frequency. How produced. Condensers. Oudin coil. Oscillating current. Types of machines. Meters. Spark gaps. Classified physiology. Electrodes. Vacuum electrodes. Non-vacuum electrodes. Precautions. Preparation of the patient. General technic. Auto-condensation. Auto-conduction. Local auto-condensation. Effects of auto-condensation. Contraindications and precautions. Care of apparatus.

DEFINITION.

A high-frequency current is one characterized by the high number of cycles completed in one second of time. It is a modified alternating and oscillating current. The ordinary alternating current which completely reverses itself 120 times per second is known as a 60-cycle current. It requires one positive and one negative alternation to complete one cycle. The 60 cycle alternating current is the one usually chosen for street lighting. However, some city lighting plants employ 125 and 133 cycle currents and a few still use the 25 cycle current. Physicians who live in places where these currents only are available are seriously handicapped as modern electrotherapeutical apparatus are designed for the 60 cycle current, and any change of frequency from the 60 cycle current supply necessitates changes in the machine which it operates.

Nikola Tesla in 1891, was the first to suggest the use of high-frequency currents in medicine.

D'Arsonval found that a current alternating less than 15 times per second produced clonic muscular contractions; a frequency of 20 to 30 per second produced tonic spasm; increasing the frequency beyond 30 per

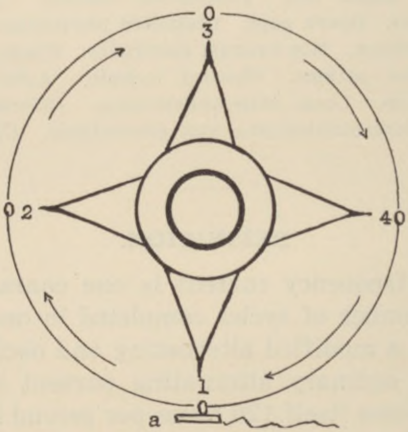


Fig. 1.—Rotor.

second increases the intensity of the spasm; the maximum intensity is reached at about 300 alternations per second; beyond 300 alternations per second the intensity gradually becomes less until a frequency of about 10,000 per second is reached when all muscular contractions cease.

Source.—The alternating current is the usual source from which a high-frequency current is obtained. When only D. C. current is available, a motor generator for changing it to A. C. is necessary.

An alternating current leaving the terminals (a) of a generator having four poles (1, 2, 3, 4) with the rotor driven at 1800 R. P. M., is called a 60 cycle current because the alternator delivers a current with 60 complete cycles or revolutions and 120 alternations per second.

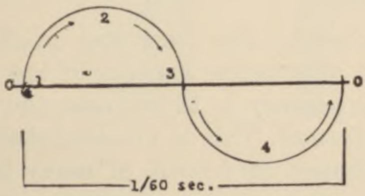


Fig. 2.—One Cycle, Two Alternations.

In the above diagrams it is assumed that the current starts from the collector ring (1) of the rotor. Following the direction of the arrow, the current ascends in voltage until it reaches its peak at 2. The voltage then descends to zero at 3 as the current returns to another collector ring. At this point (3) the rotor of the machine passes to the next set of poles and the current reverses and starts anew reaching its peak at 4 when it again ascends to zero.

The rotor revolves 60 times in one second. The current completes one cycle and two alternations in 1/60 second; one-half of each cycle is positive and one-half negative in direction.

Change of Frequency.—It can be readily understood that a change of frequency may obtain from change in number of poles or speed of the rotor. If the number of poles be doubled the frequency is doubled; the frequency is also increased in direct proportion to the increased number of revolutions of the rotor.

The frequency coming from an alternator may be ascertained by multiplying the number of revolutions per minute by the number of poles and dividing the product by 120.

How Produced.—The first step in changing a 60 cycle, 110 volt alternating current of low frequency to one of high frequency is to increase the voltage by a step-up transformer. This is accomplished by taking a rectangular shaped core made of many layers of thin sheets of iron, upon one arm of which are wound a few turns of heavy copper wire or ribbon and upon the opposite arm are wound many hundred turns of small insulated wire.

Fig. 3 illustrates what is known as a closed core transformer. This type of transformer is more efficient than the open core type because a path of metal is provided for the passage of lines of force in the place of a dialectric of air. This arrangement brings the two coils close together but not touching and reduces the magnetic leakage to a minimum. A current of electricity passing through the first coil, called the primary, causes a current to be set up at once in the secondary coil. This property of the alternating current is called induction, and the current produced in the secondary coil is said to be induced. The voltage of the induced current in the second coil is in direct proportion to the ratio between the number of turns of wire in the first and second coils. If the first coil contains ten turns and the second 100 turns the voltage induced in the second coil will be ten times that of the first. In

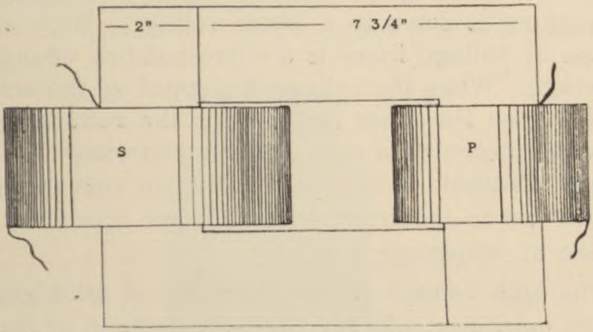


Fig. 3.—One-half Kilowatt High-Frequency Transformer.

P. Primary. S. Secondary. Core 9¾x6¾ inches.

For a 110-volt, 60 cycle supply current the primary coil consists of 237 turns of No. 14 wire and the secondary of 16,480 turns of No. 32 enameled wire. For a 25-cycle current the primary consists of 462 turns of No. 14 wire and the secondary of 32,000 turns of No. 32 enameled wire.

For a 125-cycle current the primary consists or 125 turns and the secondary of 8,240 turns.

such a transformer with a current supply of 110 volts in the primary there will be 1100 volts induced in the secondary. If the primary consists of 100 turns and the secondary 4000 turns of wire and the voltage impressed on the primary be 110, the voltage of the secondary will be forty times that of the primary or 4400 volts.

The production of high-frequency currents of almost any desired potential may be had by the combination of two coils of proper proportions and number of turns of wire with a transformer, condenser, and spark gap. The principles of transformation may be used for stepping up a current to higher voltage as well as stepping it down to a lower voltage. With every change of voltage there is a corresponding change in amperage. When the voltage is stepped up the amperage falls; on the other hand, when the voltage is reduced by means of a step down transformer the amperage is raised. An understanding of this principle enables one to construct a transformer of almost any voltage or amperage.

The high voltage of the secondary of all high-frequency machines calls for the best methods of insulation. The current from the secondary of a high voltage transformer is dangerous to handle consequently something must be done to safeguard the patient. Before this high voltage current can be utilized in therapy it must be converted into a current of very high frequency. The frequency of a 60 cycle current must be raised to a frequency of 10,000 or more per second to be safe to handle. The frequency of the alternations in ordinary machines is not 10,000 but several millions per second.

The next step in the process of producing a high-frequency current is to pass the current from the secondary of the transformer to a device called a condenser.

CONDENSERS.

A condenser may consist of Leyden jars or plates. A plate condenser consists of a number of sheets of tin foil separated by plates of mica or glass. The sheets of tin foil of each alternate layer on either side are connected together and to which the wires of the transformer are attached. The condenser acts as a reservoir

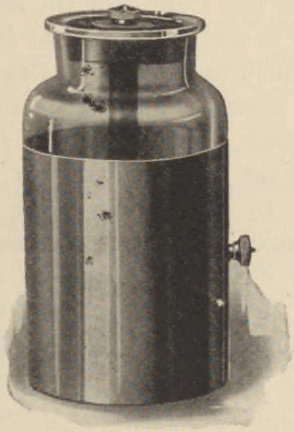


Fig. 4.—Leyden Jar Condenser.

for the current which stores up as a charge on the plates until the tension becomes so great that the current discharges across the spark gap. The discharge across the gap has a to and fro movement of many thousand little charges. During the time of discharge across the gap the condenser is collecting a new supply from the transformer ready to renew the discharge which has taken place across the gap. All of this takes place in something like one ten thousandth part of a second. The alternating charge and discharge of the current from the condenser give it an oscillating character so necessary in high-frequency work.

Theoretically the oscillations from a Leyden jar and plate condenser of like capacity are the same, but the experience of the writer leads him to favor the Leyden jar. It is not clear how the oscillations differ in character but it seems that those from the Leyden jar are more uniform and have less faradic effect. The oscillations across the gap produces a current of very high frequency. The current is further modified by passing through the primary of another transformer which by the way has no core; it consists of a simple coil of wire or solenoid. This coil is known as the d'Arsonval solenoid and acts as the primary of the second transformer within which is placed a secondary of a suitable number of turns of wire to obtain a high-frequency current of any desired potential. The current flows through the primary of the second transformer or d'Arsonval solenoid back to the condenser thus completing the circuit. There is no electrical connection between the primary and secondary of the transformer, the secondary receiving its charge from the primary by induction. The primary of this transformer having no core makes the current easy to handle as there is no possibility of the patient receiving a shock of low frequency from the terminals of the transformer.

OUDIN COIL.

Oudin attached to the d'Arsonval solenoid another coil of wire which he named Resonator. This coil is in reality an auto-transformer. The Oudin coil gives an enormous brush discharge from a single terminal and is used in unipolar application thru vacuum and non-vacuum electrodes. This current is usually employed in light desiccation work. The ordinary application of this current thru vacuum electrodes causes but a sensation of slight warmth unless the electrode is lifted from the skin in which case the resultant spark is quite painful. It is important that the electrode be not applied or taken from the patient without first having the current shut off or diverted thru the operator by placing his hand on the electrode.

The effect of vacuum tube application is to increase arterial tension and when applied to the thoracic spine will increase blood-pressure while in auto-condensation application with the d'Arsonval current will reduce blood-pressure. A point well worth remembering is, never to apply the vacuum tube treatment to cases of arteriosclerosis or any other condition accompanied by hypertension.

OSCILLATING CURRENTS.

An oscillating current while alternating in character differs from the ordinary alternating current in the wave length of the alternations. The modification is brought about by the introduction of condensers into the circuit.

A high-frequency current possesses qualities unknown to other currents. It does not require a conducting wire to make a circuit. The resistance offered by a conductor of high-frequency currents is directly opposite that of other electric currents. The greater the diameter of the conductor, the greater the resistence to the flow of high-frequency currents.

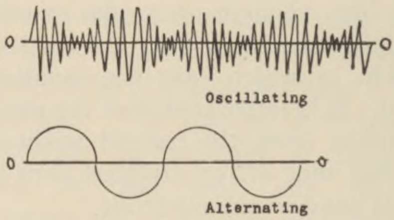


Fig. 5.—The Difference Between an Oscillating and Alternating Current.

TYPES OF MACHINES.

The original d'Arsonval received its current supply from direct current mains. This required the introduction of an interrupter in the circuit. The machine of today equipped with a d'Arsonval transformer delivers a modified form of the d'Arsonval current. Practically all high-frequency machines are equipped to deliver the modified d'Arsonval, Tesla and Oudin currents. The d'Arsonval current is of medium voltage and high amperage. The Tesla current is of extremely high voltage and medium amperage. The Oudin current is one of high voltage and low amperage.

METERS

High-frequency currents cannot be measured by the ordinary electric meter. In order to approximate the amount of current passing from a high-frequency apparatus, a thermostat is used and is known as a hot wire meter. It simply measures the amount of heat instead of the electromotive force, coming from the apparatus while an electric meter measures the current strength or amperage of the current.

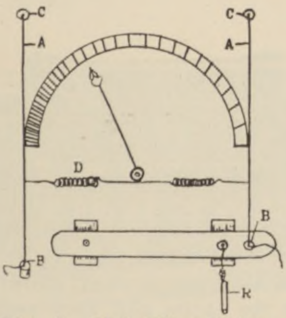


Fig. 6.—Hot Wire Meter.

The construction of a hot wire meter is shown in Fig. 6. A is a wire stretched between B and C; A and A are connected by a wire spring. When the wires A expand the pull of A on the spring D deflects the needle. R. Adjuster.

SPARK GAPS.

In order to facilitate the charge and discharge of the condenser of a high-frequency apparatus, a gap or dialectric of air is introduced between the secondary of the step-up transformer and the d'Arsonval solenoid, this gap being known as a spark gap. A spark gap not only acts as resistance, but multiplies the oscillations of the current. There are many forms of spark gaps, single and multiple-point, multiple ball, rotary and multiple section. The single point, multiple ball and rotary gaps make considerable noise in operation and require

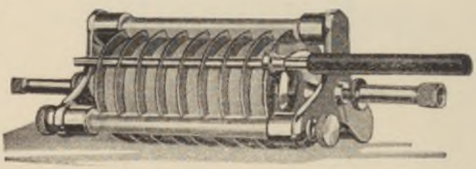


Fig. 7.—Multiple Section Spark Gap. This is a modification of the DeKraft Gap. It is arranged to be connected to an air pump or tank, allowing free passage of air through the entire gap, thus preventing it from overheating.

frequent cleaning and periods of rest to cool. The heavy tungsten point spark gap is of excellent construction and noiseless in operation. It is arranged to be connected to an air pump or tank allowing free passage of air thru the entire gap, thus preventing it from over heating. It is also provided with a series of copper discs to dissipate the heat generated by the spark. This style of spark gap will operate for hours without periods of rest to cool.

Another style of gap is very efficient in high-frequency work; it is known as the Quenched Gap; it is constructed of metal, massive in form and consists of large radiation surface. The large surface tends to dissipate the heat. This style of spark gap has the advantage of multiplying the discharges, that is to say, the condenser becomes charged and discharged many more times per second. It also increases the fatness of the spark. While this gap has its advantages in auto-condensation work, it has the disadvantage of being noisy.

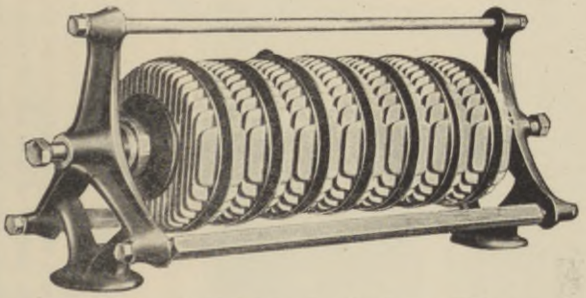
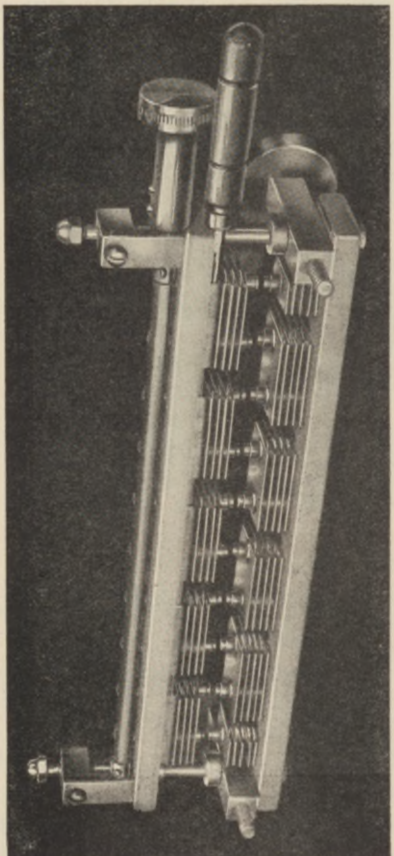


Fig. 8.—Victor Multiple Spark Gap. This type of Spark Gap is somewhat different from the prevailing type. It is self-cooling and designed for hard service.

PHYSIOLOGY OF HIGH-FREQUENCY CURRENTS

General.—The physiological action of high-frequency currents varies with the type of apparatus as well as the method of application. Increased metabolism is one effect common to all methods of application. Applications which induce currents in the human body have a general sedative effect upon the vasomotor mechanism and reduce blood-pressure.



(The open Spark-Gap with slab removed for cleaning tungsten points)

Fig. 8A.—Multiple Spark Gap. The gap shown in the illustration is of the open type being ventilated and cooled by air currents circulating thru it. It is easily cleaned. This gap is provided with two controls—a slide-rod to regulate the number of gaps and a rotary control to adjust the distance between the tungsten points. The two controls admit of fine adjustment. This gap is used on all High-frequency machines made by The High Tension Transformer & Equipment Company, Hoboken, New Jersey.

Sparks from a vacuum tube have a local stimulating effect, and when applied to the spine have a tendency to raise blood-pressure, especially in cases of hypotension.

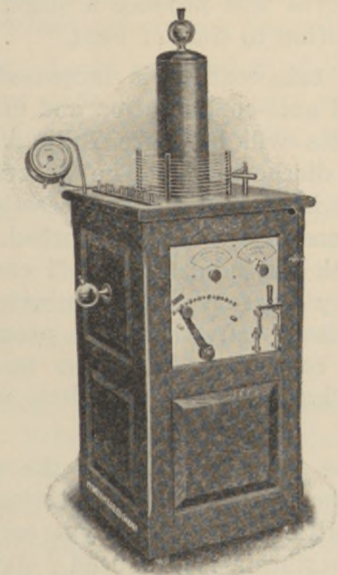


Fig. 9.—The Hogan High-Frequency Apparatus.

This apparatus has a number of distinctive features. The spark gap consists of six metal discs operating in open air inside of the cabinet, having no insulating discs, therefore, no insulation to puncture. A number of holes drilled in bottom and top of cabinet provide ventilation, keeping the spark gap cool. The Condenser is oil-immersed, sealed in a metal tank, increasing its di-electric strength.

If a metallic or vacuum electrode be placed in good contact with the skin or mucous membrane, a current up to 200 milliamperes will produce no sensation other than that of heat, but a current of over 250 milliamperes will produce a slight sparking sensation in addition to that of heat.

The body temperature is increased by a general application of auto-condensation and diathermy. (The thermal effects will be more fully discussed in the chapter on diathermy.) The increased oxidation causes a loss in weight in the obese. Inflammatory infiltrations and exudates are absorbed. The roentgen ray will break up indurations and exudates and the high-frequency current will eliminate the product. Infiltrated tissue anywhere is promptly drained. Considerable constitutional effects may be produced by local application with very little visible local effects.

Skin.—The first effect upon the skin is one of vasoconstriction followed by dilatation of the capillaries with little consequent hyperemia. A limited superficial anesthesia is produced. Activity of sweat glands is visibly increased. Repeated applications will tan the skin. Heavy sparks are highly counterirritant, the effect varying in intensity from a blister to necrosis. If the current be condensed upon a needle point the effect will be one of dehydration. In prolonged application of heavy sparks the small arterioles are plugged with gas products thus destroying the hair follicles with consequent falling of hair. Skin bacteria are destroyed. The effects of the application of a vacuum electrode thru very thin clothing are practically the same as when applied to the skin. The effects thru heavy clothing are revulsive and irritating and should not be employed except when intense counterirritant effects are desired.

Tissue Cells.—Local application of high-frequency currents produce an increased activity of cellular protoplasm and increases the resisting power toward pathological processes.

Blood.—High-frequency currents cause chemical and physical changes of the protoplasm of the red and white cells. The red cells are increased in number and the percentage of hemoglobin is also increased. Phagocytosis increased. Nitrogen content reduced.

Liver.—Activity of liver cells increased and drainage promoted. Relaxed common bile duct. Increased defense to bacterial invasion.

Bone.—Bone offers material resistance to the passage of high-frequency currents, consequently is last to be heated. The heat is retained for hours and is slowly given up to the surrounding tissues. Activity of bone marrow is increased, resulting in an increase of hemoglobin content.

Nerves.—High-frequency currents, depending upon the method of application, have profound stimulating or inhibitory effects upon the autonomic nervous system. Trophic effects are increased. Pain is relieved thru circulatory and reflex effects. Electric excitability is lessened. Visceral reflexes are incited by application to certain spinal nerves. A current from a multiple-point electrode held away from sparking distance from the skin (effluve) produces a sensation of a mild breeze and is sedative to tired nerves.

Glands.—High-frequency currents penetrate more deeply than other electric currents and have a more profound effect upon lymphatic and other glands. Secretory function is increased by local application and inhibited thru incitation of reflexes.

Blood Vessels.—The first effect is one of vasoconstriction followed by dilatation of capillaries. There is a marked increase in activity of the arterial circulation which mechanically relieves venous congestion. Splanchnic stasis is relieved thru a general stabilization of the circulation. Large blood vessels may be dilated or contracted by stimulation of certain spinal nerves. Arterial tension is lowered or raised in accordance with the method of application. Indurated arterial walls are softened.

Stomach.—Direct application increases gastric secretion and muscular activity. Pyloric dilatation may be secured thru incitation of spinal reflexes. Intestinal peristalsis is increased by local application and may be inhibited thru spinal reflex.

Heart.—Increase of diastolic pause allowing fresh oxygenated blood to enter heart muscle, thus promoting nutritive effects. Direct application to the heart increases cellular activity which proves a factor in

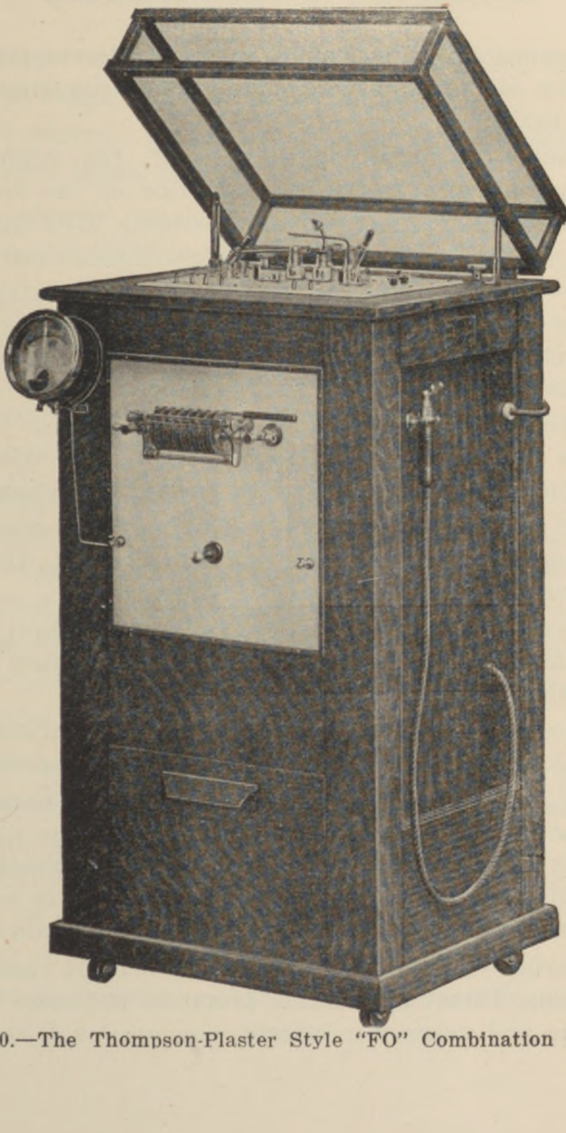


Fig 10.—The Thompson-Plaster Style "FO" Combination Outfit.

the restoration of weakened muscles. Vertebral application influences vagus control which regulates the heart rythm.

Kidney.—General application of the high-frequency current increases the function of the kidney evidenced by increased urinary output. The kidney pelvis may be contracted or dilated thru proper application to the vertebral interspaces.

Pancreas.—The secretion of this gland is influenced in some unknown manner which results in decreased output of sugar in the urine.

Eye.—High-frequency currents dilate the blood vessels and promote drainage. The reflex of contraction and dilatation may be incited thru application of the current to certain spinal nerves.

Lungs.—Output of carbon dioxid increased. Drainage promoted thru circulatory effects.

Brain.—Direct application induces cerebral hyperemia. Cerebral congestion may be dissipated thru excitation of spinal reflexes.

Bronchi.—Effects of contraction and dilatation may be obtained by incitation of certain nerve reflexes.

Spleen.—The reflex of contraction and dilatation may be incited thru spinal application, thus in a limited manner controlling certain infections. Direct application favors the freeing of specific bacteria which enter the circulation causing recurrence of malady.

Uterus.—Intrauterine application induces vasoconstriction. Direct application promotes drainage thru thermic and vasomotor effects.

Rectum and Bladder.—Direct application stimulates secretion and has a general toning effect upon all structures. Sphincters may be dilated thru incitation of spinal reflex.

Organs of Generation.—Increased activity of ovaries and testicles results from direct and vetebral stimulation. Power of erection is increased.

Mucous Surfaces.—The effects upon mucous surfaces are similar to those upon the skin—stimulation of secretion, transitory hyperemia and vasomotor vitalizing effects.

Muscles.—Electric excitability lessened in close proximity to electrode. Upon ordinary application high-frequency currents do not cause muscles to contract, but they may be made to contract by the introduction of an air gap in the circuit. Muscles deprived of nervous control may have their nutrition sustained by proper application of diathermy.

The machine illustrated in Fig. 10 is the Thompson-Plaster Style "FO" Combination Outfit. This cabinet supplies an exceedingly high oscillating current, from practically zero potential to all that can be safely applied. It embraces all the high-frequency modalities, as well as cautery transformer, diagnostic light, compressed air, nebulizing outfit, electric heater, pneumatic vibrator, Bier's hyperemia, etc.

ELECTRODES.

Almost every conceivable material that absorbs moisture has been tried in the manufacture of electrodes for the application of the different electrical modalities. In high-frequency work the solid metal and block tin electrodes are to be preferred to wet pads. Pure tin electrodes have the following advantages: 1. A suitable electrode may be fashioned in one minute. 2. They are pliable and may be made to conform to almost any contour of surface. 3. They are cheap. 4. They are less liable to corrosion.

In fashioning a block tin electrode care must be exercised. The edges must be made smooth and they should be circular or oval in form. Disagreeable sparks are liable to occur from sharp corners of square and rectangular shaped electrodes, and again sharp corners are liable to press too deeply into the skin and cause concentration of current at that point. Concentration of current is apt to occur at the point of attachments, such as snap-button, soldered or snapped-on rheophore sockets. Care must also be exercised to see that there are no points of the electrode which are not in close contact with the skin as perspiration may collect, and its vaporization cause a burn. In surgical diathermy, solid needle point, button and ball-shaped electrodes are used.

Vacuum Electrodes.—Vacuum electrodes for the purpose of delivering charges of high-frequency currents are made in almost every conceivable shape to conform to the anatomy of the part to be treated.

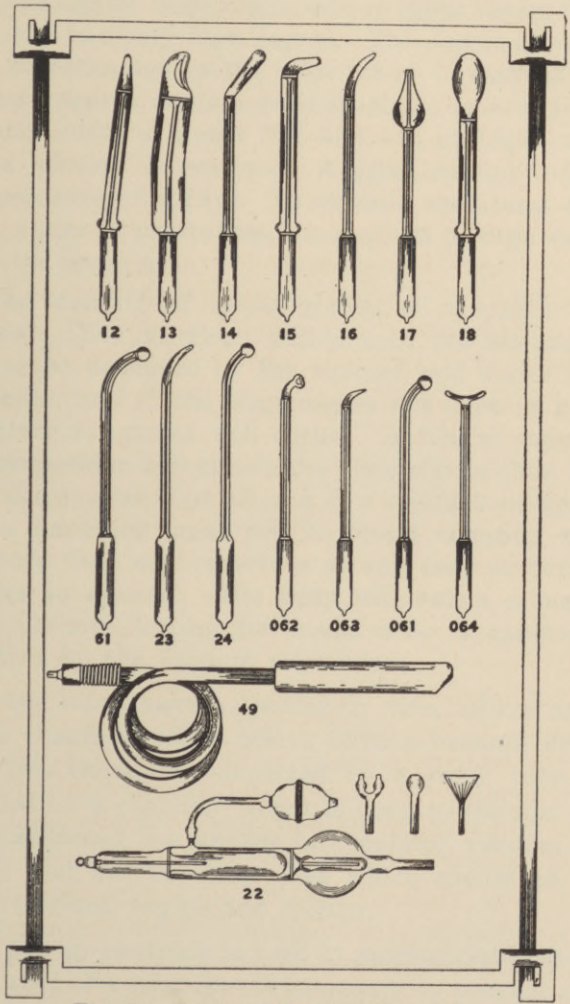


Fig. 11—Insulated Vacuum Electrodes.

The vacuum of these electrodes or tubes varies from a very low to a very high degree. The degree of vacuum may be estimated by the color which is emitted. One of low vacuum emits a reddish glow; one of medium vacuum emits a bluish tint and one of high vacuum has a whitish appearance. A greenish tint indicates the presence of x-rays. In chronic conditions of the skin, ulcers or prostatitis, the medium or high vacuum is to be preferred.

The activity of sweat glands of the skin is increased. The secretion unites with the nitrous acid and ozone produced by the current and sticks to the electrode, and if the electrode is not kept in motion disagreeable sparks will occur. A liberal supply of talcum powder will enable the electrode to slide easily over the surface, but after a few minutes of application a hardened mass will be found adhering to the electrode that will require a strong soap or washing powder to remove. The body will retain a peculiar odor, perhaps lasting for hours after a general application by the vacuum electrode.

Some tubes have a leading-in wire, others have a single chamber, while others have a vacuum divided into two chambers connected by a small tube surrounded by a chamber which is open to the air. The last mentioned are known as insulated vacuum electrodes and are the only ones which should be used in the urethra, vagina and rectum.

When an electrode is used in mucous-lined cavities, some kind of a lubricant is necessary to prevent sticking to the membrane. Almost any kind of cerate, vaseline or tragacanth jelly may be used. A prolonged application of the high-frequency current to any mucous surface is liable to cause a burn. Such applications should not exceed seven minutes in duration.

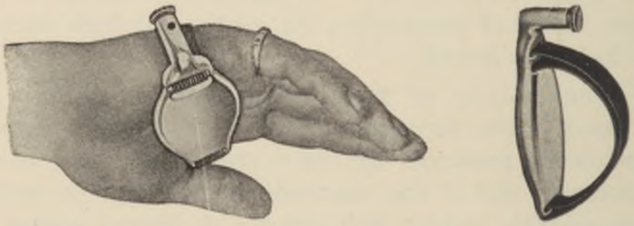


Fig. 12.—Diathermy Hand Electrode. A most convenient method of applying the Diathermic Current by the hand, for local treatments. The rubber band holds the plate in close contact with the palm of the hand, and allows a free movement of the fingers for massage purposes.

There is a so-called cataphoric glass electrode made and recommended by some for the ionization of drugs, but it is practically useless, since a high-frequency current is alternating in character and has but little if any ionizing power. In order to drive medicaments into the skin a direct current is required.

In local applications, by means of the vacuum electrode, the effects may be increased by having the patient connected to the opposite pole of the machine.

The popular notion that a vacuum tube emits ultraviolet rays is misconceived. While, no doubt, a few actinic rays are produced within the tube, the glass screens them off and they never reach the patient. In order for the patient to receive the few ultra-violet rays present, the tube must necessarily be composed of quartz.

Fig. 13.—A Surface Non-vacuum Electrode.

NON-VACUUM ELECTRODES.

A non-vacuum electrode in many respects is superior to the vacuum electrode. There is a direct metal connection with the lining of the electrode, and as there is no vacuum to overcome, the efficiency of the current when it reaches the patient is materially increased. The glass is heated quickly and a greater degree of heat reaches the patient than is possible with a vacuum electrode. They may be employed with any electric current. When employed with the static current, a direct positive charge may be delivered which is impossible with the vacuum electrode. They are not easily broken and may be sterilized by boiling. They are a distinctive improvement over the vacuum electrode in high-frequency work.

Precautions.—Inflammable material is liable to be set on fire by high-frequency currents whenever a spark is produced.

In treating the scalp, all kind of ornaments should be removed. Many ornaments are composed of celluloid, an exceedingly highly inflammable material. Short fuzzy hair should also be avoided.

The use of glass electrodes within the urethra is a hazardous procedure, as a slight movement of the patient or side pressure by the operator might break the electrode and require an external urethrotomy for removal of pieces of glass.

The machine illustrated in Fig. 14 is the Victor Model "Wantz." This high-frequency outfit is up-to-date and well adapted to all kinds of high-frequency work. It is equipped with a spark gap which permits of long continued service without periods of rest for the purpose of cooling off.

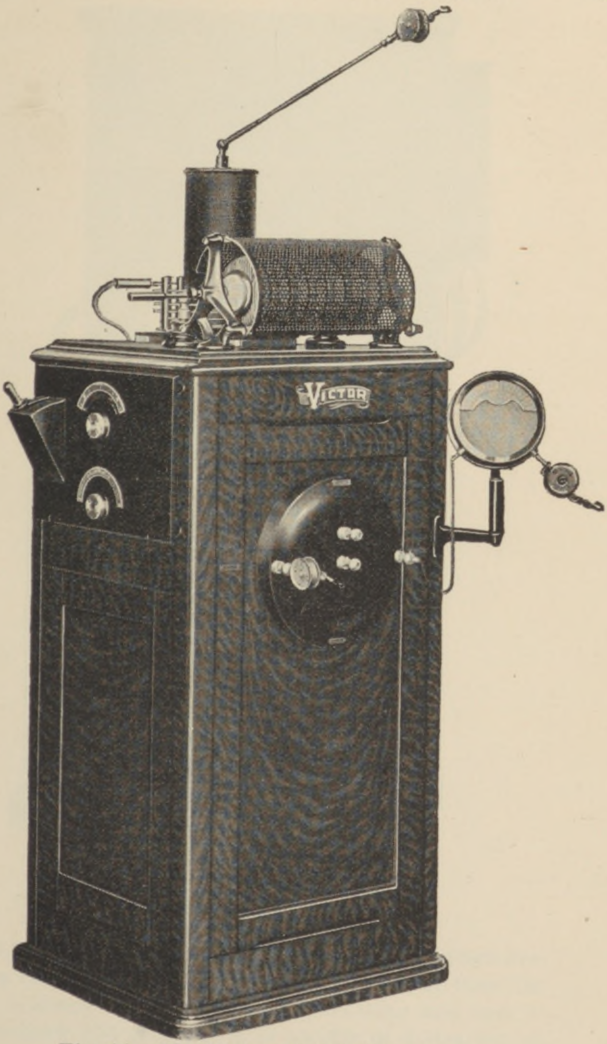


Fig. 14.—The Victor Model "Wantz."

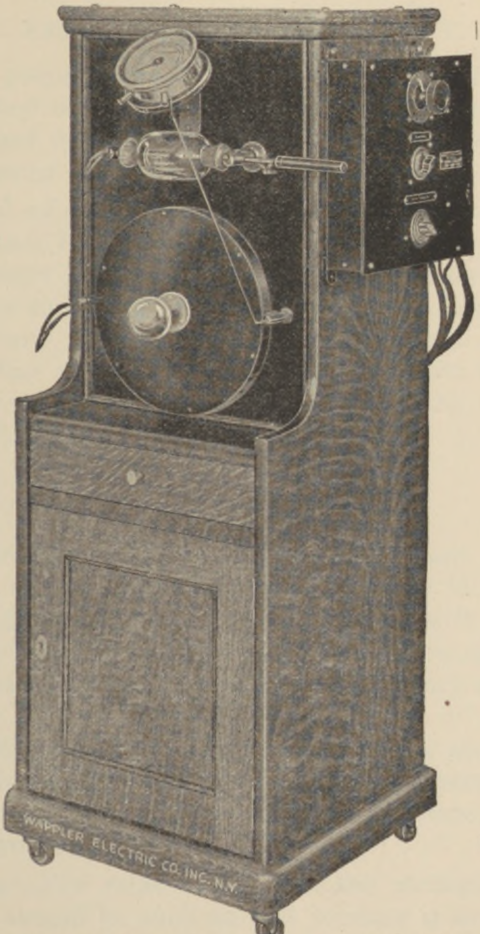


Fig. 15.—The Wappler Excell. The Excell High-Frequency Outfit appeared in 1902, and since that time has given evidence of its mechanical durability and ease of maintenance and control. It is capable of delivering all high-frequency modalities.

PREPARATION OF THE PATIENT.

The preparation of the patient all depends upon the method of application and effects desired. If no sparks are desired all clothing from the part to be treated must be removed.

Metal of all kinds, such as ornamental chains, corset steel, hairpins, etc., must be kept out of sparking distance of the electrode. If a mild spark be desired, the application may be made thru a sheet of thin underwear. A spark thru the clothing will have the same effect as if the electrode were held the same distance from the skin as represented by the thickness of the clothing.

GENERAL TECHNIC.

In treating diseases of the skin, such as acne, eczema, etc., a reasonably heavy charge is required. The electrode should be kept in contact with the skin and moving. If itching occurs the electrode should be raised sufficiently to allow a few short sparks to escape. In skin ulcers, a layer or two of gauze is useful in keeping the electrode clean. A short spark is not uncomfortable, it produces a hyperemia and at the same time bathes the part in ozone, both of which are desirable.

Pain.—For relief from pain the strength of the current should be such as will produce a counterirritant effect. Sparks should be avoided unless a very prolonged effect, as obtained from minute blisters, be desired.

AUTO-CONDENSATION.

Auto-condensation means that the patient forms a part of the condenser in the circuit of the high-frequency current. An auto-condensation couch consists of a metal plate attached to one pole of a high-

Fig. 16.—Auto-condensation Couch and Patient.

frequency apparatus on the top of which is an insulating mattress upon which the patient lies. The insulating material may be of mica, glass, rubber, felt or cushion material. The other pole of the machine is held in the hands. The plate underneath the mattress becomes one side of the condenser, similar to the lining of a Leyden jar, the patient becomes the other plate of the condenser, corresponding to the outer coating of the jar. The mattress forms the dialectric and corresponds to the glass of the Leyden jar. The current enters the plate on one side and sets up another current in the patient's body by induction, and finds its exit thru the electrode held in the hands. This arrangement condenses electricity

Fig. 17.—Auto-condensation Chair Pad.

in the patient's body and he undergoes many millions of oscillations per second. This produces profound effects upon the vasomotor mechanism which causes a reduction in blood-pressure, an increased metabolism as well as an increased elimination of the products of combustion and toxins.

In auto-condensation a chair pad may be substituted for the mattress. A chair pad is made in two sections hinged together, one part forming the seat and the other the back of the chair. The pad consists of some indurated fiber covering two sheets of metal connected by wire or other metal hinges.

Fig. 18.—Auto-condensation Pad and Patient.

This form is very convenient and probably most frequently employed. A thick dialectric mattress has the advantage of better diffusion of current thruout the patient and lessens concentration of current at points of poor contact with the pad. If a strong current be employed with a thin dialectric, there is considerable brush discharge passing to the patient, which is more or less disagreeable and lessens the effect upon the general circulation. In case it be desired to administer more than 800 milliamperes in auto-condensation the thick mattress is to be preferred.

AUTOCONDUCTION.

Autoconduction is another form of procedure to secure the same effects as auto-condensation. In autoconduction there is another solenoid or cage added to the d'Arsonval apparatus which is made large enough for the patient to be placed therein. The principal difference between auto-condensation and autoconduction is that in the latter the patient forms part of the coil while in the former he forms part of the condenser. Some operators favor autoconduction for reducing blood-pressure, but there is not enough difference in the effects to compensate one for giving the cage space in the office.

LOCAL AUTO-CONDENSATION.

If for any reason local auto-condensation be desired it may be applied by connecting one pole of the d'Arsonval current to a couch upon which the patient reclines, the other pole being connected with a metal or vacuum electrode applied to the patient with rubber, glass, several layers of gauze which have been saturated with salt solution, or any other dialectric interposing.

EFFECTS OF AUTO-CONDENSATION.

While under treatment by auto-condensation, there is no sensation experienced other than that of warmth to the hands and wrists from holding the electrode.

High-frequency currents become condensed in passing thru limited areas, and as the wrists are smaller than other parts thru which the current passes in auto-condensation, the greatest heat will be felt in them. Usually the left is smaller than the right wrist, consequently it will experience the greater degree of heat.

Auto-condensation is a great factor in the reduction of blood-pressure, the effects being due to an increase of tissue changes by increasing oxidation, elimination of waste products in the urine due to a more complete oxidation of nitrogenous matter in the body; its special effects upon the protoplasm of tissue cells; its elimination of carbon dioxid and its rapid elimination of toxins; its increasing oxygen-carrying power of the blood, as well as increased amount of hemoglobin. These effects are due to an action upon the sympathetic nerves controlling vasomotor, secretory and peristaltic functions.

There is a general soothing effect upon all painful conditions. Some patients experience a drowsy sensation on coming from the auto-condensation couch, while others feel exhilarated. In either case it is advisable to administer laxatives between treatments to avoid effects of increased metabolism.

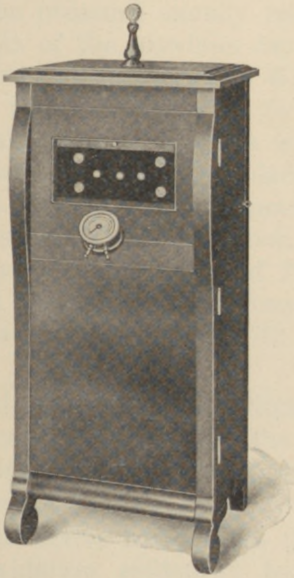


Fig. 19.—The Vulcan High-Frequency Treatment Apparatus, Type "D." This machine is capable of delivering all forms of high-frequency current, all under finely graduated control of the operator. The spark gap may be adjusted to suit the volume and frequency of current desired for any purpose. The condenser of this machine is composed of India mica.

The effects upon cases of hypertension are quite prompt; one treatment will often reduce the pressure from 10 to 30 mm. of mercury. In the course of twenty-four hours the pressure usually returns to within five to ten points of the previous day. The average net result is 5 mm. per treatment. While in cases of hyperpiesia, the result of treatment by auto-condensation is prompt and lasting, in cases where cardiovascular changes have already taken place the reduction is not so marked and has a greater tendency to return, but even in these cases the reduction is progressive from day to day until the point of fixed tension is reached. Fixed tension will be found considerably above the normal in every case with cardiovascular change.

Normal blood-pressure is very little, if at all, effected by auto-condensation. All the effects of increased metabolism may be secured without any fall in the blood pressure.

In cases of defective metabolism there is always an increased oxidation evidenced by an increased amount of urea in the urine and decreased amount of nitrogenous products in the blood. Uric acid usually disappears from the urine. These effects are not transitory, but more or less permanent. The increased output of carbon dioxid and production of heat may be easily ascertained by the usual metabolism test.

In patients whose glandular system is in a state of dysfunction there may be an immediate rise in blood-pressure on coming from the auto-condensation couch, but this will be followed by a fall several hours later.

Auto-condensation increases the body as well as the surface temperature. During an ordinary treatment (400 to 600 milliamperes) for a period of 12 minutes, the rise of body temperature seldom exceeds 1-5° F.; continuing the treatment for a long time may increase the temperature from ½ to 1 degree F. The increased heat within the body is probably due to the action of the high-frequency current on the vasomotor system causing increased cellular activity. The equalization of the general circulation is also an important factor in the reduction of blood-pressure.

Contraindications and Precautions.—There are very few contraindications to the use of auto-condensation. It should not be employed in cases of hypotension nor in patients whose temperature is 100° F., or over. In cases of advanced arteriosclerosis, very mild current may be employed; the first treatment must not exceed 300 milliamperes for a period of 10 minutes. If for any reason a current of 300 to 400 milliamperes produces faintness, vertigo, dyspena or sleeplessness, the treatment should not be repeated until after the alimentary canal has been cleared by castor oil; if any of the above-mentioned symptoms appear after clearing the food tube, auto-condensation should be abandoned.

Care should be exercised in the employment of any electric modality in the aged, as their organs are frail and very sensitive to electricity in any form.

A pricking sensation experienced by the patient while under treatment by auto-condensation indicates a lack of insulation; a folded sheet or any dialectric material placed between the pad and patient will relieve the situation.

If the patient be well insulated and experiences faradic sparks, the fault lies in the construction of the machine.

A chair or table composed wholly or in part of metal should not be used in the administration of any form of high-frequency currents.

While undergoing treatment by auto-condensation, if the patient be accidentally grounded by touching him, or in any other manner, he will be exposed to disagreeable sparks.

Care of Apparatus.—The spark gap of a high-frequency apparatus should be kept clean to secure maximum efficiency and avoid unpleasant effects. The discharging points of single point and rotary gaps should, from time to time, be rubbed smooth with emery paper.

If the condenser consists of Leyden jars it is necessary to keep them well filled with salt solution to prevent breaking and to secure best results; a layer of paraffin oil on top of the solution will prevent evaporation and lengthen the time for replacing the solution.

If a motor or pump be part of the equipment, it should be cleaned and oiled after a six-hour run; it is well to have a set time once a week to clean up the machine.

CHAPTER III.

Medical Diathermy

CHAPTER III.

MEDICAL DIATHERMY.

Definition. Differentiation. Physiology. Physiology of the cell. Current density. Technic. Time of treatment. Contra-indications and precautions.

DEFINITION.

The name diathermy has been accepted as the proper term to be applied to the method by which an elevation of temperature is produced in the tissues of the body without destructive effects.

Other terms, such as "thermopenetration," "endothermy" and "transthermia," are sometimes employed instead of the generally accepted one, diathermy.

Zimmern defined diathermy as "a form of thermotherapy which utilizes electrical energy for the production of thermal effects in the depth of the tissues."

D'Arsonval was the first man to show that high-frequency currents, if allowed to pass thru the body, produce an increase of temperature of the tissues, but it remained for other investigators to apply the method in the treatment of a variety of diseased conditions.

The passage of an electrical current thru the tissues of the body will always produce heat, but the continuous current produces the greatest degree of heat at the points of contact with the electrodes, and in order to secure penetration of heat, the application becomes too painful. The faradic and the ordinary alternating city light currents also produce heat, but the violent contraction of muscles precludes their use.

It has been found that the high-frequency current which oscillates millions of times per second is the only form which can be passed thru the tissues of the human body without pain, muscular contraction or any discomforture, other than that of heat. The explanation of this lies in the rapid oscillations which prevent ionic or chemical effects.

It was not until 1910 that the therapeutic value of diathermy was brought out by Nagleschmidt, thru the agency of an apparatus designed by himself. During the same year Doyen reported his experiments with high-frequency currents in the treatment of cancer.

He found that normal cells of the body are able to withstand a temperature of 140° F., while cancer cells are destroyed by a temperature of between 122-131° F.

DIFFERENTIATION.

The characteristic difference between the ordinary high-frequency current and a diathermic current lies in the windings of the secondary transformer. The ordinary high-frequency machine is one of high voltage and low amperage. In order to secure a high amperage for diathermy, a secondary solenoid wound on the principle of the stepdown transformer is necessary. To illustrate, let us assume that the first coil is made of 100 turns of wire charged at 100 volts and one ampere from the alternating current mains, and that the second coil has 10 turns of wire. This arrangement will reduce the voltage in the second coil ten times ($100 \div 10 = 10$) or to 10 volts and the amperage will be increased to ten times amperes. If the secondary coil consists of but five turns of wire the voltage will be reduced twenty times ($100 \div 5 = 20$) and the amperage correspondingly increased twenty times or 20 amperes.

PHYSIOLOGY.

Heat for the aleviation of pain has been employed by man since history began. We are familiar with the soothing effects of the local application of heat in the form of hot bricks, poultices, hot water bottle, electrothermic pads, etc.

The physiological effects of hyperemia and skin reflexes were not understood by our grandmothers, but they did know that heat applied to the skin would relieve pain.

By means of high-frequency currents, we are now able to apply an internal poultice to the organ itself. By application of properly sized electrodes, we are able to concentrate heat in any part of the body desired. Diathermy not only soothes pain by its effects upon the autonomic nerves, but dilates the veins, allowing an increased supply of freshly oxygenated blood from the arteries to take the place of the stagnant blood of the affected gland or tissue.

The passage of high-frequency currents thru the tissues of the body sets up a violent agitation of the electrons of which the tissues are composed; the resistance offered to the movement of electrons results in heat. As the density of high-frequency currents is under our control, we are able to increase the agitation of electrons and thus raise the temperature of any part desired. While every tissue traversed by the current will resist its passage and thus produce heat, the greatest concentration may be directed to any part by properly shaped electrodes.

There is more or less heat introduced into the tissues by a high-frequency current, but the greater part of the heat is produced by violent agitation of the electrons of the tissues. In other words, there is an actual generation of heat in the tissues.

Conductive heat applied to the skin has but little penetration and its effects are principally reflex in character; no heat of importance reaches the tissues underneath the skin. Radiant heat from high power electric light lamps is more penetrating than conductive heat, but it is quite improbable that it penetrates to any material depth of tissues underneath the skin.

The greatest resistance to the passage of direct current electricity is offered by the skin, hence the heat effects are concentrated therein. The skin offers very little resistance to the passage of high-frequency currents, the heat destiny being equal thruout the tissues between electrodes of the same area. Bone offers the greatest resistance of any of the tissues of the body and retains the heat for a longer period of time; after becoming thoroughly heated, bone slowly gives up heat to the surrounding tissues making this feature a useful one in therapeutics.

PHYSIOLOGY OF THE CELL.

The cell is the physiological working basis of all vegetable and animal organism and without a proper electrical balance, ceases to function.

The human body is the most marvelous laboratory of which we have conception. Each cell being a little workshop where the mysterious work of metabolism is carried on. The animal cell is the true analogue of the primary cell of a battery. The contents of the cell proper is a colloidal substance which we call protoplasm and has alkaline reaction; within this mass of protoplasm is the nucleus separated therefrom by a semipermeable membrane, thru which the potential of the cell is maintained by osmosis. The nucleus is composed mostly of chromatin or nuclein, and is of an acid reaction, probably due to nucleinic acid.

The vitality of the cell depends upon the permeability of its membranes, maintenance of potential and oxidation. These dependable qualities may be seriously impaired by excessive oxidation brought on by excessive exercise, infection, worry, fear, anxiety or trauma. Certain drugs and glandular function play important roles in cellular vitality. Oxidation, while a normal process of cell function, may be overworked to such an extent that the protoplasm may be changed to an acid reaction, thereby changing its electrical potential to such an extent as to destroy its function and possibly the cell itself. In that condition, called acidosis, all cell function is seriously impaired and many cells are destroyed. In order for these billions of workshops to keep up their metabolic efficiency, there must be a sufficient supply of proper material and an escape for its waste products, without which work ceases and the shop becomes effete junk and has to be removed by other workshops or become a nidus of that condition which we are pleased to call disease.

We know that heat applied to the cell increases oxidation and may be so concentrated as to destroy it. While medical diathermy properly applied will greatly increase the supply of fresh arterial blood, it also hastens, through the channels of dilated capillaries, the escape of waste products and thus increases cellular efficiency. The mechanical bombardment of the cell by any high voltage current increases its potential and incites greater activity in the workshop and results in an increased metabolic output. On the other hand the cell may be overworked by a too prolonged application of the current and result in cellular dysfunction as evidenced by sore muscles and fatigue.

Clinical observations and many laboratory tests show conclusively that a moderate degree of heat increases cellular activity and that all electric currents increase metabolism.

The end result of all internal glandular and muscular activities incidental to the maintenance of life is *heat* and the level of vital activity may be inferred from the amount of heat produced.

Dr. deKraft says: "Venous congestion wherever present is relieved because of the marked activity of the arterial circulation. Anemia of the splanchnic area ensues, visceral congestion is relieved. The liver, the intestines and other organs within the abdominal cavity are made to disgorge the stagnant pools of blood which bathes their structures. When the action of the diathermic current has subsided and the blood stream returns again to its normal channels, freshly oxygenated arterial blood enters in greater abundance into the previously anemic and (before heating) venously congested area. The parts are placed in a better state of defense against invasion of toxins and bacterial colonies."

It will be found that in individuals with subnormal temperatures the application of diathermy will raise the temperature to normal, improve the appetite, increase weight, promote sleep and a feeling of comfort.

The passage of high-frequency currents through any portion of the body raises the temperature of the part several degrees. The heat, while concentrated between the electrodes, if long continued will be distributed by the general circulation and will heat up the entire body. If it were not for the increased activity of the circulation set up in the tissues under the electrodes by the application of diathermy the parts would become very much overheated.

When general diathermy be given (hand to hand) for the purpose of heating the entire body, the wrists of the patient become very hot and painful. This may be avoided by substituting large block tin sheets (4x7) for the hand electrodes. The large electrodes should be moulded to fit the flexor surface of the forearms and carefully watched to prevent burns. Some operators place pads well moistened with salt solution underneath the electrodes; this procedure changes the character of the current effects as salt acts more or less as an insulator.

In hand to hand diathermy the temperature varies in different regions of the body. The highest temperature will be observed in the wrists and becomes gradually lower as the current approaches the trunk. The temperature in the axilla and in the mouth is about the same; in the lower limbs the temperature gradually falls from the body to the toes where there is no perceptible change.

In foot to foot diathermy the highest temperature is found in the ankles and popliteal spaces and gradually becomes less as the current approaches the toro; the temperature in the rectum and mouth will be found to be about equal; in the upper limbs the temperature gradually falls from the axilla to the wrists where no perceptible change is found.

In these applications the rise in temperature is due to the general heating of the blood as it passes through the heated area.

When the current is directed through the abdomen or chest the temperature in the mouth is little affected, the heat being concentrated between the electrodes. Diathermy applied to the knee joint is more effective in raising the body temperature than when applied to the body itself; this is probably due to the close proximity of the electrodes to the circulating blood and to the heating of it as it passes.

When electrodes are placed on the same surface of a limb or body there will be little penetration of heat as high-frequency currents take the shortest route between the electrodes. For example: if one electrode be placed on the posterior aspect of the thigh and the other on the calf of the leg the heat will only penetrate the skin between the electrodes, but if one be placed on the anterior aspect of the thigh and the other on the calf of the leg the entire limb between the electrodes will be heated.

The elevation of temperature caused by diathermy has nothing in common with fever from disease. After cessation of treatment the temperature soon returns to normal.

The activity of heated blood set up by the rapid oscillations of the current causes flushing of inflamed tissues which promotes drainage and absorption of inflammatory products and deposits.

Heavy diathermy treatments cause, in the obese, a liquification of fat and consequent increase of acetone in the urine.

Diathermy produces marked analgesic effects and relieves all kinds of pain. Relief from diathermia is more lasting than from conductive or radiant heat. The long continued relief experienced by heating the deep tissues is due to the slow return to normal temperature; the cooling of tissues takes place by conduction through the circulation while skin cooling is rapid through radiation.

Bergonie says: "In cases of defective alimentation, diathermy, by supplementing the natural heat-production of the body, relieves the strain on the weak digestive system, and replaces to a certain extent the calories usually derived from food."

The diathermic current takes the shortest path between the electrodes instead of the one of least resistance. With the single exception of bone the tissues of the body are about equal in conductivity. Longtitudinal and cross sections of muscular fiber are equally resistant to diathermic currents. In heating tissues the only consideration is the structural mass of the tissues between the electrodes; the greater the mass the greater amount of heat required. A low milliamperage applied for a long period of time will heat the part more effectually than a heavy current for a short time.

It has been found by placing one electrode on the back and the other over the epigastrium that the temperature within the stomach is higher when a current of 300 milliamperes is employed than when one of 2000 milliamperes is used.

The deep effects of heat may be studied through the laryngoscope by application of diathermy to the larynx or by placing one electrode over the hypogastrium and the other over the sacrum of a female and observing through the speculum the changes taking place in the cervix.

All vital energy and activity come from the combustion of organic material. The more fuel we burn the greater our activity and vitality. It is therefore apparent that stimulation of metabolism raises the energy of the organism and is of first importance in the conservation of health.

The production and elimination of body heat are prominent factors in the treatment of diseased conditions. The abstraction of heat from the body necessitates oxidation to replace the lost heat. Any condition that promotes heat discharge stimulates oxidation and metabolism.

Health and vigor are associated with active metabolism. Anything that interferes with dissipation of body heat lowers metabolism and produces debilitating effects, examples of which we have in low diet, indoor life and sedentary habits.

Practically all cases that come to the physician are ones of defective anabolism or katabolism many of which are amenable to diathermy.

There is no means at the command of the physician so potent in correcting deranged metabolism as high-frequency currents.

Dr. George W. Crile says: "In what way may heat exert its beneficial influence? Grant the premise that the natural defense of the organism against infection is made through the agency of phagocytosis and the chemical antagonism of the blood plasma, it becomes evident that in either case the defense is chemical. The fact that the defense is chemical gives at once a clue to the mechanism by which heat assists the defense against bacteria. It is probable because with the rise of each degree of temperature in any system, inorganic or biologic, that chemical activity is increased 10 per cent and the electric conductance 2½ per cent. The increased chemical activity increases the chemical defense. The increased electric conductance increases the metabolism. Therefore, we may suppose that heat accelerates the chemical defense as far as it involves chemical defense of the blood plasma, and that the heat aids also by increasing the total amount of blood in the inflamed part, thereby increasing the number of phagocytes."

Cumberbatch says: "The warmth which is felt when the high-frequency current traverses the body is due to the actual generation of heat in the tissues while the current overcomes their resistance. To generate perceptible heat the density of the current must be high. If it is low, no sensation of any kind will be perceived.

A high-frequency current is also unable to produce any chemical (electrolytic) changes in the tissues. It

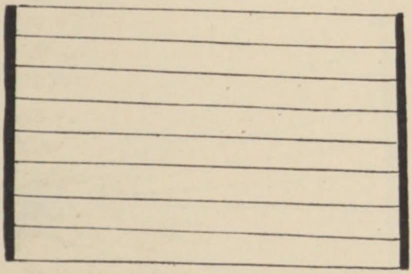


Fig. 20.—Current Density between two electrodes of the same area is equal throughout.

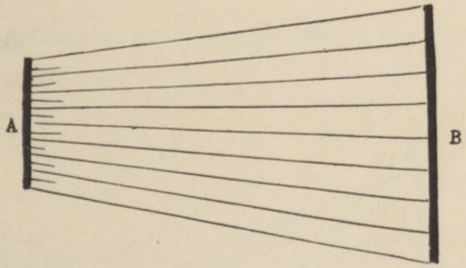


Fig. 21.—Current Density at A is four times greater than at B.

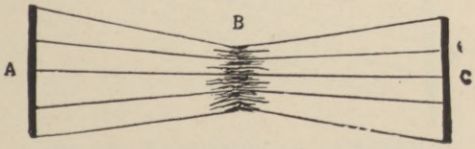


Fig. 22.—Current Density is four times greater at B than at A or C.

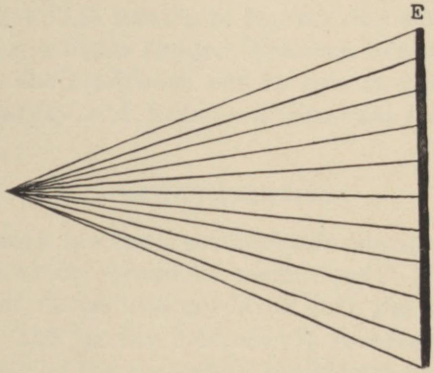


Fig. 23.—DESICCATION. Current Density at needle point.

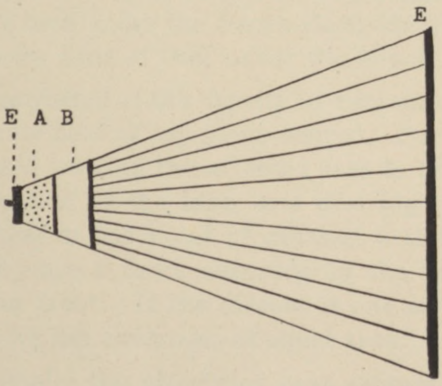


Fig. 24.—ELECTROCOAGULATION
A—Area of coagulation; B—Area of sterilization; E—Electrodes.

flows for such a short time in either direction before reversal that it is unable to impart any movement to the ions in the tissue fluids. The ions therefore do not migrate to the electrodes and so cannot give up their electric charges and form new chemical compounds."

CURRENT DENSITY.

There are a few basic principles in the application of diathermy which should be memorized: The density of a current varies in accordance with the area of the electrode. The density increases in inverse proportion to the square of the surface of the electrodes. For example: An electrode 8 inches square contains 64 square inches and another 4 inches square contains 16 square inches. If the 8-inch electrode be placed on one side of the body and the 4-inch electrode on the opposite side, each square inch under the 4-inch electrode will receive four times the heat of that under the 8-inch electrode.

This knowledge of the density of current enables us to concentrate heat at any point desired. For example: in pneumonia we find the affected area to be near the anterior portion of the lung, and desiring to concentrate the heat at the point of greatest activity of the disease we place a large electrode on the back and a small one in front. If the disease is one affecting an entire lobe we use electrodes of equal area.

Theoretically the effects of heat currents vary as the square of the amperage. If a milliamperage of 200 is being given and a change is made to 400 milliamperes, the meter reading has been doubled but the heat effects have been quadrupled; if the milliamperage be increased from 200 to 800 the heat effects have been increased sixteen times.

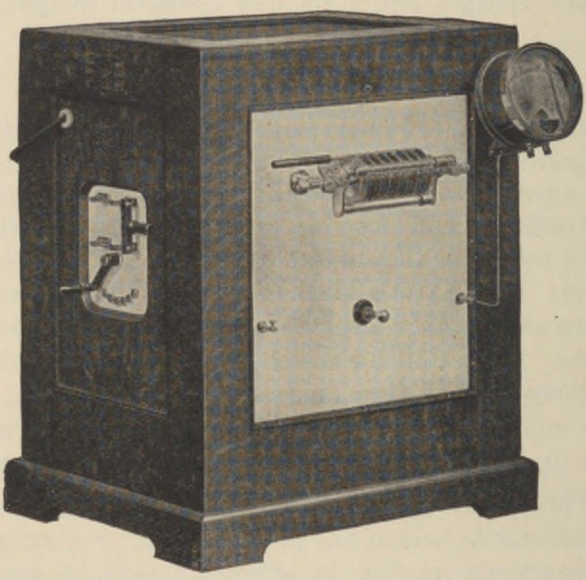


Fig. 25.—Fischer Military Model Diathermy Outfit. This apparatus is capable of delivering upward of 2,500 milliamperes in diathermy and an average of 1,450 milliamperes in auto-condensation. It is dependable and well adapted for surgical diathermy.

In practice upon the living subject this principle does not hold, because when strong currents are employed the body reflexes are stimulated to such an extent that all the functions which regulate heat in the body are stimulated to combat the heat from the outside, but when the smaller current strength is employed the reflexes are not stimulated, allowing the current to get by.

TECHNIC.

Electrodes.—The choice of electrodes is of first importance in diathermy. Heavy metal electrodes are furnished with all high-frequency machines which, for many applications are satisfactory, but over bony prominences are useless. In selecting an electrode the contour of the surface to which it is to be applied must be taken into consideration; the object being perfect contact at all points. The experience of the writer leads him to select a metal electrode composed of block tin as they possess the following advantages: 1. They are pliable and can be made to conform to almost any contour of surface; 2. They are easily fashioned for the individual case in hand; 3. They are not easy to corrode and are easily kept bright and clean.

In fashioning tin electrodes the edges must be made smooth in order to prevent sparking; this is easily accomplished by turning the edge backward; they should be oval or circular in form and of proper size for the administration of the dose desired. As a general rule 15 square inches of surface for each 1000 milliamperes of current should be employed. Wherever possible the electrodes should be securely fastened by means of a roller bandage. When employed on the back of a patient the weight of the body may secure proper contact. On the front of the body they may be weighted down with sand bags or held firmly in place with the hands.

Even contact must be secured to prevent concentration of current and consequent burns. Usually the sensation of the patient will be a proper guide, but in cases of skin anesthesia it proves no guide at all. Again, sometimes the first contact of the current with the skin anesthetizes it to such an extent that a burn may occur regardless of precautions; at any rate the patient's toleration should not be exceeded; if a greater effect be desired than the patient seems to tolerate the amperage should be reduced and time of application lengthened. Better results are obtained by a low amperage and long time than by high amperage for a short time. Naturally the more tissue between the electrodes the greater the resistance, and this must be taken into consideration in choosing the size of the electrodes to be employed. In medical diathermy the metal is placed in direct contact with the skin, but some operators interpose 10 to 20 layers of gauze thoroughly soaked in salt solution.

Sodium chlorid solution is an excellent electrolyte and being easily ionized by direct continuous currents increases their conductivity. High-frequency currents being alternating in character their conductivity is more or less impeded by electrolytes hence the use of pads wet with salt solution is illogical. The effects of high-frequency currents upon the body tissues are decidedly modified by salt pads. The pads being insulators the tissues receive the current by induction, the diathermic effects being transformed into those of modified auto-condensation. However, in surgical diathermy where the effects are to be concentrated at or near the surface, their use may be justified.

In case the patient experiences a faradic sensation from bare metal electrodes the skin may be moistened with water or soap suds which will obviate the trouble. Where wet pads are used they should be at least two inches greater in diameter than the electrode. In locations such as prominent ribs and sternum, prominent spine and knee joints, bare metal electrodes are impractical.

Perfect technic is important in all treatments by diathermy. The apparatus must be of proper construction and in perfect order; all connections must be secure and perfect coaptation of electrodes be secured before the current is turned on. The current must be under perfect control of the operator and turned on gradually until warmth be felt by the patient and continued at that point for at least five minutes after which the current strength is increased gradually to the point desired and when treatment is completed the current must be gradually reduced to zero.

Time of Treatment.—The resistance of the skin, the thickness of fat underneath the skin or anywhere between the electrodes, the moisture of the tissues, the density of all the tissues, the reflexes of the patient, the distance between the electrodes, the size of the electrodes and degree of temperature desired, all enter into the consideration of time for each treatment. The greater the skill of the operator the better the results.

CONTRAINDICATIONS AND PRECAUTIONS.

Diathermy is positively contraindicated where there is a recent history of hemorrhage; no matter where the hemorrhage be from that part must be avoided. While

Fig. 26.—Hand-to-Hand Diathermy. Useful in brachial neuritis and insomnia without known pathology.

papillomata of the bladder are easily destroyed by diathermy, a most disagreeable hemorrhage might occur therefrom through an application of high-frequency current to the prostate. It should not be applied to the pelvis if there be a recent history of bleeding. It should

Fig. 27.—Foot-to-Foot Diathermy. Useful in cold limbs of the aged, sciatica, etc.

not be employed within 24 hours of the menstrual period. Pregnancy is a positive contraindication to its use below the waistline.

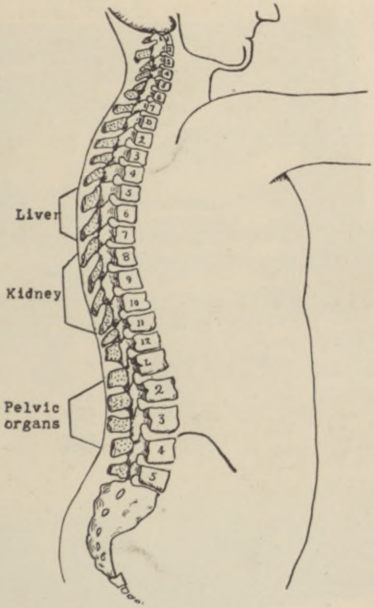


Fig. 28.—Diagram showing location of posterior electrode in Diathermy of Liver, Kidney and Pelvic Organs.

Diathermy powerfully stimulates the secretion of glandular organs consequently it should not be applied to the thyroid gland in hyperthyrodism. It should not be applied to any place where there is a collection of pus. The strepto and staphlococci are increased by the stimulation and there might be sufficient absorption to produce pyemia. However, diathermy is often of great service in pus accumulations where there is good

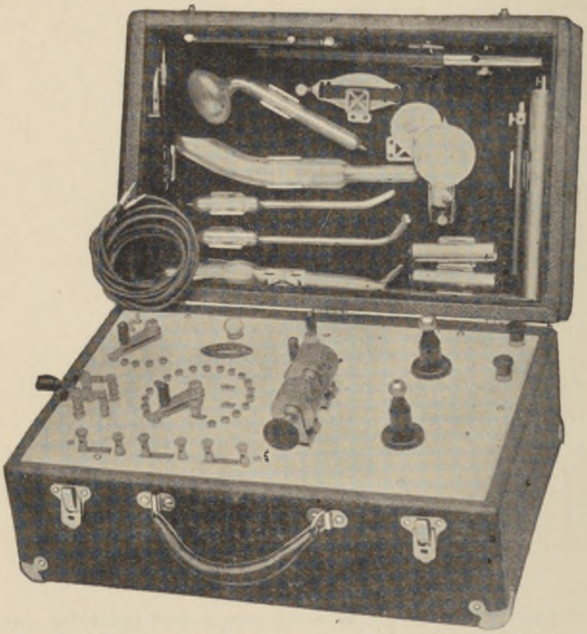


Fig. 29.—Portable Combination Type "K"—Fischer

drainage. It should not be applied to an acutely infected joint; it is therefore contraindicated in acute rheumatism.

It is best to avoid its application to sinuses of the head unless there be good drainage. It should not be employed in gall-bladder infection unless there be drainage through the common duct. Gastric, duodenal and other internal ulcers are positive contraindications to diathermy.

In giving treatments by diathermy it is important to see that no part of the body is constricted by tight clothing as the heat will concentrate wherever the circulation is impeded. When bandages are used to hold electrodes in place, care should be exercised to see that they are not too tightly applied. Through stimulation of the circulation the tissues swell to such an extent that bandages may unduly constrict the part.

CHAPTER IV.

Surgical Diathermy

CHAPTER IV.

SURGICAL DIATHERMY.

Definition. Desiccation. Advantages of desiccation. Disadvantages of desiccation. Effects of desiccation. Technic. Fulguration. Electrocoagulation. Advantages of electrocoagulation. Disadvantages of electrocoagulation. Types of electrodes. Points in technic.

Definition.—Surgical diathermy is rapidly becoming the method of choice in dealing with malignant disease about the face, mouth and throat. It differs from medical diathermy simply in the density of the current applied. In medical diathermy the object to be attained is to raise the temperature of the tissues without destructive effects while in surgical diathermy the object is the destruction of the tissues by heat. When the current is concentrated by means of special electrodes the current density may be increased to a degree sufficient to destroy not only soft tissues but bone as well.

Before attempting to employ surgical diathermy on living tissue the operator should become familiar with its effects on dead tissue. The destruction of living tissue requires a greater degree of density of current than dead tissue on account of the circulating fluids of the body which rapidly carry away the heat.

Considerable skill and practice are required to be able to judge the amount of heat required to completely destroy malign tissue without unnecessary destruction of normal tissue.

Surgical diathermy contemplates two distinct methods of destruction of tissues, and are known as desiccation and electrocoagulation.

DESICCATION.

Desiccation is a dehydrating process, rupturing the cell capsule and transforming it into a dry mass. For this purpose a needle point instrument known as a fulguration electrode is employed. The electrode may or may not be brought into contact with the tissues. Usually an air space of from one-eighth to three-fourths of an inch is interposed. Due credit should be given Dr. William L. Clark of Philadelphia for the name "desiccation" as well as the technic of application.

Another method known as the "disruptive arc" may be employed, the technic of which is as follows: Place the patient on the auto-condensation couch or pad and connect it as in the unipolar method. Connect the electrode to a water pipe or other ground; place point of electrode upon the spot to be treated; switch on the current of sufficient strength to do the work desired. For mucous surfaces this method has some advantages.

Advantages.—The advantages of desiccation as given by Dr. Clark are: (1) The rapid and effective destruction of abnormal growths without the loss of blood; (2) Precision, considerable area may be destroyed without infringement upon normal tissues; (3)

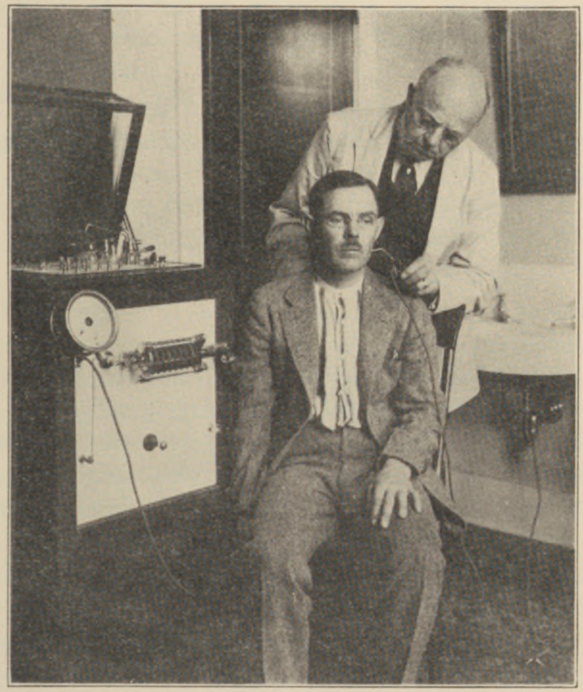


Fig. 30.—Desiccation by the Indirect Method.

no instrument of any kind enters the growth; (4) normal cells are left intact; (5) sterilized wounds result; (6) the blood and lymph channels are sealed which lessens the likelihood of metastasis in malignant cases; (7) the cosmetic result is good, leaving no contracted cicatricial tissue.

Desiccation Effects.—The area and depth that may be desiccated with one application are controlled by the operator and depend not only upon the current strength but on the distance of the electrode from the part, time of application, density of tissue and whether the unipolar or bipolar method be employed.

Desiccation is usually but not always contraindicated in neoplasms that are covered with healthy skin, as in order to reach the diseased tissue the skin must be removed or destroyed. After desiccation a dry crust forms and the time required for separation depends upon the character of the tissue. In case of mucous membranes the desiccated tissue soon becomes macerated by the secretions and may separate in a few hours while on the skin surface 10 to 21 days are required. Regeneration of skin takes place underneath the crust. The crust should remain until the healing has taken place underneath. No application to the crust is necessary; let it dry and fall.

Indications.—Desiccation is applicable to the treatment of warts, moles, nevi, tatoo, powder and coal marks, keloid, papillomata of the urethra and bladder, urethral caruncle, unrethral granulations, closed crypts of Morgagni, tumors in the nose, throat, mouth and larynx, diseased tonsils and hemorrhoids. It is specific in tuberculous ulcers of the throat, rectum and bladder. Fissures that can be reached by the electrode require but one application.

Fig. 31.—Desiccation of Warts, Moles, etc.

Technic.—There is little to be said regarding technic. When the electrode is brought within 1/8 of an inch from the part, with current of sufficient strength the electrons are thrown from the electrode into the tissues, the sparks following one another with such rapidity that to the eye the appearance is that of a luminous glow.

A few long sparks applied at first will usually anesthetize sufficiently the point to be destroyed, except in supersensitive persons. A local anesthetic of procain may be used where the growth is non-malignant. In rare cases a general anesthetic is required. Where the field of operation is in the mouth and throat a topical application of cocain and adrenalin is usually sufficient. See Diseased Tonsils.

Fulguration.—The term fulguration is commonly used when desiccation, electrocoagulation or genuine fulguration by the deKeating-Hart method is employed. Fulguration as practiced by deKeating-Hart does not destroy tissue. The method consists of applying long sparks of 6 to 10 inches to the field in malignant disease after radical operation, changing the nutrition of the part to such an extent as to prevent the formation of cancer cells.

ELECTROCOAGULATION.

Doyen employed the high-frequency current for the destruction of cancer cells by heat. The cell destruction in this method is the result of tissue coagulation. The electrode is applied directly to the part with the opposite pole placed on some indifferent part of the body. The tissues are coagulated to almost any desired depth by simply prolonging the time of application. This method is diathermy carried to the point of destruction of tissue. Electrocoagulation has been employed for the treatment of benign as well as malign tumors by Doyen and Luys in France, Berndt in Austria, Nagleschmidt of Germany, Clark and many others in America. Dr. Georges Luys of Paris employs a combination of galvanocautery and electrocoagulation in tunneling the prostate for the purpose of restoring the urethra to normal in cases of prostatic hypertrophy.

Fig. 32.—Experiment on Meat. Electrode ¼ inch in diameter applied 10 seconds. Current strength, 700 milliamperes. Area of coagulation, ½ inch wide and ¼ inch deep.

Advantages.—1. The operation is bloodless; 2. There is no shock; 3. The parts are thoroughly sterilized; 4. Dangers of metastasis are practically *nil;* 5. Tumors otherwise inoperable may be safely removed; 6. The operation is easily and quickly done; 7. Postoperative adhesions are rare; 8. Rapid convalescence.

Disadvantages.—1. Destruction of important blood vessels and nerves. 2. Secondary hemorrhage from important blood vessels which have been overheated. 3.

Formation of keloid in operations on skin surfaces. 4. Destruction of periosteum when operating on tissues close to bone.

The difference between effects of electrocautery and diathermy lies in the fact that in the former the tissues are heated from without while in the latter the heat comes from the tissues themselves. In electrocautery a hot electrode is plunged into the tissues and is rapidly cooled resulting in a superficial carbonization. In electrocoagulation the tissues are gradually cooked for some distance about the electrode.

Dose.—It is impossible to state the amperage required in any particular case. Much depends upon the size of the electrode. Generally speaking the depth of coagulation is the same as the diameter of the electrode, but this depends upon the strength of current and time of application.

An amperage of 300 is sufficient in small operations while in large operations a current strength of 2000 milliamperes may be required.

TYPES OF ELECTRODES.

The indifferent electrode should be 8 to 10 inches in diameter and must fit perfectly to avoid a burn. All connections must be perfect. Choice of active electrode depends upon the character and situation of the part to be treated. It must be well insulated.

Many active electrodes are fashioned to suit the fancy of the operator among which the following list will be found useful: 1. Circular or oval plates varying in diameter from 1/8 to 1 inch. 2. Properly constructed needles for the treatment of nevi and papillomata. 3. Button shaped electrodes for coagulating base of tumors after removal and for cavities. 4. Scalpel shaped electrodes 1/8-inch in width and 1 inch in length for the ablation of tumors.

Technic.—After the electrodes are properly placed switch on the current at zero and gradually increase its strength until the effect desired is produced. The current should be switched off as soon as sparks are seen to jump from the edge of the electrode to the surrounding tissues. If for any reason sufficient coagulation has not taken place when the sparking appears, the tissues may be saved from carbonization by the application of a few drops of normal salt solution which acts as an insulator. Always switch off the current before removing the electrodes. In small operations the coagulated mass should be left *in situ* to slough later on. Anatomy of the part to be treated must be understood in order to avoid coagulating the walls of important blood vessels and destruction of nerves. If the part to be removed be pierced by large arteries they must be ligated before the operation. Care must be exercised when coagulating tissues over bone as destruction of periosteum means slow convalescence. Considerable edema follows operations in the mouth and throat, so much so that the operator should prepare for tracheotomy. However, this extreme measure is seldom called for.

It is important that the operator become familiar with the action of currents of various densities upon

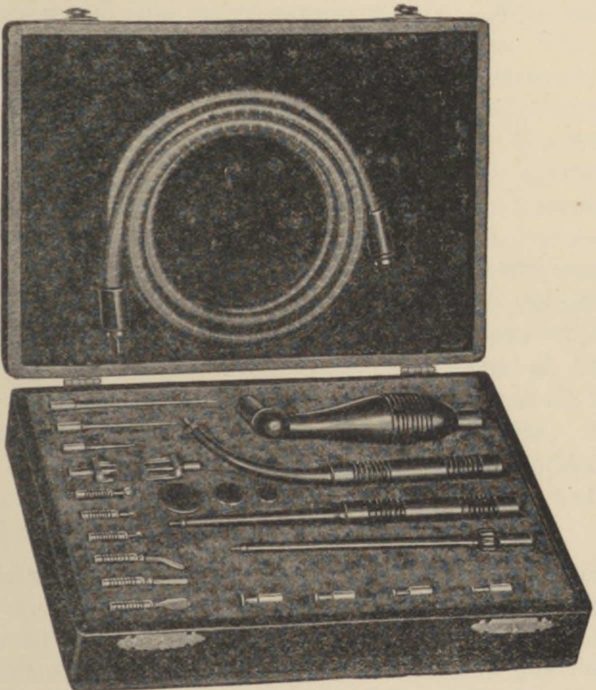


Fig. 33.—Surgical Diathermy Electrodes.

dead tissue before he attempts operative diathermy on living tissue. Many experiments on beef steak will be required to enable the operator to closely approximate the depth of the coagulation process on living tissues. As a general rule the requirements are: More current and longer time on living than dead tissue. The activity of the circulation in the part to be destroyed is an important factor in arriving at the probable time and amperage required in each individual case. The greater the circulatory activity, the stronger the current or longer the time required. The greater the diameter of the electrode the greater the time required. In operating on living tissue the depth of coagulation may be roughly estimated by the width the tissue is dehydrated around the electrode; the depth being approximately twice the distance of the coagulated tissue at side of the electrode. Again, this may be no guide at all, much depending upon the rapidity of the operation. When the current is applied slowly giving the circulation time to adjust itself, the coagulation will be more uniform and charring of tissues obviated.

As the tissue about the electrode becomes dried out as evidenced by its pale color, there is a tendency for the current to spark across to moist tissue beyond, the result of this sparking is carbonization or charring of the normal tissue, which should be avoided. As soon as the tissue is coagulated there will be an escape of particles of steam. Considerable experience is required to know the exact distance from the electrode the steaming should extend before sparking takes place. However, in any case if sparks appear the current should be turned off or salt solution applied. The smaller the diameter of the electrode the sooner coagulation takes place. As an average proposition with an electrode of 1/4 inch in diameter the tissue will coagulate and steam escape in 8 to 10 seconds. If a disc electrode to which spikes are attached be employed, the depth of the coagulation will be in direct ratio with the length of the spikes and area of tissue covered by the disc. For example: When spikes one-half inch in length and set one-half inch apart are plunged into the tissues, the

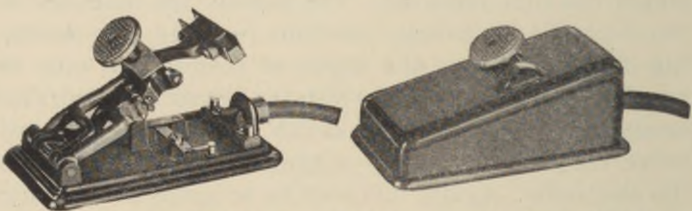


Fig. 34.—Fischer Foot Switch. A convenient device in urological work.

depth of coagulation will be one-half inch below the points of the spikes. Disc electrodes of a larger diameter than one inch are impracticable because the current density is not sufficient to coagulate the tissue in a reasonable time. When the area to be coagulated cannot be covered by a disc of one-half inch in diameter, it is better to move the electrode than use a larger one. When the depth of the tissue to be coagulated exceeds one-half inch it is advisable to employ the spike electrode.

Another factor in depth of coagulation is the degree of moisture in the tissues. The drier the tissue the less the penetration before sparking takes place. Periosteum dries quickly and sparking occurs very soon after application.

The most important matter in technic is the rapidity with which the current is increased after being turned on; the amount turned on should be just sufficient to warm up the tissues and gradually increased so that the coagulation point be reached in 40 seconds; if the maximum of current be employed at the start, the heat will suddenly dry the tissues close to the electrode and the area and depth of coagulation be limited at least one-half. An experiment on dead tissue will easily demonstrate this fact, and when applied to living tissue the reaction of the body tissues further limits the area of coagulation.

When the disc or needle electrode remains after the tissues have become dry, it will adhere to them and when removed will bring particles of tissue with it. This unpleasant feature may be avoided by removal of the electrode while the tissues are still moist. In case a disc electrode does adhere a few drops of hot salt solution on the electrode will facilitate its removal. When coagulated tissue adheres to the needle electrode it must be cleaned before using again by boiling in salt solution.

Coagulated tissue mass should not be removed but allowed to slough unless it is impossible to reach the required depth without, in which case a portion of the growth may be removed with the diathermy knife and the base coagulated by the disc electrode.

The tissues about blood vessels will become coagulated with less heat than the vessels themselves because the moving blood cools the vessel walls but the forcible removal of coagulated tissue near blood vessels is liable to cause a hemorrhage. When bleeding does occur the vascular wall has been destroyed but no thrombus has formed. Under such circumstances the bleeding is best controlled by a disc electrode pressed firmly against the bleeding surface with sufficient current to coagulate the entire vessels. Electrocoagulation should not be performed close to important blood vessels without previous ligation. When small vessels have been coagulated the bleeding is prevented by thrombi which may come away with the sloughing mass and cause a secondary hemorrhage. However, this accident rarely occurs.

When operating close to bone care should be exercised not to destroy the periosteum or a slow healing will follow and a favorable nidus of infection be formed.

Operations about the face, mouth and throat are quickly followed by edema of the surrounding tissues which lasts for two or three days. This calls for no special treatment unless it involves the larynx when a tracheotomy may become necessary. Operations on the larynx require tracheotomy before the operation.

Most operations by electrocoagulation require a general anesthetic; ether on account of its inflammibility should not be employed in operations in the mouth, throat or larynx.

In prolonged operations where very heavy currents are used, the indifferent electrode should be of large

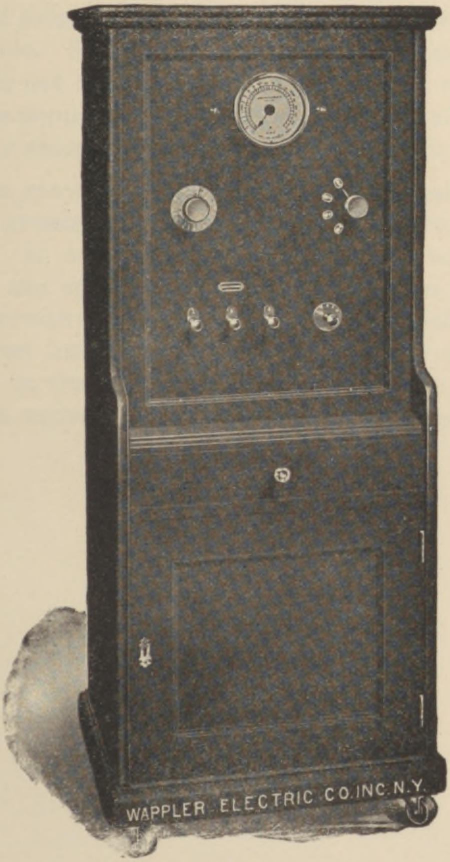


Fig. 35.—The Wappler Telatherm. This apparatus has sufficient capacity for all kinds of high-frequency work.

area and well padded with gauze previously saturated with salt solution. The pad must be kept wet or a burn will result. Such pads act more or less as insulators and their use demands a great increase of current. The electrode should be placed on the back or abdomen and be firmly secured in place by bandage or sand bags.

Some growths are so situated as to make the operation a greater success when no indifferent electrode is used. In such cases two active electrodes are employed; one small disc electrode is placed on one side of the growth and the other, a spike or needle electrode is plunged into the tissues near the disc electrode or possibly on the opposite side of the growth. This procedure is entirely with the option of the operator.

CHAPTER V.

Blood Pressure

CHAPTER V.

BLOOD-PRESSURE.

Physiology. Etiology. Protein sensitization test. Effects of altitude. Blood-pressure reading. The sphygmomanometer. Essential factors. Normal blood-pressure. Conditions affecting blood-pressure. Hypertension. Energy index. Hyperpiesia. Blood-pressure interpretation. Blood-pressure therapy.

Physiology.—The general conditions governing the blood-flow through the circulatory system are the same as those governing the flow of fluid through any system of tubes. The rate of flow from any such system depends upon two essential factors: (1) The head and end pressure of the system; (2) the caliber of the tube at the outlet. Raising the head pressure will increase the flow if the caliber of the outlet remain the same. The flow may be increased by enlarging the caliber of the outlet.

The circulation of the blood is maintained by pressure given by the heart and the resistance offered by the blood vessels. Blood-pressure depends upon five principal factors:

1. Heart force.
2. End resistance.
3. Elasticity of vessel walls.
4. Amount of blood.
5. Viscosity of the blood.

These factors vary somewhat in the norm and very much in disease.

Etiology.—The exact etiology of high blood pressure has not yet been discovered, but considerable evidence has been obtained from which we are tentatively assured that the cause lies in certain substances circulating in the blood. These substances are called *pressor* and *depressor* substances because of their effect upon the pressor and depressor nerve fibers. The pressor substances are probably parts of protein molecules which have been split in an improper manner during the process of digestion. In cases of defective elimination they enter the circulation, and, coming in contact with the pressor nerve fibers, stimulate them to increased activity, causing a spasm of the minute blood vessels with which they are abundantly supplied. The lumen of these small vessels is narrowed, under which condition the systolic pressure rises to overcome the resistance. This condition when prolonged leads to cardiac hypertrophy.

It is also true that influences other than pressor substances circulating in the blood cause elevation of blood pressure, among which may be mentioned pain, worry, mental overwork, anger, etc. The last mentioned causes being usually of brief duration, the hypertension consequently is not continuous. If the pressor substances are continually formed the hypertension necessarily is continuous.

Hypertension is not a disease, but a condition which, if not corrected, leads to pathological changes in the arterial tree.

The chronological data of high blood pressure runs something as follows: 1. Defective metabolism resulting in the formation of pressor substances which enter the circulation and stimulate the pressor nerve fibers to overactivity. 2. Hypertension due to spasm of the arterioles (at which time there is no evidence of arterial degeneration). Later on there are changes in the larger vessels. 3. Cardiac hypertrophy. 4. Kidney dysfunction, intracranial tension, retinal changes, hemorrhages, etc. 5. Chronic myocarditis and nephritis.

Following recent discussions upon the subject of blood pressure it is said that *depressor* substances may be formed through another form of improper splitting up of the protein molecule. When a depressor substance circulates with the blood stream it excites the depressor nerve fibers, causing relaxation of the walls of the smaller blood vessels producing another effect known as *hypotension.*

It is well known that neurasthenia is usually accompanied by hypotension, but there is not sufficient evidence at hand upon which to form a conclusion that depressor substances circulating in the blood is a prominent factor in the etiology of this condition. A high venous pressure naturally increases capillary pressure and this phenomenon, in a way, may account for the low systolic pressure in neurasthenia.

There is a type of hypertension which results from spastic contraction of the external layer of the larger blood vessels. This phenomenon may be due to excitation of the sympathetic nerves with which this muscular layer is richly supplied.

A purely local hypertension is sometimes encountered in the hands, feet and portions of the face. To this form of capillary hypertension Cordier has applied the neonym, *acrocyanosis*. Cordier says, "the primary cause seems to be some toxic action on the vasomotor centers. The nervous intoxication being the successor to some latent infection."

All evidence at our command seems to prove that arterial disease when accompanied by hypertension is the result rather than the cause of the hypertension. Chronic nephritis associated with hypertension is primarily a vascular disease caused by hypertension. The glomerular lesions which are always present in nephritis are of an arteriosclerotic nature: in other words, nephritis is an "arterio-capillary fibrosis"—a neonym given to this condition by Sutton & Gull. The cause of the vascular changes in albuminuric retinitis is also found in hypertension.

It has been suggested by workers in the field of endrocrinology that hypertension is sometimes due to hyperthyroidism and dysfunction of the sex glands and that hypotension is often due to adrenal insufficiency.

Hypertension may be due to venous stasis in the liver or altered viscosity of the blood. Focal infections may give rise to hypertension but more often they cause a lowering of blood-pressure. Fever, pain and worry generally increase the systolic pressure but have little effect upon the diastolic.

Heredity is a dominant predisposing factor in the etiology of diseases of the vascular system. Entire families are often found with poor vascular systems. Some individuals have a poor vascular system from birth and are destined to cardiovascular lesions in early and middle life. Human arteries are not unlike in efficiency the garden hose sold by the merchant; one grade will last one season, another two seasons while the best grade will last for years.

To differentiate the true etiological factor in any particular case of hyper or hypotension requires the most painstaking investigation. To place one's finger upon any one factor and exclaim "Eureka" is extremely hazardous to a correct diagnosis. Too much significance must not be given to any one particular symptom. The experience of the writer leads him to beleive that in a large percentage of cases of hypertension the cause will be found in faulty metabolism due to absorption of the products of incomplete alimentation. It is not usual for metabolism to fail to care for all proteins, but rather particular proteins which must be ferreted out. Many people acquire an anaphylaxis to certain articles of diet such as meat, eggs, beans or certain fruits. It is not the *quantity* of proteins consumed that produces an anaphylaxis as a small amount will react as promptly as a larger one.

The protein sensitization test will often assist in the discovery of some particular protein as the etiological factor. While the test does not prove absolutely that a particular protein is the cause it suggests that such may be a factor.

Sensitization Test.—A slight scarification of the skin of the flexor surface of the forearm is made, not deep enough to draw blood but sufficient to penetrate the skin. On the scarified surface is placed the suspected protein to which is added a drop of 1/10 normal sodium hydroxid solution to dissolve the protein and permit its absorption. At the end of one-half hour the portein is washed off and the reaction noted. Always compare with normal control. A positive reaction consists of a white elevation or urticarial wheel. Positive reaction to any protein suggests its removal from the diet. The effect upon the blood-pressure should be carefully observed.

Another method is the removal of all proteins from the diet for one week. If the blood-pressure is materially reduced in that time it is reasonable to conclude that the patient is sensitive to some particular protein. One protein at a time is added to the diet and blood-pressure carefully noted until the offending one or ones be found, when it should be removed from the diet forever.

Effects of Altitude.—In a normal individual there is little or no effect upon the blood-pressure until an altitude of 8000 feet is reached. Individuals with high pressures who have arterial changes in the form of sclerosis and those with poor vasmotor control do badly in altitudes over 8,000 feet.

Blood-pressure Reading.—Nearly every physician possesses an instrument for the estimation of blood-pressure. This instrument, the sphygmomanometer, consists of two types—one, a column of mercury, the other built upon the principle of the aneroid—both of which record the pressures in millimeters of mercury.

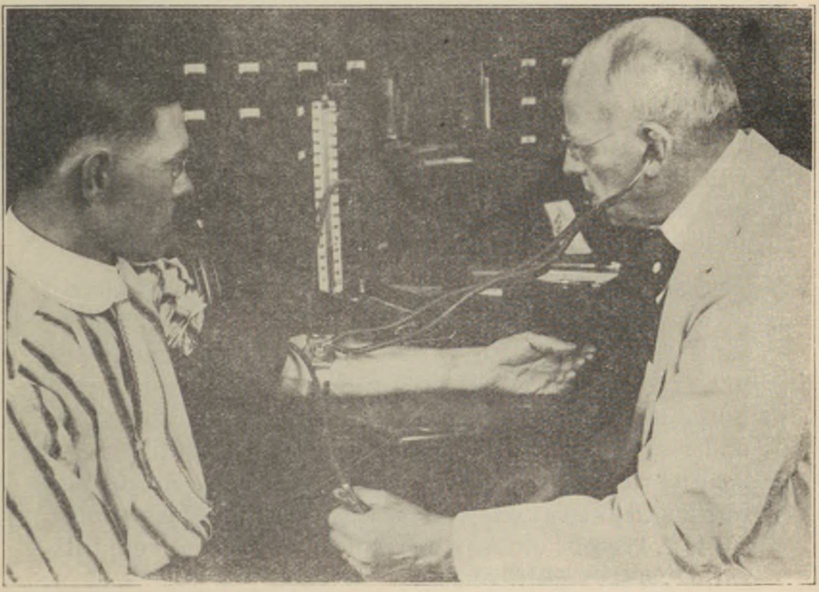


Fig 36.—Taking Blood-pressure with Mercury Sphygmomanometer (Baumanometer).

The technic in the use of both types of instrument is the same. The brachial artery of either arm may be chosen. All constricting clothing should be removed from the arm which rests on a table with all muscles relaxed. The manometer sleeve is applied over the biceps, making sure that it does not impinge upon the elbow joint. Do not wind too tight nor too loose. Place the stethoscope over the radial artery close to bend of the elbow; inflate the sleeve until the instrument records ten points above where all sound ceases then allow the air to escape slowly until the first distinct sound (a distinct click) is audible. The point registered will be the systolic pressure. Open valve slightly and carefully record the point when all sound ceases, which point will be the diastolic pressure. The pulse pressure is the difference between the systolic and diastolic pressures.

Essential Factors.—The essential factors in blood-pressure reading are: Systolic pressure, which represents the energy of the heart during systoli; diastolic pressure, the energy exerted in overcoming resistance; pulse pressure, the energy exerted on the arterial walls and recognized as the pulse. These factors in the norm bear a practically fixed ratio to one another. According to Faught the ratio is 1, 2, 3, viz: pulse pressure 1, diastolic 2, systolic 3. Any substantial deviation from this ratio has its significance.

Normal Blood-Pressure.—Many tests have been made to establish a table of normal blood-pressures. There is no hard-and-fast rule and we can but approximate the normal pressures because a variation of ten points up or down may and usually does occur in the norm during any 24-hour period. The normal limits vary under the following conditions, viz:

1. *Position of the Body.*—About 4 mm. higher when standing than sitting. About 4 mm. lower in the recumbent than in the sitting position. 2. *Muscular Ex-*

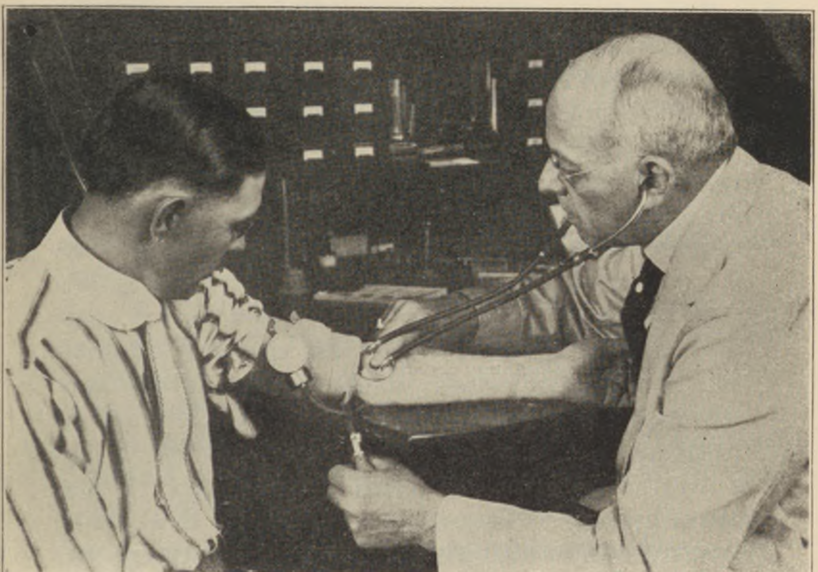


Fig. 37.—Taking Blood-pressure with Aneroid Sphygmomanometer (Tycos).

ertion.—Higher immediately after exercise, amounting to an average of 20 per cent, but should return to normal within five minutes. In exertion followed by fatigue the pressure is lower than normal but should return within an hour. 3. *Excitement, Anger, Passion, etc.* —A sudden rise which may continue for 24 hours. 4.

Time of Day.—Lower in forenoon than in afternoon. 5. *Digestion.*—A fall immediately after a meal followed by a gradual rise, reaching the maximum about one hour after the meal.

In conducting a series of experiments on hyperpietics observations were made of the effects of food upon blood-pressures: A cup of coffee invariably raised the systolic pressure 10 to 15 mm., the pulse pressure also being invariably raised. A bowl of hot cereal and cream lowered the pressure, but when taken cold there was either a slight rise or no effect. A cup of tea was followed by the same effect as coffee. A square meal of meat, potatoes, bread, butter and dessert was followed by lower systolic and pulse pressures, but after two hours the systolic pressure was raised by 20 to 30 mm., and did not return for 24 hours. Raw oysters were followed by a rise of 10 to 15 mm. which remained for 24 hours. Toast, bacon and eggs, followed in one hour by a rise of 10 mm., returning in 4 hours. In one case of hyperpesia buttermilk was followed by a rise of 10 mm. which remained for 24 hours. However, buttermilk usually has the effect of lowering the pressure after a few days' consumption of one to two pints per day.

6. *Locality.*—Usually a difference of about 4 mm. between the right and left side arteries, also between the femoral and brachial arteries. A difference will be found between a fat and a lean arm.

7. *Sleep.*—During sleep the systolic pressure in men is about 94 mm. and in women 88 mm. in normal

conditions. The drop during sleep is due to general relaxation of the arterial musculature. Blood pressure elevation due to functional disturbances while awake is wiped out during sleep. Systolic blood pressure elevation due to pathological changes while reduced will be found to be 100 or over during sleep.

8. *Pain.*—Intense pain will always increase blood-pressure—the greater the intensity the greater the elevation. Taking the blood-pressure of patients complaining of pains will aid materially in diagnosis. Gastric crises of tabes dorsalis will often raise the blood-pressure 70 to 80 mm. Hysterical and neurasthenic pains have no effect upon blood-pressure.

9. *Age.*—It is quite probable that age in itself has no effect upon blood-pressure, the moderately elevated pressures found in elderly persons being due to abnormal vascular conditions.

While different observers make tables of their own and all vary somewhat, the following will be found practical and safe:

TABLE OF BLOOD-PRESSURE AT DIFFERENT AGES.

Age	Systolic	Diastolic
10 to 17	80 to 110	50 to 70
20 to 30	120 to 125	70 to 85
30 to 40	120 to 130	75 to 90
40 to 50	125 to 135	80 to 90
50 to 60	130 to 140	80 to 90
60 to 70	135 to 145	85 to 100
70 to 80	140 to 150	90 to 105

Females 10 mm. lower for same ages.

A sustained systolic pressure of over 150 or diastolic of 105 or over, at any age, is always pathological.

Hypertension means a sustained blood-pressure above normal; *hypotension* means a constant pressure below normal; *hyperpiesia* means hypertension without cardiovascular changes.

Hypertension does not always depend upon the work of the heart, since it has been noted often that in cases of weakness of the heart muscle the pressure may be high.

The systolic pressure alone cannot be depended upon unless supported by the diastolic and pulse pressures together with the pulse rate.

It is also important to know the total amount of energy spent by the circulatory system in a minute or an hour. This information is of value in cases where we suspect the giving-way of the vessels—such as apoplexy and other hemorrhages.

ENERGY INDEX.

Barach has applied the neonym "Energy Index" to the method of obtaining the above information. He says: "From the pulse rate we know how many systoles and how many diastoles to each minute there are in the arterial tree." For example, if the systolic pressure is 120 mm., the diastolic pressure 70 mm. and the pulse rate 72 per minute, the energy exerted in one minute would be:

In systole 120x72 or 8,640 mm. of Hg.
In diastole 72x72 or 5,040 mm. of Hg.
In both 190x72 or 13,650 mm. of Hg.

The energy index is obtained by multiplying the sum of the systolic and diastolic pressures by the pulse rate. Repeated experiments show that the maximum energy index consistent with safety to the vascular system is 21,000 mm. of mercury. The normal index range is from 13,000 to 20,000. When less than 13,000 it suggests general weakness; when above 20,000 an excessive circulatory load which will sooner or later, if not corrected, lead to disastrous consequences.

A careful consideration of blood pressures, pulse rate and energy index will yield an abundance of information of inestimable value in arriving at a diagnosis of many pathological conditions.

In taking readings on the same patient over a period of time it is important that they be taken as near the same hour of the day, the same time from a meal and under conditions as nearly alike as possible.

BLOOD PRESSURE INTERPRETATION

The interpretation of signs elicited through the aid of mechanical diagnostic devices is liable to be faulty. Based upon the readings of the sphygmomanometer, many conditions are erroneously assumed to be present, nevertheless, it is one of the most useful diagnostic aids in our armamantarium.

My acquaintance with physicians who use the sphygmomanometer leads me to believe that a very large proportion of them are satisfied with systolic readings; a greatly reduced number take both the systolic and diastolic pressures and but few compare these readings with the pulse rate.

While the systolic pressure taken alone may give some idea of vascular tension it is of little value in diagnosis. The diastolic pressure is a better guide to diagnosis than the systolic. Systolic pressure represents the force of the heart to drive the blood through the arteries. The diastolic pressure represents the tension which the arterial walls exert upon the blood; it is the pressure that the left ventricle must overcome before the aortic valve opens. The systolic and pulse pressures show heart values and the diastolic pressure shows resistance to be overcome. The systolic pressure is easily influenced by psychic phenomena. It has been suggested that the courts take cognizance of this fact by submitting witnesses on the stand to blood pressure tests to test their veracity. If the witness bears false testimony his systolic pressure will suddenly rise; if he is telling the truth there is no effect upon the blood pressure. Anger will raise the systolic pressure from 10 to 80 mm of mercury with little or no effect upon the diastolic. The elevation of the systolic pressure is more or less a physiological process; the elevation of the diastolic pressure depends largely upon pathological changes.

Pulse pressure, the difference between the systolic and diastolic pressures, when taken by itself represents the force applied to the arteries by the heart during systole or the heart's energy which produces a distension of the arteries known as the pulse. The pulse pressure represents the heart load or overload and is of great importance in prognosis. The pulse pressure should be fifty percent of the diastolic and an increase of 40 mm in load would indicate that danger is lurking near.

The importance of the pulse rate in connection with the systolic and diastolic pressures may be appreciated by reference to the following examples: A normal systolic, high diastolic and *high* pulse rate suggest myocardial weakness—a normal systolic and diastolic with a *low* pulse rate suggest the opposite, cardiac hypertrophy.

A low systolic, normal diastolic and *normal* pulse rate suggest neurasthenia while the same systolic and diastolic pressures with a *high* pulse rate suggest tuberculosis or other infection.

A high systolic, high diastolic and high pulse rate suggest failing heart while the same pressures with a *low* pulse rate suggest arterial changes and a competent heart.

A high systolic, low diastolic with a normal pulse rate suggest a weak myocardium, while the same pressure with a *high* pulse rate points to thyroid intoxication.

Many other examples could be cited but these will illustrate the importance of considering the pulse rate with blood pressures in differentiating cardiovascular conditions.

In typhoid as the disease progresses the systolic pressure gradually falls and the diastolic gradually rises with a corresponding lowering of the pulse pressure; the lowering of the systolic is not of much importance provided the diastolic remains normal, but with a descending systolic and ascending diastolic a weakening of the heart is imminent. About the third or fourth week of the disease, a gradual rise of the systolic and decline of diastolic is an indication of recovery. A sudden fall followed by a rapid rise of the systolic points to perforation. The blood pressures and pulse rate are of more importance than the temperature in prognosis of this disease.

Blood pressures are of signal importance in tuberculosis. A condition of hypotension exists for a long time prior to any manifestations of physical signs. When tuberculosis is suspected and hypotension is not present we may be almost assured that our suspicions are groundless. The differentiation between pleurisy and tuberculosis is often difficult; if the systolic and diastolic pressures are normal the evidence is in favor of pleurisy; if the systolic is low, diastolic normal and pulse rate high, the evidence is strongly in favor of tuberculosis. However, it is possible in cases of nephritis combined with tuberculosis that the effects of the nephritis on the vasomotor mechanism may offset the hypotension of tuberculosis, but low pressures in nephritis suggest tuberculous kidney. A gradual rise of systolic and gradual decline in pulse rate point to an arrest of the disease. In tuberculosis the pulse rate per minute is frequently higher than the systolic pressure in mm of mercury, but when this occurs in an acute disease like pneumonia an unfavorable prognosis is suggested.

Hypotension always means lowered vitality and occurs in acute infections, chronic wasting diseases, most nervous diseases, some cardio-vascular conditions, blood dyscrasias, intoxications, etc.

Another factor in blood pressure interpretation which is often underestimated is the position of the patient.

All readings especially the first should be taken in the horizontal (supine) sitting and standing positions. If these readings are reversed they indicate vasomotor insufficiency, myocardial weakness or an accumulation of blood in the splanchnic area.

With a normal heart the pulse pressure will fall upon changing from the supine to erect position.

NORMAL RELATION OF COMPONENT ELEMENTS OF BLOOD-PRESSURE

Position	S.	D.	P. P.	P. R.	E. I.
Standing	124	90	34	84	179
Sitting	120	80	40	80	160
Supine	116	78	38	75	145

If there be a rise in pulse pressure on changing from the supine to standing position it points to cardiac hypertrophy. Example:

Position	S.	D.	P. P.	P. R.	E. I.
Supine	135	70	65	60	123
Standing	150	70	80	68	150

The diastolic pressure in changing position from horizontal to erect rises in the norm. If it lowers look for valvular disease of the heart. Example:

Position	S.	D.	P. P.	P. R.	E. I.
Supine	135	60	75	90	175
Standing	135	50	85	90	166

Should there be a fall in all pressures in changing from supine to standing position it points to cardiac dilatation which an examination of the heart will confirm. Example:

Position	S.	D.	P. P.	P. R.	E. I.
Supine	110	70	40	90	162
Standing	90	55	35	110	159

A continued pulse pressure higher than the diastolic points to failing heart, although such a condition may prevail for a short time in hyperpiesia. A high diastolic pressure always means great vascular tension and when constant points to cardiovascular changes.

A normal systolic, high diastolic with high pulse rate suggests a poor myocardium. The deficient heart muscles require an increased rate of contraction to overcome the peripheral resistance or diatolic pressure. This condition leads to cardiac dilatation. Example:

S.	D.	P.P.	P.R.	E.I.
135	110	25	100	245

A normal systolic, low diastolic with a low pulse rate suggests that the diastolic pressure is making an effort to compensate for an over-worked heart. This condition leads to cardiac hypertrophy. Example:

S.	D.	P.P.	P.R.	E.I.
135	70	65	60	123

A normal systolic and pulse rate with an extremely low diastolic suggests aortic insufficiency. The diastolic is failing in its effort to compensate for the increased cardiac effort. Example:

S.	D.	P.P.	P.R.	E.I.
135	40	95	76	126

A high diastolic, high systolic with but slightly increased pulse pressure and a normal pulse rate suggests vascular changes met with in arteriosclerosis. Example:

S.	D.	P.P.	P.R.	E.I.
210	150	60	70	252

A high systolic, high diastolic with low pulse pressure and high pulse rate suggests failing myocardium. Example:

S.	D.	P.P.	P.R.	E.I.
180	160	20	110	374

A low systolic, normal diastolic, pulse pressure and pulse rate suggests neurasthenia. Example:

S.	D.	P.P.	P.R.	E.I.
100	70	30	80	136

A low systolic, normal diastolic and pulse pressure with increased pulse rate suggests cardiac insufficiency. Example:

S.	D.	P.P.	P.R.	E.I.
110	70	40	100	180

A low systolic normal diastolic and low pulse pressure with increased pulse rate suggests infection. This condition is met with in tuberculosis. Example:

S.	D.	P.P.	P.R.	E.I.
90	70	20	100	160

A low systolic and diastolic with increased pulse pressure suggests abnormal relation of the components of the blood as met with in anemia. Example:

S.	D.	P.P.	P.R.	E.I.
100	30	70	100	130

The normal range of diastolic pressure is from 70 to 90 mm. of mercury. A persistent diastolic pressure of 130 which cannot be reduced suggests a fatal termination within a period of from two to five years.

When all pressures are low general infection is suggested. In cases of hemorrhage a progressive decline in pulse pressure indicates a continuance of the hemorrhage.

Systolic pressure is easily influenced by physiological factors, while the diastolic is not so easily influenced. Systolic and pulse pressure show heart values; diastolic shows end resistance.

In myocardial degeneration with or without arrhythmia there may be high blood-pressure, but sooner or later the pressure falls. In such cases if the pulse pressure be much over 50 per cent of the diastolic, look out for heart failure. In myocardial disease mild exercise will be followed by a fall in the systolic pressure. If the heart be competent there will be a slight rise in pressure. In cases of nerve exhaustion the systolic pressure may be lower in the standing than in the sitting position. Systolic pressure may be high in cases of weak heart due to the action of the vasoconstrictors in an effort to compensate for cardiac insufficiency.

In organic heart affections the pulse pressure may be normal, but should it suddenly increase decompensation is indicated. Normally the pulse rate is 8 to 10 beats faster in the standing than in the recumbent position. In cases of failing heart the rate may be as fast in the recumbent as in the standing position. In aortic incompetency there is a high systolic and low diastolic pressure, hence a high pulse pressure.

In mitral stenosis the systolic pressure is low on account of the small amount of blood passing from the auricle to ventricle. It is possible, however, to find normal pressures in valvular diseases of the heart.

HYPERPIESIA.

Hyperpiesia is a word coined by Dr. Clifford Allbut descriptive of cases of hypertension without marked cardiovascular changes.

Hyperpiesia is a premonitory indication of pathological changes yet to come and is not, as has oftimes been supposed, the result of arterial changes. In other words, hypertension is now considered to be the primary cause of structural changes in the arteries. Persistent hypertension naturally causes cardiac hypertrophy which develops to overcome the resistance. This is a physiological and not a pathological process. Whenever hyperpiesia exists it may be known that in the course of time hypertrophy will follow unless the cause be removed. Heart murmurs are ear-marks of previous hyperpiesia.

The argument that hypertension is compensatory and should not be interfered with will not hold good, as the condition antedates by months and even years the cardiac hypertrophy and kidney lesions.

TREATMENT OF CARDIOVASCULAR CONDITIONS.

Much has been said and written for and against the use of high frequency currents in cardiovascular conditions, but after many years experience the writer is willing to go on record in saying that hyperpiesia or that stage of hypertension which exists for years prior to pathological changes in the arteries, in a large majority of cases, can be cured by a combination of high frequency currents and common sense hygienic measures.

After a hyperthrophic condition of the smaller blood vessels and a mild degree of cardiac hypertrophy has developed as evidenced by a systolic pressure of 170 or less, a normal or slightly elevated diastolic accompanied with a normal pulse rate, the effects of treatment, while not so prompt, are satisfactory and a favorable outcome may be expected.

Even after the urinary and blood findings justify a diagnosis of nephritis, the systolic pressure very high and diastolic under 120, with a slightly decreased or increased pulse rate, while the cardiovascular condition cannot be restored to normal, much may be done toward prevention of further changes in the arterial tree.

The systolic pressure alone, regardless of its height, is no guide at all in the consideration of prognosis, but when the diastolic persists at 120 or above for a period of two years a fatal termination within one or two years more may be expected. Yet under these conditions much can be done to modify the symptoms and make the patient comfortable.

High frequency currents in the form of autocondensation, diathermy and the unipolar application, each under indications of its own, are employed in the management of cardiovascular conditions.

Hyperpiesia or hypertension prior to cardiovascular changes is easily controlled by auto-condensation. The patient should be treated daily until the systolic pressure reaches the same point after each treatment for three days in succession. This point is known as *fixed tension* and it will be impossible further to reduce the pressure. When the point of fixed tension is reached the frequency of the treatments is so regulated that this point may be approximately maintained. The patient for a time should report at least once a week for blood pressure reading. If there be no important rise in pressure for a month the periods between reports may be extended to 30 days. Every person in supposed good health should have his blood pressure taken at least twice a year that faulty conditions may be detected and corrected.

The blood pressure in hyperpiesia can always be reduced to normal and be maintained if it has not exceeded 170 systolic. In cases of nephritis with hypertension, while the pressure may be lowered it cannot be maintained without increased elimination by the kidneys.

A normal or slightly elevated systolic, high diastolic and high pulse rate suggest a poor myocardium.

This condition is best treated by autocondensation, 350 to 450 milliamperes for a period of 10 to 12 minutes; the milliamperage and time may be varied to suit the case, but strong currents must be avoided. After the pressures have been reduced nearly or quite to normal a static breeze over the precordial region is of value in restoring efficiency to the heart muscle. In case a static breeze is not available a high frequency effluve may be substituted. Cardiodiathermy is also of value in this condition.

A normal or slightly elevated systolic, a very low diastolic and high pulse rate point to aortic insufficiency. Autocondensation in this condition will probably do more harm than good. The diastolic may be raised and the systolic lowered at the same time by application of the static wave current over the third to sixth cervical vertebrae. The unipolar application of the high frequency current to the same locality, while inferior to the static wave, is of value in the reduction of high pulse pressure in these cases.

A very high systolic, very high diastolic with a normal or low pulse rate suggest arterial changes. While autocondensation is indicated in this condition, it is advisable to begin the treatment with a low amperage, not over 300 milliamperes, for a period of 10 minutes and gradually increase the dosage from time to time, but it is not advisable to exceed 600 milliamperes at any time. Now and then a case will be met with in which the pressures will be higher immediately after the treatment, but will be found to be much lower the following day. While a gradual decline in pressures may be anticipated, a return to normal can only occasionally be experienced. Unipolar high frequency currents are contraindicated in this condition.

In connection with autocondensation a careful hygienic management is required in order to hold the pressure near to normal limits and prevent cerebral accidents. See Arteriosclerosis.

High blood pressures may be reduced through excitation of the depressor nerve fibers by concussion or vibration of the second to fifth dorsal interspaces. In some cases the same results may be achieved by unipolar application of the high frequency current through a double pronged spinal electrode to the same area, but a strong current is required. However, the unipolar current is liable to have the opposite effect and raise the blood pressure.

The writer has never seen a high systolic pressure that could not be reduced by high frequency currents. However, he has seen a few patients who require daily treatments to keep the pressure below 200. These usually are cases of interstitial nephritis associated with marked cardiovascular changes. While such cases do not yield to autocondensation, much can be done for them by diathermy to the liver and kidneys. As a general rule valvular diseases of the heart with decompensation are benefited by high frequency effluve to the cervical region and static breeze to the precordial region.

In cases of hypotension of nervous origin the blood pressure may be raised through excitation of the pressor nerve fibers by concussion or vibration of the sixth and seventh cervical vertebrae or by application of the slow sinusoidal or high frequency current. Another method of raising blood pressure is: apply a metal electrode to the epigastrium with a vacuum or non-vacuum electrode over the sixth and seventh dorsal vertebrae, emitting a succession of sparks within toleration of the patient.

For treatment of hypotension due to loss of nerve tone, see Neurasthenia.

CHAPTER VI.

Pain

CHAPTER VI.

PAIN.

Definition. Painful stimuli. Classification. Referred pain. Reflex pain. Occupational neuroses. Inflammatory pain Susceptibility to pain. Persistency of pain. Digestive pain. Muscular spasm. Backache. Pain in the limbs. Penile pain. Shoulder pain. Subacromial bursitis. Treatment of subacromial bursitis. Headache.

Definition.—Nearly all diseases either commence with or have pain as a symptom at some time during their course. Pain is a mental interpretation of a harmful process occurring in the organism and is due usually, if not always, to pressure from within or without the nerve sheath.

The mind interprets three kinds of sensations: Painful, pleasurable and neutral.

Painful Stimuli.—The intellect is able to produce sensations of pain without any objective means, the result being known as *subjective pain.* The production of pain depends upon a proper stimulus. The stimuli which produce pain may be divided into those due to pressure, toxemia, chemical, electrical and thermic reactions, all of which in their finality may be reduced to pressure. The mind being capable of interpreting but a single sensation at a time, pains of equal intensity cannot be felt in two places at the same time.

Classification.—There are many types of pain, such as emotional, subjective, associated, referred, reflected, occupational, objective, organic, functional, sympathetic, habit, etc. While all types of pain are important

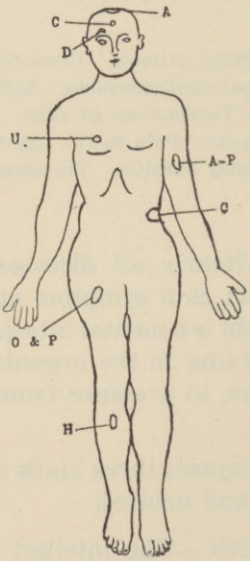


Fig. 38.—Location of Reflex Pains. A, anemia; C, constipation; D, dental infection; U, uterus; A-P, angina pectoris; O and P, ovaries and prostate.

and interesting to the physician, for obvious reasons only the most important in high-frequency practice will be discussed.

Referred Pain. — When irritation occurs in the course of nerve fibers, and pain is experienced in the peripheral distribution of those fibers, it is called *referred pain.*

Examples of referred pain: Pain in the knee from hip-joint disease; leg ache from prostatitis; penile pain

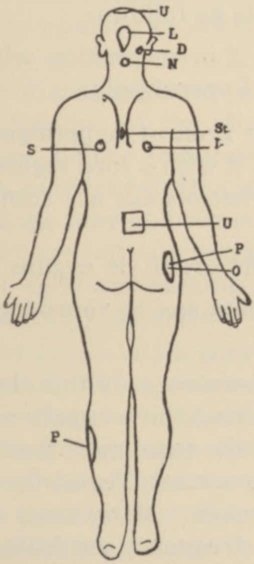


Figure 39.—Location of Reflex Pains. D, dental infection; L, liver; N, neurasthenia; O, ovary; P, prostate; S, spleen; St, stomach; U, uterus.

from calculus in the bladder; pain in the fingers from brachial neuritis.

Reflex Pain.—Painful stimuli carried to the cord and from there deflected to some secondary neuron is known as *reflex pain.* It differs from referred pain in that it is deflected from one set of neurons to those of another system.

The most common examples of reflex pains are those due to diseased viscera.

The Behan method of localizing the viscus causing the reflected pain is as follows:

1. Determine if in connection with it, there is an associated area of hyperalgesia.

2. Delimit the area of hyperalgesia as nearly as possible and orient it with a cord segment.

3. Find out what organs are supplied by this segment.

4. Examine the organ or organs for disease.

5. See if the pain can be reproduced by manipulation of the organ.

Occupational Neuroses.—In this class the pain is induced only thru making the occupation movements, and every repetition of the same movement will cause pain. This condition occurs most frequently with piano players, typists and penmen. Many cases are benefited but few cured by high-frequency currents. The only cure lies in change of occupation.

Inflammatory Pain.—The principal cause of pain in inflammatory conditions is pressure from stasis. The throbbing character of the pain is due to the alternate contraction and dilatation of the vascular walls. While stasis exists in all inflammatory conditions, many important viscera are not supplied by sensory nerves to convey the stimulus to the brain, therefore are painless.

Practically all non-infectious inflammations are amenable to high-frequency currents.

Susceptibility to Pain.—Susceptibility to pain varies with the individual, light skins being more susceptible than dark ones. Unsusceptibility to pain may be due to lack of mental development. Will-power may be sufficiently intense to produce an immunity to pain. There are many degrees of intensity of will-power to withstand pain. Emotional influence may be sufficient to overcome interpretation of the stimuli which produce painful sensations, or the emotions may be carried to such a high pitch as to transform pleasure into pain sensations. Sensations may be both pleasant and painful. Pain and pleasure are but attributes of sensation. Heat, cold, taste, smell, sight and hearing may all be painfully as well as pleasurably perceived.

Persistency of Pain.—Pain may be *constant, remittent or intermittent.* When constant it calls for investigation into conditions which act constantly, such as new growths which press upon the nerve fibers somewhere in their course. When the pressure is constant the pain also is constant, but it is usually referred to peripheral distribution of the nerve fibers.

If an inflamed mass has periods of less congestion these periods will be accompanied by pain of a remittent character. A remission of pain may be complete for a time again to reappear. This form is known as intermittent pain.

Pains of intense paroxysmal character are known as *crises.* They come suddenly and suddenly disappear. This form of pain is usually caused by muscular spasm, and the cause of the muscular spasm may be far removed from the site of the pain.

Digestive Pain.—Pain experienced during digestion occurs only when there is some disease of the food tube or organs closely related thereto. Pain during ingestion of food points to disease of the esophagus or cardiac end of the stomach; immediately following the ingestion of food, gastric ulcer is suggested; two or three hours after taking food, duodenal ulcer is suspected; four to five hours after food is taken, gall-bladder disease is thought of; six to seven hours after a meal, pain suggests trouble in the appendix or colon. If ingestion of food relieves pain, duodenal ulcer is suspected.

Muscular Spasm.—Muscular spasm is a frequent cause of pain. Spasm of certain muscles producing pain leads to an investigation of all joints, periosteum, bone and all tissues and organs liable to inflammation in the neighborhood as well as the corresponding spinal segment area. Spasm of muscles lying over an inflamed viscus is nature's method of protection.

Backache.—Among the diseases associated with pain in the back may be enumerated lumbago, trauma, inflammation, debility, fatigue and neuralgia of muscles; inflammation of joints; caries, eroding growths and trauma of bones; tumors and inflammation of the meninges and cord; referred from diseased viscera; infectious diseases, herpes and tuberculosis. (See Neurasthenia).

Pain in the Limbs.—Generally pains in the limbs result from systemic disease; however, in a few instances the pains are associated with local lesions. Soreness, stiffness and local tenderness may result from overstrain. Legache and general muscular pains are quite common at the onset of acute infectious diseases such as coryza, tonsilitis, influenza, etc.

Chronic pains in the limbs occur in diseases such as peripheral neuritis, all forms of arthritis, liver and kidney disease, blood dyscrasias, arteriosclerosis, locomotor ataxia, disease of the spine, disease of sacroiliac and hip joints and many disorders of the pelvic viscera. Hysterical and neurasthenic patients often complain of pain in the limbs.

Penile Pain.—Pains in the penis are nearly all referred from disease of the uretha, prostate, bladder or kidney. Pain experienced during micturition points to disease of the urethra or prostate; pain immediately following urination points to some lesion of the bladder. Penile pain not associated with micturition is usually due to some local lesion or referred from the ureter or kidney. Ejaculatory pain suggests verumontanitis.

Shoulder Pain.—Pain in the shoulder may be due to local conditions of the shoulder or causes more or less remote. Among the local causes may be enumerated: Trauma, arthritis, bursitis, neuritis, occupational neuroses and local palsies. Among the remote causes may be mentioned cardiovascular, pulmonary and mediastinal lesions; gastric and duodenal ulcers; diseases of the liver; diseases of the spine; nerve lesions affecting the brachial plexus and focal infections.

Shoulder is rather an indefinite term and may mean any place from the posterio-inferior angle of the scapula to the elbow. The most painstaking examination is necessary to a correct diagnosis of the cause of shoulder pain. The first important thing to do is *to locate* the pain. If definitely localized in the region of the shoulder it points to a lesion of the joint, bursæ, ligaments, muscles or nerves about the joint. Pain about the scapula usually suggests remote causes; if under the left scapula, digestive causes; if under the right scapula, hepatic causes; if of a constructive nature about the entire shoulder and deltoid it suggests cardiovascular disturbance.

The shoulder is supplied by the suprascapular and circumflex branches of the brachial plexus, and irritation of these nerves is likely to be reflected and cause pain in any part of the plexus.

Tenderness and pain about the claviculo-acromial juncture, following trauma accompanied with painful abduction of the arm, without x-ray findings, are most surely caused by infiltrations.

Teniosynovitis of the biceps tendon may cause shoulder pain. Irregularities in the bursæ are common causes of shoulder pain, the symptoms of which are retarded movement accompanied by crepitus and periods of exacerbation and apparent recovery.

In brachial neuritis the pain and tenderness are to be found under the spine of the scapula or about the deltoid, the joint being unaffected.

Subacromial bursitis is often the result of indirect or direct violence, overstrain, sudden jerking of the arm common with ball players and in certain occupations. The symptoms of subacromial bursitis are ten-

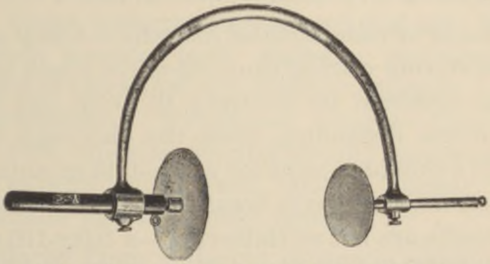


Fig. 40.—The Universal Diathermy Clamp. A practical electrode for application of diathermy in difficult places. The two round electrode discs are made of block tin. The set screws hold the electrodes in place during treatment. It is especially useful in the application of diathermy to the shoulder, hip, knee, kidney and to face in "tic."

derness just below the acromial process and which disappears with adduction of the arm; pain over the deltoid and upon adduction of the arm. The familiar catch-pain upon adduction is significant.

To diagnose between bursitis and tuberculosis is often difficult. The history of the patient and the roentgen ray will assist in the differentiation. Arthritis may be differentiated from bursitis by observing the degree of abduction. In bursitis this is limited to a few degrees without pain, while in arthritis there is no abduction without pain.

There are three stages of subacromial bursitis: Congestion, following trauma or infection; adhesion and contraction; deposit of lime salts in or underneath the bursæ and atrophy of the shoulder muscles.

Treatment of Subacromial Bursitis.—Daily application of diathermy during the congestive stage of bursitis will be followed by recovery in from one to four weeks, success depending upon the thorough heating of the entire shoulder joint for at least 45 minutes every day. The second stage is treated in the same manner but the results are not so flattering—a fifty-fifty result may be anticipated in from six to eight weeks. The third stage may be treated by diathermy, radiant-light-heat for temporary relief, but surgery followed by physiotherapeutic measures for restoration of muscular function is the best treatment for this stage of the disease.

Headache.—The most common pain complained of by man; a concomitant symptom of many diseases and pathognomonic of none. It is the leading symptom of many functional and pathological conditions. Were we to consider one thousand cases of headache taken as they naturally come, we would find 350 due to psychoneuroses; about 200 from nephritis; about 200 due to hypertension, eyestrain and infectious diseases; 100 to meningitis, sinusitis, neuralgia and migraine; about 50 to brain tumor and syphilis and about 100 from unknown causes.

Two causes, *toxic* and *functional,* may be mentioned among those of headache outside of organic diseases within the skull. The *toxic cause* may be divided into two groups: 1. Due to toxic causes outside the body; 2. Due to toxemia produced within the body. Included in the first group are alcohol, tobacco, mineral poisons, certain drugs, poisonous gases and foul air; in the second group uremia, gout, diabetes, constipation and other gastro-intestinal disturbances, specific fevers and local infections. *Functional causes*—Hypertension, hypotension, anemias, mental strain, menstruation, migraine, epilepsy, eye-strain, fatigue, hunger, hysteria, neurasthenia and persistent noise.

Headache from reflected causes is common and in many instances suggests the causative factor but often is no guide at all. A pain in the top of the head suggests uterine disease, but many men suffer from pain in this locality. Pain in the occipital region suggests eye-strain, but it may be caused by a diseased prostate. Frontal headache suggests gastro-intestinal disturbance: it may be caused from sinusitis. The pain from an infected tooth may simulate trigeminal neuralgia. Earache, while suggesting aural disease may be caused by infection in the nose or throat. Headaches of a throbbing, boring and burning character suggest brain tumor but may be due to extrinsic causes. The character of the headache is of little importance in diagnosis. Syphilitic headache is worse at night, but not all nocturnal headaches are due to syphilis. The passing of a headache at about the noon hour and returning at some definite time suggests malaria but may be due to infection, especially that of influenza.

One of the causes of headache especially in women and children is pituitary hunger which may be termed carbohydrate dipsomania or craving for sweets. A candy spree is often followed by pituitary headache; the pain is deeply seated behind the eyes and persists from one to forty-eight hours. The spree terminates, not unlike alcoholic intoxication, in nausea and vomiting.

In locating the cause of headache do not minimize the patient's story: it will often lead to a diagnosis of psychoneurosis or disturbance of the vasomotor mechanism. While the majority of causes of headache are extrinsic it is best to thoroughly examine the eyes, the nose and its accessory sinuses; take the blood-pressure and temperature and look for foci of infection; examine the blood and urine. A Wassermann test will often clear up a difficult diagnosis.

The treatment of headache depends entirely upon the cause. Many cases are amenable to treatment by high-frequency currents especially when due to vasomotor disturbances. Above all things, the route which leads to the acetanilid shelf should be avoided.

Note.—Much of the information contained in this chapter is gleaned from the writings of Richard J. Behan and Richard C. Cabot.

CHAPTER VII.

High-Frequency Therapy

CHAPTER VII.

HIGH-FREQUENCY THERAPY

ABSCESS.

Essential Features.—Acute when due to staphylococci, streptococci and other microorganisms; chronic when due to a specific microbe such as the bacillus of tuberculosis.

Therapy.—High-frequency currents are contraindicated in all closed cavities containing pus, however, abscesses such as boils, carbuncles, etc., may be aborted by early application of the high-frequency current from a vacuum or non-vacuum electrode carrying a current capacity of 1½-inch spark. The electrode should be in contact with the part for a period of 5 to 8 minutes.

Physiology.—The current raises the temperature of the part and produces an intense hyperemia; the capillaries are dilated; the arterial blood supply is increased flooding the part with fresh blood which clears the congested area of microorganisms. In cases of accumulation of pus, it can be readily understood that this procedure would carry a large amount of purulent matter into the general circulation which might result in metastatic abscesses or general pyemia. The borderline cases require skill in differentiation. There can be no objection to the use of high-frequency currents after the abscess is opened and drainage established and are often of great service in cleaning the field of micro-organisms.

Zinc ionization is to be preferred in all closed abscesses. See Ulcers.

ACNE.

Essential Features.—Acne may or may not be a bacterial infection. In acne vulgaris the mouth of the sebaceous gland duct is obstructed, the plug appearing on the surface as a small black point—the comedo or black head. The lesion may remain in this stage, but it usually grows into a reddish papule when the lesion is known as *acne papulosa,* the papules having no disposition to form pus and disappear by absorption or exfoliation.

In *acne pustulosa* the papules are usually of large size and pass rapidly into the pustular stage. The infection is usually of the streptococcus family. It is quite common for black heads, papules and pustules to be present at the same time. When the papules are crowded together and form an indurated mass the lesion is called *acne indurata.*

The diagnosis is usually easy but should be differentiated from syphilis sycosis, variola and varicella.

Therapy.—The first indication to be met is the removal of the plug to the gland duct; the following lotion is very efficacious in cleaning the duct. Green soap and alcohol equal parts—apply freely and wash out with clear water. After removal of comedones the high-frequency current from a vacuum or non-vacuum electrode will stimulate the sebaceous glands by increasing the activity of the circulation, carrying away effete products and restoring normal function. In acne pustulosa all pustules should be opened and the pus expressed with the side of a needle. The electrode should be kept on the skin and moving to avoid sparks which are irritating and should be avoided. Hyperemia is the effect desired.

The time consumed in each treatment cannot be stated definitely on account of the variation of the sensibility of different patients' skin.

Treat every second day until results are obtained. While the treatment of acne by high-frequency currents is quite satisfactory, it is less efficacious than fractional doses of X-ray which require from one to four exposures. Actinic rays from a standard apparatus is said to be beneficial in this disease.

ACNE ROSACEA.

The local application of high-frequency currents thru a vacuum tube is of little if any benefit in this disease. The effects being to further dilate the already over dilated vessels.

Dr. William L. Clark treats cases of moderate hypertrophy of the nose by desiccation. His technic is as follows: After local anesthetization with a solution of novocaine and adrenalin (2%), a small needle is inserted at right angles directly into the hypertrophied tissue as deeply as is necessary, and the current allowed to pass for a few seconds until slight blanching takes place. The needle is again inserted about six millimeters away from the original puncture, and so on until the whole involved area is systematically treated. Clark says: "The heat from the current sterilizes the infected glands, obliterates the sebaceous orifices and dilated capillaries, and restores the nose approximately to its normal color. The scar tissue produced by the heat from the current causes the hypertrophic connective tissue to contract in the course of several weeks with subsequent reduction in size of the nose. A second treatment after an interval of about three months will cause still further improvement."

ADENITIS.

High-frequency currents in the form of diathermy may be used with benefit in glandular infections before suppuration has taken place, but are less effective than one intense dose of X-ray. After suppuration has taken place the gland should be treated as an abscess.

ALBUMINURIA.

Albuminuria is a term employed to denote the presence of one or more albumins in the urine. It may or may not be a symptom of disease. It often occurs in febrile diseases, diseases of the nervous system, violent exertion, cystitis, enlarged prostate, exopthalmic goiter, etc. When accompanied with a pathological amount of renal casts we are justified in making a diagnosis of nephritis.

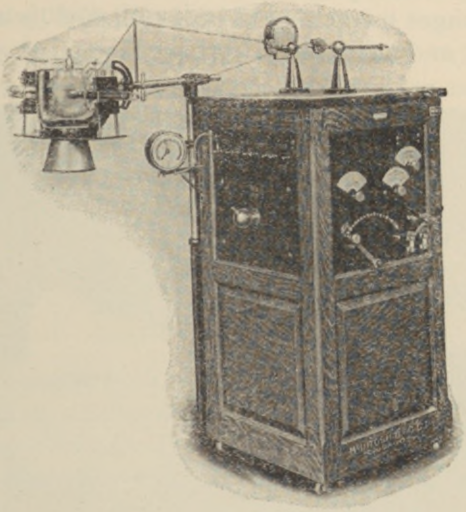


Fig. 41.—The Hogan 2 K. W. Combination of X-Ray Unit and High-Frequency. This apparatus is somewhat unique, as it affords all of the advantages of a modern Bedside Unit, capable of operating a 30 M. A. Radiator Type Coolidge Tube to full capacity, or a Self-Rectifying Gas Tube, with built-in Coolidge Control with filament transformer in the same tank with the high-tension winding, together with a complete high-frequency resonator operable from the same high-tension transformer which is employed for X-Ray work.

Therapy.—The treatment of albuminuria depends entirely upon its origin and cause. When due to nervous disturbances, pregnancy, toxemia and early circulatory changes much may be accomplished by auto-condensation and diathermy, the physiological action of

Fig. 42.—Diathermy of Kidney.

which is explained under auto-condensation and diathermy.

Albuminuria when due to nephritis is preceded by as well as accompanied with hypertension. The sphygmomanometer will advise us of approaching albuminuria weeks, months and even years before albumins can be detected in the urine. If the early hypertension be corrected cardio-renal disease may be prevented.

Albuminuria due to nervous disturbances is benefited by the unipolar application of the high-frequency current from a vacuum or non-vacuum electrode to the fourth and fifth dorsal vertebræ.

Cardio-renal conditions associated with edema should be treated by diathermy to the liver and kidneys. See Figs. 42 and 59. However, only amelioration of symptoms is to be expected.

The high-frequency current from a multiple-point electrode to the 10th dorsal spine is very gratefully received by the patient. See Fig. 63.

ALOPECIA (BALDNESS).

Alopecia, a term applied to baldness, may vary in degree from slight thinning to complete loss of the hair. There are three distinct varieties, viz: Congenital, senile and premature.

Congenital Alopecia.—This form of alopecia is accompanied by defects in development. It may be partial or complete. When complete there is no hair on any part of the body.

Senile Alopecia.—This form needs no description, it may be seen in the parquet of the theater at almost any performance.

Premature Alopecia.—This form may be temporary or permanent, gradual or rapid and is dependent upon local and constitutional causes. Among the local causes may be mentioned *seborrhea, psoriasis, eczema, erysipelas, favus and ringworm.* Among the constitutional causes we find prolonged debilitating influences, excessive mental labor, excesses, struma, typhoid fever and exanthemata, mercury poisoning, diabetes, syphilis, etc. The most common form of falling hair is due to seborrhea of the scalp.

Alopecia Areata.—In this form of alopecia the hair falls out in more or less circular patches leaving the skin smooth and white. In rare cases the whole scalp and possibly the entire body may be denuded.

Prognosis.—In the congenital and senile forms the prognosis is unfavorable. The prognosis in the premature form depends largely upon the cause. When due to local causes the prognosis is favorable. When due to constitutional causes the result depends upon the correction of the cause. Alopecia areata under proper treatment usually recovers.

Therapy.—When baldness is due to seborrhea of the scalp, eczema, psoriasis or ringworm, the first indication is to kill the germ which is most effectually accomplished by x-rays. If the treatment be too intense the hair follicles may be destroyed. The dose applied should be just enough to act as a germicide. A dose of ¼ to ½ H. at intervals of one week is usually sufficient. The rays not only kill the bacillus or other germ, but act as a stimulant to the hair follicle, if there be any to stimulate.

The stimulating and germicidal effects of actinic rays are also known to be of service in this affection.

Alopecia areata usually yields to high-frequency sparks from a vacuum electrode. The application should be of sufficient strength to produce a very active hyperemia and be repeated three times a week. Small blisters may be produced and a crust formed; when the crust separates there will often appear a growth of very fine hair.

Physiology.—Elimination of effete matter from the skin ducts thru hyperemia; stimulation of hair follicles to renewed activity.

AMENORRHEA.

Amenorrhea is defined as an absence of menstrual flow in women of suitable age who are not pregnant.

Classification.—*Complete* when all menstrual flow has ceased; *comparative* when it appears occasionally; *primary* when menstruation has never appeared; *secondary* when, having appeared, the flow ceases.

Etiology.—Among the causes of *apparent amenorrhea* may be enumerated imperforate vagina, imperfect cervix, imperforate hymen, absence of any of the genital organs, retention in hematometria and hematosalpinx.

The causes of real amenorrhea are *physiological, pathological* and *toxic.* Physiological causes are, before and after the menopause, pregnancy and lactation. Pathological causes are absence of essential organs, pelvic inflammation, superinvolution, anemia, chlorosis, leucocythemia, Hodgkin's disease, malignancy, tuberculosis, pyemia, diabetes, late stage of cardiorenal disease, cretinism, insanity, exposure to cold at the time of menstruation, fear of pregnancy, myxedema, exopthalmic goiter and obesity. Toxic causes are chronic poisoning from lead, mercury, morphine or alcohol; specific fevers.

Essential Features.—Among the essential features of amenorrhea may be stated: Alterations in the blood itself; changes in blood-pressure; altered nerve impulses; altered relations between the ductless glands such as ovary and thyroid and opposed action of the suprarenal and pituitary.

Therapy.—The etiology of this disease demands a painstaking examination of the pelvic contents in every case. Laboratory confirmation of diagnosis is often of extreme importance.

Secondary amenorrhea is often relieved by drugs. When due to some chronic disease outside the local condition, general medicinal and hygienic management is required.

Treatment by properly selected currents constitutes the most efficacious method known for amenorrhea not dependent upon organic irremedial causes.

Physiological Indications. — The indications in faulty metabolism are met by auto-condensation; anemic conditions by diathermy of the bones of the thigh; hypertension by auto-condensation; altered nerve impulses by stimulation of the spinal roots of affected nerves by high-frequency current thru a double pronged vacuum electrode applied for five minutes daily; in faulty ovarian function the gland may be stimulated by diathermy, one electrode over the hypogastrium, the other over the sacrum, in the rectum or vagina; the last named position being the one of choice in married women; pass a current of tolerance for seven minutes every second day. (See Fig. 64).

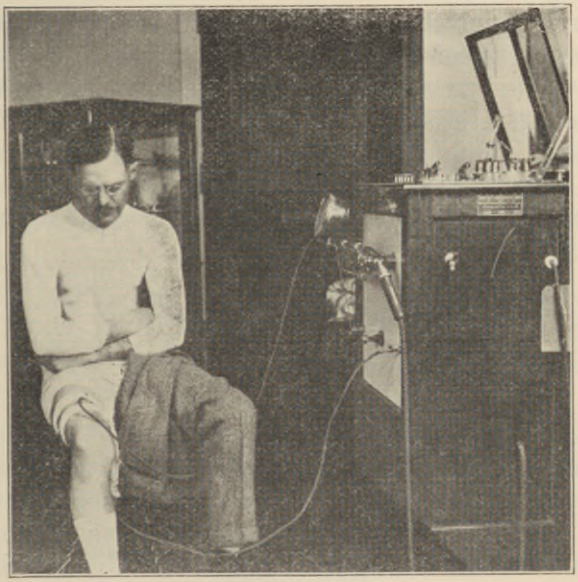


Fig. 43.—Diathermy of the Femur.

In hypothyroidism, diathermy of the thyroid may correct the glandular dysfunction. (See Fig. 65). The technic of which is as follows: Seat the patient on the auto-condensation pad, place a well fitting metal electrode to the thyroid, turn on a current of 500 milliamperes for five minutes. This may be repeated every third day. Care should be exercised not to over stimulate the gland.

Infantile uteri usually require electrolysis and sinusoidal currents, but much good may be accomplished by flooding the parts with new arterial blood thru diathermy. Apply one electrode over the hypogastrium and insert within the vagina a well insulated electrode that will be best adapted to the case, turn on a current of toleration for seven minutes and repeat daily. (See Fig. 64). While uterine flexions, adhesions and exudates are best treated by electrolysis, much good may be done by diathermy with same technic as above mentioned.

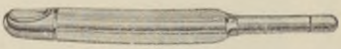


Fig. 44.—Vaginal Non-Vacuum Electrode.

ANEMIA.

Anemia is a term employed to denote many different changes in the blood. It is a symptomatic disorder characterized by a deficiency of some of the important constituents of the blood; clinically, a diminution in the amount of hemoglobin, usually, but not always, associated with a decrease in the number of red cells.

Diagnosis.—The simple form should be differentiated from the severe forms, chlorosis, pernicious anemia and leucocythemia.

Etiology.—The principal causes of simple anemia are hemorrhages, deficient metabolism and abnormal expenditure of blood constituents as in pregnancy and lactation.

Prolonged use of mercury, arsenic or salicylates will produce a blood picture of anemia. The causes are so numerous and varied that each case becomes an individual one and the underlying etiological factor must be sought and found before any therapeutic measure be applied.

Therapy.—The treatment of anemia may be summed up as follows: Removal of cause; hygienic measures and proper medication. In benign anemia the administration of iron and arsenic is of prime importance.

Physiological Indications. — Auto-condensation for faulty metabolism; diathermy of long bones, especially the femur, to increase the hemoglobin; high-frequency from a body electrode (vacuum or non- vacuum) to correct nervous dysfunction.

General radiation of actinic rays over the entire body improves the general vitality and may be employed with benefit in anemic conditions.

ANEURYSM.

Dr. Albert Abrams has made exhaustive studies of aneurysmal conditions and his conclusions demand respect. In his book "Spondylotherapy" he says: "It occurred to the writer when he first employed the aortic reflexes in diagnosis that if concussion of the seventh cervical vertebra would cause contraction of the aneurysmal sac, this fact would prove advantageous in the treatment of thoracic aneurysm. The results achieved have exceeded his expectations."

The treatment may be administered by any suitable apparatus that will give a hammer stroke. In

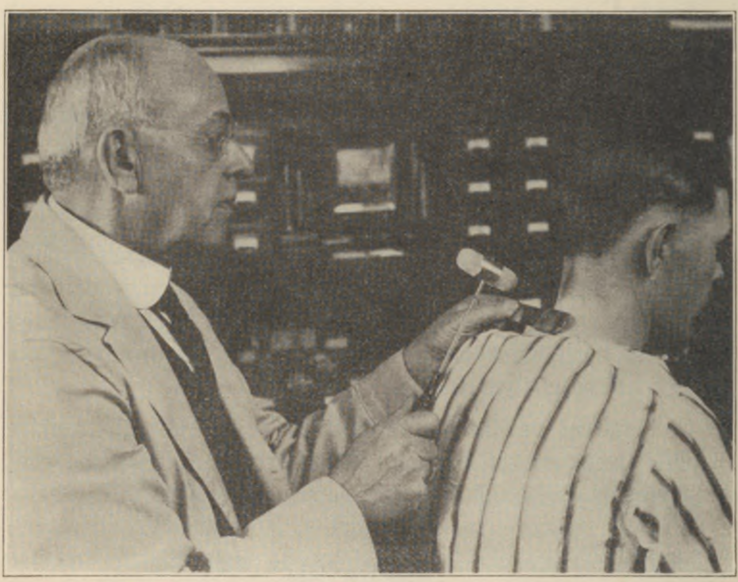


Fig. 45.—Percussion of Seventh Cervical Vertebra.

the absence of an apparatus a plexor and pleximeter may be employed. The percussion stroke may be delivered directly to the spine of the seventh cervical vertebra or indirectly thru a strip of rubber or linoleum. The rapidity of the stroke employed by Abrams is about

150 per minute for a period of from 5 to 15 minutes with several interruptions to avoid irritation of the skin.

Physiological Indication.—The treatment is not empirical but founded on scientific principles. By percussion of the seventh cervical vertebra the vagus is stimulated and thru the effects of the stimulation the heart beat is lowered in frequency and at the same time the aorta is contracted.

The sinusoidal current will accomplish the same results when applied to the space between the seventh cervical and first dorsal with opposite electrode over the sacrum.

The high-frequency current thru a non-vacuum electrode applied to the seventh cervical vertebra, or thru a double-pronged vacuum electrode applied between the sixth and seventh cervical in some cases will be efficient, but a strong current must be employed. As a rule the high-frequency current is inferior in efficiency to percussion or the sinusoidal current.

ANGINA PECTORIS.

The term "angina pectoris" is employed to denote an intense paroxysmal pain and constricting oppression about the heart. The symptoms are characteristic, but the condition should be differentiated from false angina which includes intercostal neuralgia, gastralgia, cardiac asthma, hysteria and tobacco heart. *True* angina is always associated with cardiac lesions, especially of the coronary arteries.

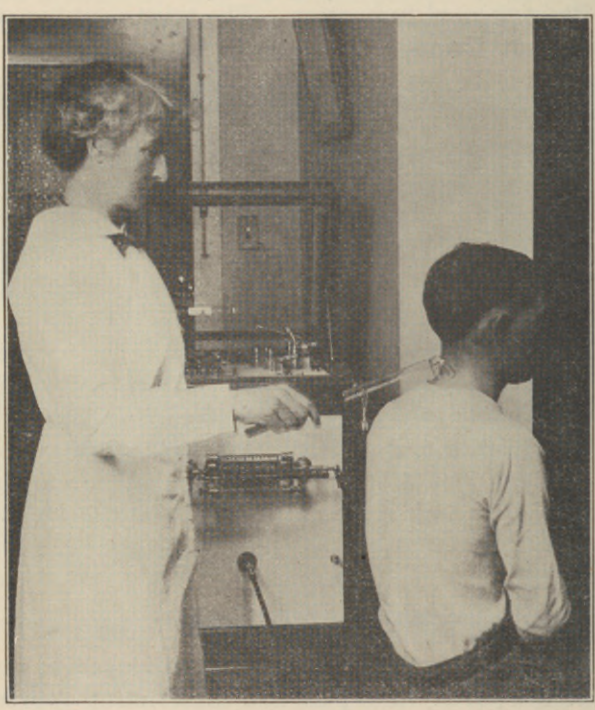


Fig. 46.—Double-Pronged Electrode to Sixth Cervical Space.

Therapy.—The underlying condition may prove fatal at any time but careful management may prolong life. The space of time between the attacks is when high-frequency currents are of value. If there be hy-

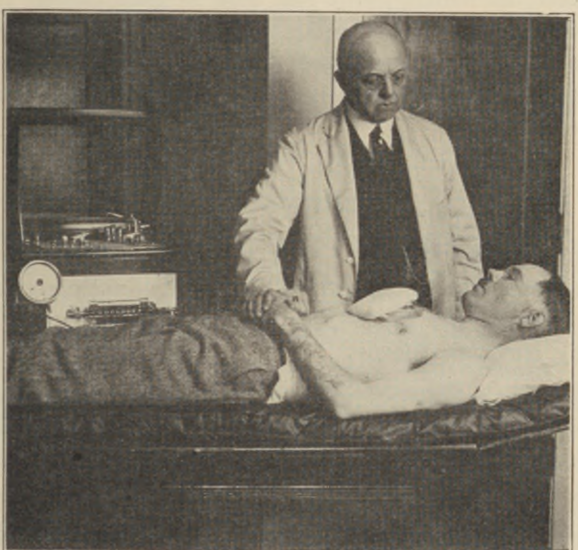


Fig. 47.—Cardio-diathermy.

pertension it should be treated by auto-condensation (the only vaso-dilator that may be employed with impunity). Arterial dilatation within the heart muscle will increase capillary efficiency and thereby improve the nutrition of the heart muscle, allowing the coronary arteries to resume their function.

Technic of Cardio-diathermy.—Two electrodes not less than five inches in diameter are employed, one directly over the heart and the other directly opposite on the back. The current should be turned on gradually, consuming three minutes in attaining a comfortable tolerance, at which point the dose is maintained for 8 to 10 minutes when the current should be slowly returned to zero. After two or three treatments the time and amperage may be increased, always depending upon effects.

ANGIOMATA.

Angiomata usually spoken of as "strawberry marks" consists of dilatation and reproduction of new blood vessels, the process giving rise to a reddish and slightly elevated tumor.

Therapy.—The objects to be attained are the coagulation of the blood in the tumor, the destruction of the dilated vascular walls and preservation of the overlying skin.

Electrocoagulation by the bipolar, or desiccation by the unipolar method may be employed but has the disadvantage of producing scars. In desiccation or electrocoagulation the needle electrode should be insulated in that portion which passes thru the skin, the needle point only entering the part to be coagulated.

Small superficial angiomata of the lips and mouth may be easily destroyed by desiccation.

APPENDICITIS.

Many cases of catarrhal appendicitis recover under medicinal treatment. The same class of cases are benefited by diathermy but it is usually an unsafe procedure. If diathermy fails to abort the disease a simple appendicitis is transformed into a fulminating one. The best procedure in all cases of appendicitis is to turn them over to the surgeon.

ARTERIOSCLEROSIS.

Arteriosclerosis is a condition in which the walls of the arteries are thickened, due to morbid changes in the intima which result in narrowing of their lumen. There are three varieties: the nodular, in which the changes are localized; the senile, due to physical degeneration attending old age; the general form, which occurs in middle life as a result of various etiological factors.

The disease is one of insidious character. The changes in the arterial walls take place very slowly. It is probable that the first change is one of arterio-capillary fibrosis; this change takes place early in the kidney. Although an increase in blood-pressure precedes recognized kidney lesion for a long period of time, probably years.

Essential Features.—After changes have taken place in the intima of arterial walls the general line of symptoms is more or less characteristic. Hypertension is constant until the last stages of the disease when a condition of hypotension may supervene; there is a tendency to shortness of breath; dizziness on sudden change of posture; inability to recall names and recent events; noises in the ears; consciousness of heart beat; increased area of cardiac dullness with apex beat more or less to the left of normal; albuminuria may or may not be present. Subacute inflammation of serous membranes such as the peritoneum, pericardium and pleura may be the first recognized symptom. Individuals supposed to be in robust health are often unaware of their condition until the nature of the case is revealed in an apoplectic seizure due to cerebral hemorrhage.

Arteriosclerosis when well advanced is sometimes attended by severe headaches accompanied with vomiting which closely resembles the symptoms of cerebral tumor.

Physiological Therapy.—It is the belief of the writer that all cases of arteriosclerosis not caused by specific infection are primarily due to faulty alimentation. Incomplete digestion results in more or less toxemia which is an important etiological factor in hypertension. A long continued hypertension results in arterio-capillary fibrosis, after which the cardio-vascular changes take on a more or less rapid course, resulting in cardio-renal disease with all its disastrous consequences.

Before arterial changes have taken place, that is, the hyperpietic stage, the changes may be prevented by auto-condensation and proper hygienic management. After the disease is well developed and cardiovascular changes have taken place there is no cure, but much may be done to prevent further changes by keeping the arterial tension within the safety zone, and this is accomplished by close observation, the occasional application of auto-condensation, together with good hygienic measures that common sense will suggest. Teach the patient how to live to avoid further changes in his vascular system that comfort be enjoyed and life prolonged.

While the physiological action of certain drugs is to reduce blood-pressure, the effects are evanescent and have a tendency to increase kidney dysfunction.

The inroads of this disease can only be estimated by the symptoms present and they are not always a safe guide, therefore, it is advisable to commence auto-condensation treatments with a low amperage. The first treatment should not exceed 300 miliamperes for a period of 10 minutes and it is not advisable to exceed 600 milliamperes at any time. There is no advantage to be gained by heavy doses. Small doses for a long period of time are more effectual than large doses for any period of time. Crampy muscles may be the only subjective symptom present. This condition calls for local diathermy; for the first treatment it is advisable to place both electrodes on the same aspect of the limb, the object being simply to heat the superficial parts; the subsequent treatments should include the affected muscles with electrodes on opposite sides of the limb with one electrode somewhat nearer the body. The heat flushes the muscles with new arterial blood and relaxes spasm. The local application of diathermy will often yield constitutional as well as local effects.

ARTHRITIS.

Classification.—The differential diagnosis of the many forms of arthritis is most important that we may know when and when not to employ high-frequency currents in their therapeutic management.

Acute Rheumatic Arthritis.—The essential features are sudden onset without previous trauma; swelling moderate; pain very severe but relieved by salicylates; a red blush over the joint nearly always present; after 48 hours from its onset one after another joint affected.

One swallow does not spell spring, neither does arthritis of one joint spell rheumatism, it flits from joint to joint as the honey bee from flower to flower, suppuration never occurs, destruction of joint seldom results, the inflammation subsides and normal function usually returns in from 2 to 6 weeks. The disease is often followed by endocarditis which permanently disables the heart.

Septic Arthritis.—This form does not affect one joint after another as in rheumatism. The trouble remains in the joint until the source of infection is cleared up; the tissues around the joint are thickened; the hue of the skin is more dusky than red as in rheumatism; suppuration is common. Septic arthritis follows accumulations of pus in other parts of the body.

Arthritis may accompany or follow such diseases as pneumonia, typhoid, scarlet fever, measles, diphtheria, small pox and influenza. In all these cases the presence of the causative disease determines the diagnosis.

Gonorrheal Arthritis.—Usually large joints like the knee are affected, but many joints may be affected simulating rheumatism; the tendons and fascia about the joint are usually involved; the pain is severe and not relieved by salicylates; fibrous ankylosis may follow; this form accompanies or follows gonococcus infection.

Rheumatoid Arthritis.—While the first attack of this disease resembles rheumatism it runs an entirely different clinical course; the joints first attacked are the phalanges; there is spindle shaped swelling; fever continues longer and is less severe; the pulse when compared with the temperature is faster than in acute rheumatism; the joints do not suppurate but become rapidly enlarged with inflammatory products; recurrent attacks are the rule and follow each other with a few weeks or months intervening until nearly all the joints of the body become affected; deformities always follow unless the treatment has been such as to prevent.

Gouty Arthritis.—The diagnosis of gout is not usually difficult. Its first appearance is usually in the ball of the right great toe; pain is often excruciating during the night; during the day the patient goes about his business, the next night it returns; the night exacerbations usually grow less and less until the disease abates; after a longer or shorter period of time the patient suffers another attack unless the etiological factor be removed.

Osteo-arthritis. — Simulates rheumatoid arthritis but is a distinct disease. Rheumatoid arthritis is a disease of the soft parts and osteo-arthritis is a disease of the bone and usually confined to one large joint. Rheumatoid arthritis is accompanied by an elevation of temperature (there is no fever in osteo-arthritis). When it attacks the hip joint of the aged the condition is sometimes called *morbus coxae senilis.*

Tuberculous arthritis is most common in children. The favorite location is the spine and hip joint; other joint affection represents about 15 % of the number of cases. The onset is insidious and often overlooked during the first month of the disease. Pain is a prominent symptom and always worse at night. Swelling of the joint is always present but may be so slight as to be overlooked. Tuberculosis of the sacro-iliac joint is often difficult of diagnosis. The pain of a tuberculous hip joint is often referred to the knee.

Congenital syphilis often causes arthritis and may be mistaken for tuberculosis, but other symptoms of syphilis should make the differentiation easy.

Charcot's disease.—This condition is an arthritis met with in locomotor ataxia. It affects large joints and results in rapid destruction of bone. Considerable swelling about the joint takes place but is devoid of pain.

Traumatic arthritis.—Joints are very prone to injury. The essential features are ecchymoses; rapid swelling due to infiltration of the soft tissues; the synovial membrane becomes inflamed followed by a pouring into the joint of synovial fluid; muscular spasm (nature's splint) is always present.

Many acute conditions herein mentioned may become chronic and some of them are chronic from the first.

Therapy.—The physiotherapist has a right to be enthusiastic because the results obtained by his methods are monuments that mark the progress made in the management of this disease.

The cure of any condition consists of the removal of the cause and the restoration of normal function. There are few cases of chronic arthritis cured, but thousands are arrested by removal of cause and restoration of function to the degree permissible by the destruction of the anatomical structures.

Acute rheumatic arthritis is caused by infection. The particular germ has not been isolated but is supposed to be of the streptococcus family and may attack fibrous tissue. During the acute stage of this form of arthritis about the worst treatment that can be applied is electricity. Any electrical current will aggravate the disease. After the temperature has returned to normal the resulting exudates and adhesions may be dissipated by the Morton wave and blue pencil discharge from a static machine. If static electricity is not available the next in order of usefulness is the high-frequency effluve from a multiple-point electrode held just outside of sparking distance from the affected joint, which application will be found to be very soothing. The judicious application of diathermy to the joint is followed by excellent results.

Septic arthritis.—Electricity should never be applied to any septic joint unless there be free drainage.

Arthritides which accompany infectious diseases should not be treated by high-frequency currents until the causative factor of the disease is removed.

Gonorrheal arthritis.—This condition seldom occurs during the acute stage of gonococcus infection. A very large proportion of cases is due to relapses of the disease from some local focus in either the deep urethra, prostate or seminal vesicles from which the coccus enters the blood and is carried to some remote joint.

The *treatment* of the disease demands first of all the removal of the focus of infection. The writer knows of no procedure that equals the static wave current to drain the prostate and seminal vesicles. The high-frequency current thru a properly insulated electrode for a period of 7 minutes daily will also drain the prostate by flooding the gland with new blood, thereby increasing phagocytosis and hastening return of normal function.

Rheumatoid arthritis.—In the early stage of this disease much damage to the joints may be averted by auto-condensation with sufficient time and dosage to thoroughly heat the entire body as evidenced by a rise of one degree with thermometer under the tongue.

The subacute and chronic stages of the disease are best treated by static wave currents and diathermy. The katabolism of the patient is always below par; this condition is greatly benefited by application of diathermy to the liver, as well as auto-condensation. The joints may also be diathermatized. Static sparks are very efficient in hastening absorption of the inflammatory products. Common sense hygienic measures are very important in this disease. The patient should not be starved by a withdrawal of all proteins. A liberal

Fig. 48.—Diathermy to knee joint anterio-posteriorly.

diet with a limited amount of proteins should be advised.

Gouty arthritis.—This form of arthritis is always one of faulty metabolism. Auto-condensation sufficient to raise the body temperature at least one degree is indicated. However, a patient here and there will be found who cannot tolerate this treatment. High-frequency currents to the affected parts often aggravate the condition, under which circumstances heat from a high power lamp should replace diathermy.

The liver should be diathermatized (See Fig. 59) at least twice a week. Physicians who are familiar with static currents prefer the static wave to diathermy to restore liver function.

Osteo-arthritis in the early stage may be favorably influenced by diathermy, but after bony changes have taken place little can be done with high-frequency currents.

Tuberculous arthritis should not be treated by high-frequency currents. Exposure of the affected joints to radiant light, X-rays and actinic rays increases phagocytosis and is often followed by excellent results.

Tabetic arthritis or Charcot's disease is benefited only by measures which favorably influence tabes dorsalis.

Traumatic arthritis.—This is the form of arthritis where physiotherapy has proven its superiority to all methods of treatment. To those familiar with the administration of static currents the management of this condition is one of the easiest in practice. The treatment is not empirical but physiological. Radiant light and heat will dilate the capillaries of the skin and hasten the removal of ecchymoses. The deeper congestion and stasis are easily removed by the Morton wave or static sparks.

While this volume is not intended to be a treatise on static electricity, the writer who employs this modality in his daily practice cannot refrain from mentioning the most efficient means in the management of sprains to ligaments and joints. Outside of static currents the most efficient treatment of this condition is diathermy.

Fig. 49.—Diathermy to knee joint laterally.

The affected joint should be heated thru and thru not only anterio-posteriorly but laterally (See Figs. 48 and 49). While the unipolar application of the high-frequency current will hasten absorption of infiltrations about superficial tendons, its action in arthritis is too superficial to be of much service.

If proper treatment be instituted soon after the injury there will be no call for strapping the joint, a simple bandage being sufficient and often not necessary.

Chronic arthritis.—The treatment of non-infective chronic arthritis with or without ankylosis is essentially the same as in the traumatic form. The static wave and sparks will relieve the muscular spasm and liven up the joint to renewed activity, so much so that it may simulate the acute form of the disease, after which diathermy and passive motion will complete the rejuvenation. Stimulation of the liver to the removal of toxins by static wave or diathermy is an important part of the treatment of every form of anthritis whether it be acute, chronic or infectious.

It is not to be expected that every case of chronic arthritis with ankylosis will be restored to normal function by the treatment mentioned, but a fairly good percentage will recover sufficiently to make useful joints. The rule of one, two, three cannot be applied to every case, but patience, perseverance and a fair degree of skill will work out the reconstruction of joints which heretofore have been considered incurable.

ASTHMA.

Asthma is a neurosis characterized by paroxysmal dyspnea due to spasmodic narrowing of the bronchial lumen, alternating with spasm of the muscles of the thorax. The term asthma is applied to symptoms just mentioned when no organic lesions can be recognized in its causation.

The essential feature of asthma is dyspnea with a history of typical recurrent attacks which were relieved

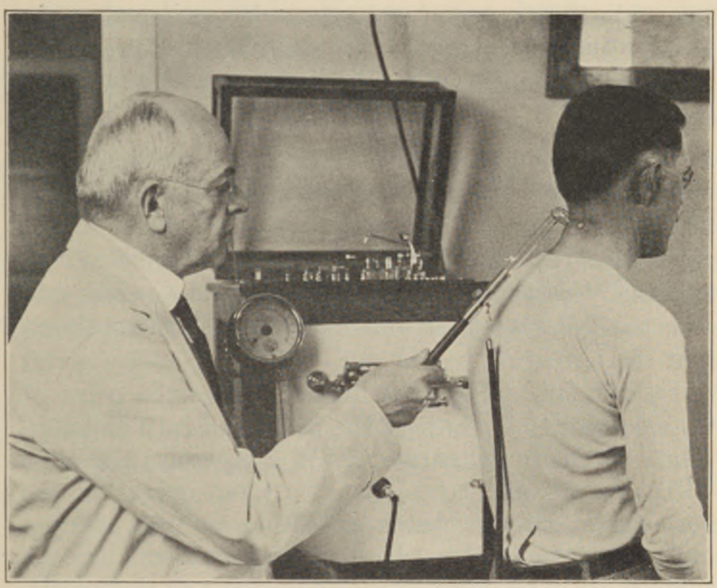


Fig. 50.—High-Frequency in Asthma.

by cocaine, sprays in the nose, inhalations of stramonium or injections of adrenalin.

Dyspnea is a symptom of many diseases such as cardio-renal disease, syphilis of the bronchus, goiter, thoracic aneurysm, bronchitis, mediastinal and laryngeal growths and tuberculosis.

Irritation of the vagus nerve from any point of its distribution may precipitate an asthmatic attack. Frequently the irritation comes from the nasal passages.

Treatment.—The prime object of treatment is the removal of the cause of irritation. When found in the nose it may be removed by surgery or desiccation. Polypi of the nasal cavities are easily removed by desiccation.

Technic: The entire field of operation as well as the mucous surfaces of the nares is anesthetized with a solution of cocaine. Seat the patient in a chair with a good head rest, the nasal cavity well illuminated. A suitable electrode for this purpose may be easily constructed from a small knitting needle insulated (except the operating point) with rubber or adhesive, set in an ordinary fulguration handle; place the point of the electrode in the base of the polyp and turn on sufficient current to dehydrate it. In a few days the mass will separate and come away. After operation the nose should daily be cleansed with normal salt solution until separation takes place. This treatment has the advantages of no hemorrhage and no post-operative discomfort. Care should be exercised not to touch any part of the nose with any part of the electrode other than the operating point, as high-frequency currents are difficult to insulate and sparks will pass thru the insulation; if allowed to touch the patient they are not only disagreeable to the patient but lessen the current strength at point of operation.

In the treatment of asthma where there is no discoverable cause, the provocation of the lung reflex of contraction may be brought about by concussion of the spines of the 4th and 5th cervical vertebrae as directed by Abrams. The unipolar high-frequency current thru a double pronged non-vacuum spinal electrode applied to the 4th and 5th cervical interspace for a period of from two to five minutes will often relieve the paroxysm. The current must be a strong one.

The sinusoidal current with one electrode over the cervical region and the other over the sacrum with a strong wave for 15 to 30 minutes every other day will also relieve the paroxysms. When the spasm is due to bronchitis there is no treatment so satisfactory as diathermy with the same technic as in bronchitis. (Fig. 56).

ATAXIA (LOCOMOTOR).

Tabes dorsalis.

Ataxia (ataxy) is a term employed to express incoordination of muscular action and is a symptom of several nervous lesions. In this article it will be considered only as a symptom of *tabes dorsalis,* a disease dependent upon degeneration and sclerosis of the posterior columns of the spinal cord.

Essential features.—The essential features of this disease consist of degeneration and atrophy of nerve fibers with hypertrophy of connective tissue. The symptoms which may be present are numerous. The chief ones characterizing the disease are muscular incoordination of locomotor and other voluntary muscles; lightning pains and disturbance of vision. The Argyll-Robertson pupil, abolition of patellar reflex and muscular incoordination when combined are pathognomonic of tabes.

The disease is essentially chronic but may not be progressive. There is practically no muscular atrophy as in multiple neuritis. The most common cause of the disease is syphilis.

Therapy.—Tabes dorsalis is an incurable disease, but much relief of symptoms may obtain from electrical modalities, the chief one being the static wave current and sparks applied to the dorsal spine. Auto-condensation is indicated for its effects upon the general metabolism, this being best accomplished with light doses (under 500 milliamperes).

Lightning pains and gastric crises may be relieved by high-frequency sparks from a vacuum or non-vacuum electrode applied over the dorsal spine. The location of the pain or paraesthesia will be a guide to the proper point of spinal application.

Fig. 51.—Double electrode to spine.

Diathermy is of special value in pains of this disease. The electrodes should be placed on either side of the spinal column corresponding to painful skin areas. If pain is below the knees the electrodes should be applied to the 11th and 12th dorsal vertebrae.

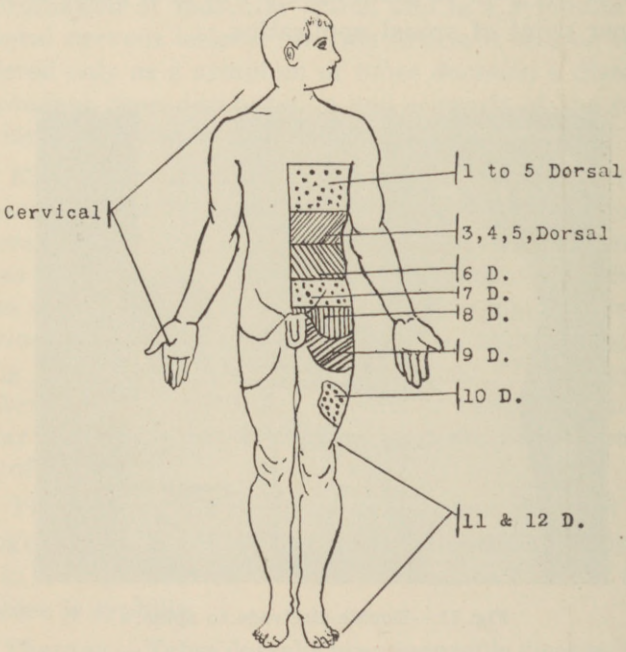


Fig. 52.—High-frequency application in tabes, front view.

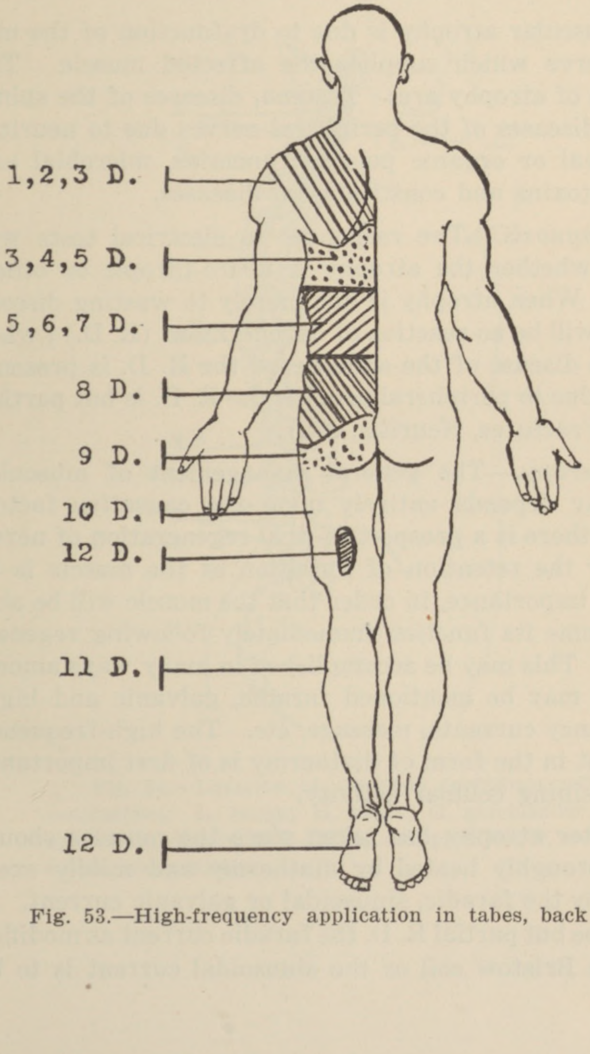


Fig. 53.—High-frequency application in tabes, back view.

ATROPHY, MUSCULAR.

Muscular atrophy is due to dysfunction of the motor nerve which supplies the affected muscle. The causes of atrophy are: Trauma, diseases of the spinal cord, diseases of the peripheral nerves due to neuritis, chemical or organic poisons; anemias, microbial and other toxins and constitutional diseases.

Diagnosis.—The responses to electrical tests will show whether the atrophy is neuro-thropic or otherwise. When atrophy is due merely to wasting disease there will be no reaction of degeneration (R. D.); when due to disease of the spinal cord the R. D. is present; when due to peripheral neuritis the R. D. is but partial. (See Fractures, Neuritis, etc.).

Therapy.—The general management of muscular atrophy depends entirely upon the causative factor. When there is a prospect of final regeneration of nerve supply the retention of nutrition of the muscle is of prime importance, in order that the muscle will be able to resume its function immediately following regeneration. This may be accomplished in many ways among which may be mentioned faradic, galvanic and high-frequency currents, massage, etc. The high-frequency current in the form of diathermy is of first importance in retaining cellular activity.

After atrophy has taken place the muscles should be thoroughly heated by diathermy and mildly exercised by the faradic, sinusoidal or galvanic current. If there be but partial R. D. the faradic current as modified by the Bristow coil or the sinusoidal current is to be

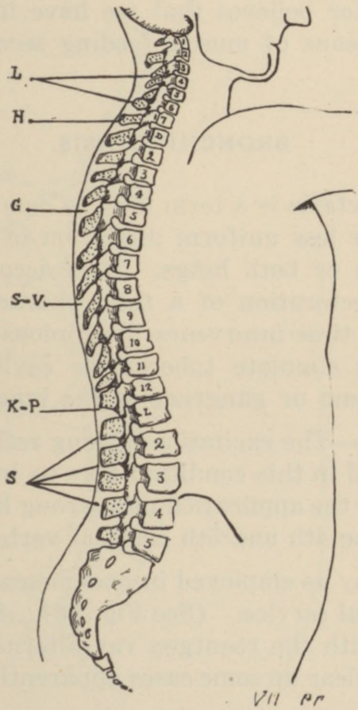


Fig. 54.—Location of electrode to induce reflex of contraction. L, lungs; H, heart; G, gall-bladder; S-V, splanchnic vessels; K-P, kidney and prostate; S, stomach, spleen and genitals.

preferred. However, the interrupted galvanic current is sometimes required.

The writer believes that we have in the galvanic current a means of muscle feeding secondary only to diathermy.

BRONCHIECTASIS.

Bronchiectasis is a term used to denote a condition of a more or less uniform dilatation of the bronchial tubes of one or both lungs. It is accompanied by a copious expectoration of a fetid character. When a considerable time intervenes the copious expectoration attacks may simulate tuberculous cavitation, a ruptured empyema or gangrene of the lung.

Therapy.—The excitation of lung reflex of contraction so useful in this condition may be induced by percussion of or the application of a strong high-frequency current to the 4th and 5th cervical vertebrae.

Diathermy as employed in pneumonia will be found to be of signal service. (See Fig. 56). Semi-intensive treatment with the roentgen ray alternated with diathermy will clear up some cases apparently almost moribund.

In the following case history pictures very well what may be accomplished by roentgen radiations:

A boy aged six. Both parents well. No family history of tuberculosis, lues or other dyscrasia. The boy was always in good health until five years of age after which he suffered several attacks of tonsilitis. In July,

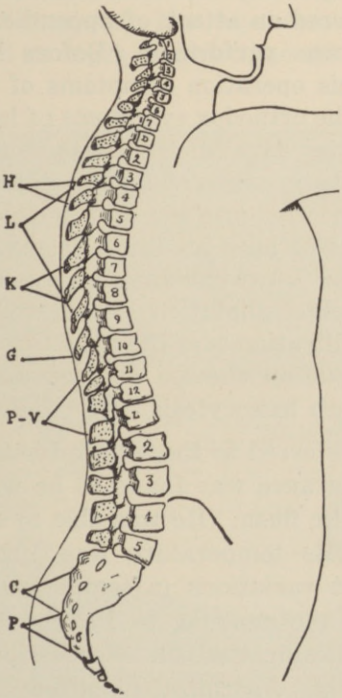


Fig. 55.—Location of electrode to induce reflex of dilatation. H, heart and esophagus; L, lungs; K, kidney; G, gall-bladder; P-V, pulmonary vessels and uterus; C, cervix and vagina; P, penile muscles.

1920, he was operated upon for adenoids and at the same time his tonsils were removed. About one month later he suffered an attack of appendicitis and an appendectomy was performed. Before he fully recovered from this operation symptoms of pneumonia supervened. The orthodox symptoms of lobar pneumonia prevailed for ten days but there was no resolution. The high temperature, cough and emaciation continued. The expectoration was profuse and purulent. A tentative diagnosis of lung abscess was made. On February 1, 1921, an X-ray examination was made with findings of bronchial dilatation, parencymatous and peribronchial infiltration over the entire area of right lung. Blood examination showed extreme anemia, low red count and high leucocytosis.

He was referred to the writer for treatment. His general appearance was found to be waxy, emaciated and with hectic flush. He was able to stand but could not walk. His temperature was 102F. The chart showed great variations in temperature. It ranged from 100 in the morning to 102-105 in the evening. Pulse 150. Respiration 40. Percussion dull over entire right chest. Auscultation—a few coarse rales and bronchial breathing. Cough almost incessant. A post-operative hernia was present over the region of the appendix.

This case was diagnosed as "bronchiectasis" and treated solely with roentgen rays. The rays were directed over the affected side every third day; the dose varied from $\frac{1}{4}$H to $\frac{3}{4}$H. After the fourth exposure his temperature became normal and remained so; expectoration reduced very much in quantity and lost much of its purulent character. His improvement was steady; his weight and strength and blood conditions improved

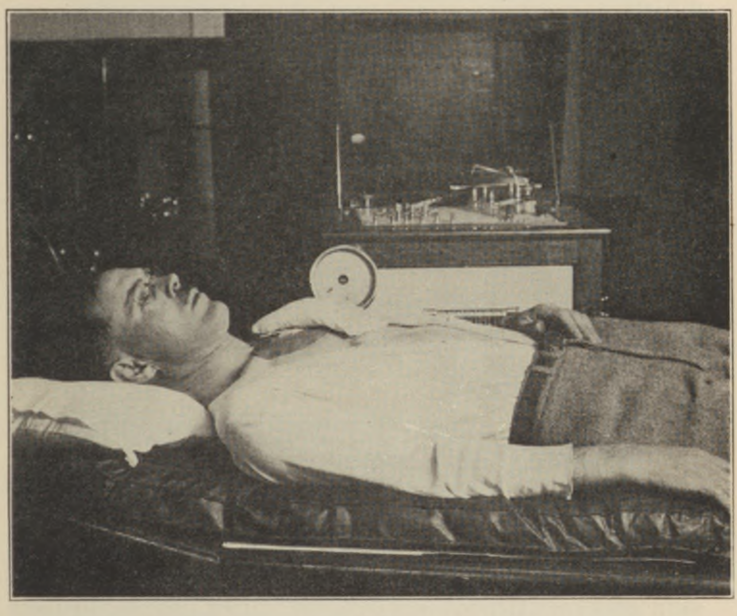


Fig. 56.—Diathermy in Bronchitis, direct method.

In a period of 30 days his weight had increased 25 per cent. In 60 days while he had a slight dry cough he had regained his normal weight and was able to take his place with other boys.

BRONCHITIS.

Many cases of acute bronchitis may be jugulated by early use of diathermy. If treated during the first 24 hours after the onset, one treatment is usually sufficient. After the first day more treatments will be required.

Technic.—Place a large electrode (6x8) over the upper dorsal spines and another of the same or smaller area over the sternum. Gradually turn the current on to 500 milliamperes for 5 minutes, then gradually increase to comfortable toleration and continue for 20 minutes, then gradually reduce current to zero. Put the patient in bed to remain for 24 hours. If he is not well repeat the treatment.

The same technic applies to chronic bronchitis but will require several treatments to subdue the disease. Some cases of chronic bronchitis will not recover under any treatment.

BRUISES.

Bruises vary in severity according to the degree of traumatism. First degree includes light bruises of the skin; second degree, more severe cases when the skin and soft tissues are injured; third degree, bruises of the periosteum and bone.

From a medical standpoint every bruise should be regarded as serious and every effort be made to restore normal circulation of the parts at the earliest possible moment. Treat all bruises as though serious consequences were to be expected. Radiant light and heat

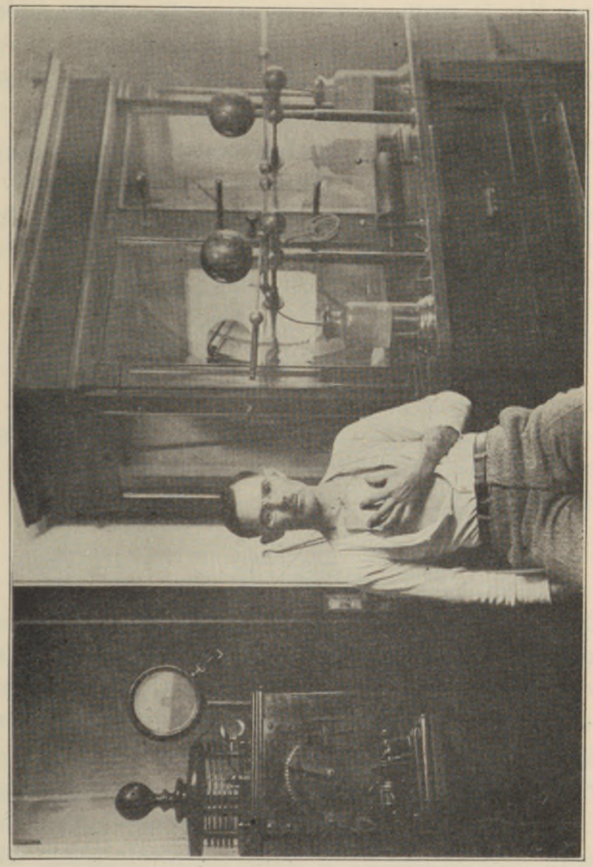


Fig. 57.—Diathermy in Bronchitis, indirect method.

should be applied as soon as possible after the trauma. Success lies in prolonged exposure. One hour twice a day is the least time to be considered and more is better. Between the exposures to light, high-frequency vacuum or non-vacuum application should be made.

First and second degree bruises will yield promptly to the above treatment. Third degree bruises may require in addition the static wave current to dissipate the infiltration. If applied sufficiently early the static wave will prevent disintegration.

BURNS.

Healing of burns may be accelerated by high-frequency application thru a vacuum or non-vacuum electrode. The application should be made thru a few layers of gauze.

BURSITIS.

Bursitis mucosae, an inflammation of subcutaneous bursae; bursitis synovial, an inflammation of bursae found between tendons; bursitis vaginalis, an inflammation of the synovial sheath, are all conditions occurring frequently about the tendons of the wrist.

Treatment.—The patient seated on auto-condensation pad connected to one pole of d'Arsonval machine, opposite pole connected to small metal electrode which is placed on the inflamed bursa. Diathermatize for 15 minutes with a current of about 400 milliamperes daily until cured, which will require from 3 to 12 treatments.

CANCER.

The real etiological factor of cancer is still in doubt. The belief held by many members of the medical profession is that cancer is caused by local irritation and recurring chronic inflammation; that it is primarily a local disease with post constitutional effects. Others

Fig. 58.—High-frequency in Bruises—black eye.

believe it to be a constitutional disease with local manifestations, among whom may be mentioned Dr. Duncan Bulkley, Member of American Association for Cancer Research, who states in his book (Cancer and its Non-Surgical Treatment): "Laboratory research has proved an utter failure in solving the Cancer Problem. The theory of its purely local nature and treatment has resulted only in a steady increasing morbidity and mortality. The mortality is less under medical than surgical treatment. Cancer is a constitutional and not a local disease, the cancer itself being a manifestation of that constitutional condition, carcinosis."

Therapy.—The treatment of cancer by diathermy is so eminently stated by Dr. Albert C. Geyser in the American Physician and reprinted in the Medical Herald and Electrotherapist, May, 1921, that the entire article is quoted:

"Cancer is both a local and a constitutional disease, therefore, both a local and a constitutional treatment is indicated.

"If the tumor has not yet broken down, diathermia is the only local treatment required. After such a mass has been consistently treated with diathermia the entire physiology of the tumor is changed and to all intents and purposes we have converted a malignant growth into a benign one. If it is desirable for cosmetic or other reasons to remove the growth this may be accomplished with the assurance of no recurrence. If the tumor has broken down the only dressing required is a ten to twenty per cent bicarbonate of soda solution. This dressing should not be changed oftener than three times in twenty-four hours.

Two conditions must be created to their fullest extent—the dialyzing and the oxydizing power of the blood. Of all drugs known, iodine or its compounds supply the former while iron induces the latter. Therefore, the cancer patient should receive an intravenous injection of sodium iodide 16 grains (1 gram) to 20 mils. of a sterile solution on alternate days for two weeks. During the third week on alternate days a solution of iron and arsenic 5 mils. containing of iron cacodylate one grain (64 milligrams) should be injected in the usual intravenous manner. The fourth week no internal medication will be given. The entire process may then be repeated as often as necessary. The weekly divisions are entirely arbitrary and can be changed to suit the individual case.

"As to diet, I am a firm believer in the vegetable diet in all patients suffering from malignancy. Animal proteins of all kinds should be reduced to the smallest amount, if not entirely interdicted.

"In selecting cases for the diathermic method of treatment, it is only necessary to use ordinary common sense. A moribund patient is no more a fit subject for diathermia than he is for operative procedure.

"Reference has been previously made to the thermic effects upon cancer cells. In all of those tests the cells had been removed from the patient for the purpose of transplantation. It was then shown that these cells, after the application of certain degrees of heat to them were no longer viable, therefore, did not produce cancer upon the experimented animal. It is not our desire to remove cancer cells and then destroy them. We intend to leave the cells *in situ,* but by the application of an electric current cause them to become heated to exactly the same degree of temperature as the experimented cells. It is not our object to interfere with their anatomy, but we do want to change their physiology. To do this it is necessary to include the entire tumor between the two electrodes of a high-frequency current. With breast or superficially situated skin cancers this is quite simple. With uterine and rectal cancers, while a little more complicated and uncertain, nevertheless, practical results may be achieved in eighty per cent of the cases.

"In cases of breast cancer, a suitable electrode is applied directly over the lesion, the other electrode containing at least four times the surface area is placed directly opposite upon the dorsum of the patient. The current is turned on to the point of tolerance, which is usually about fifty milliamperes to each square inch of the anterior electrode. If the skin overlying the growth is as yet intact, the reading may go as high as one hundred milliamperes per square inch. From forty-five to sixty minutes should be consumed for each treatment, repeated daily or at least on alternate days. When the growth is situated in the cervix uteri or rectum, a suitably shaped electrode is placed in position, then a larger posterior electrode is placed in the skin of the abdomen and back of the patient; these two larger electrodes are short circuited and led to one binding post of the high-frequency machine. The uterine as well as the rectal cavity will bear temperatures considerably higher than the external skin. It is not uncommon to use 200-300 milliamperes per square inch of area in these mucous membrane applications. The treatments should be given daily or at least on alternate days for at least two months, then once per week for an indefinite time.

"Let it be thoroughly understood that the application of diathermia does not necessarily remove the growth, but it does interfere with the physiology of the cancer cells in such a manner that the previously present cachexia disappears, there is complete cessation of pain, all lymphatic enlargements subside, the patient gains weight and appears to all intents and purposes normal.

"After diathermia has been used for a sufficient length of time, and these constitutional changes have been brought about, there is no reason why the growth should not be removed surgically, because practically all chances of recurrence have been removed. The growth which was previously malignant may now be looked upon as a benign tumor and dealt with correspondingly."

For the electro-surgical treatment of cancer see "Surgical Diathermy." The treatment of cancer by radium and X-rays is not *apropos* in a treatise on high-frequency practice.

CARUNCLE, URETHRAL.

Caruncles yield rapidly to desiccation. *Technic.*—Bring the growth well into view and anesthetize with procaine injection into its base. Desiccate with a needle point electrode for sufficient time to dehydrate the tumor; apply a wet boric acid dressing. Owing to the constant moisture of the part the dehydrated mass will soon separate and leave a clean base. There will be no postoperative cicatrix.

CERVICAL EROSIONS.

Therapy.—One thorough treatment by surgical diathermy will usually clear up cervical erosions.

Technic. — (Unipolar) The vagina should be cleansed with a hot solution of sodium chlorid. Place the patient upon a wood table with feet in stirrups; introduce a glass speculum, bringing the cervix well into view; wipe away every vestige of the salt solution; connect a long needle electrode with the Oudin post and thoroughly desiccate every portion of the erosion.

The bipolar method is some times desirable. The same technic as that in the unipolar method is followed with the exception that the d'Arsonval current is employed. The indifferent electrode should be not less than 36 square inches in area and placed underneath the buttocks or some other convenient locality and connected to one post of the d'Arsonal apparatus, the long needle electrode is connected with the opposite post and sufficient current employed to thoroughly destroy every vestige of the eroded surface. No after treatment is needed.

CHANCROID.

Chancroid is usually rebellious to ordinary germicidal or antiseptic treatment. The disease may be cut short by a thorough dehydration of the ulcerating surface by desiccation.

Technic.—The part to be treated should be anesthetized by cocain and every part of the ulcer surface thoroughly destroyed. If the operation is thorough one treatment is sufficient, the destroyed mass will separate in a few days leaving a clean base. If any part of the ulcer escape dehydration there will be an exacerbation of the disease and another treatment will be required.

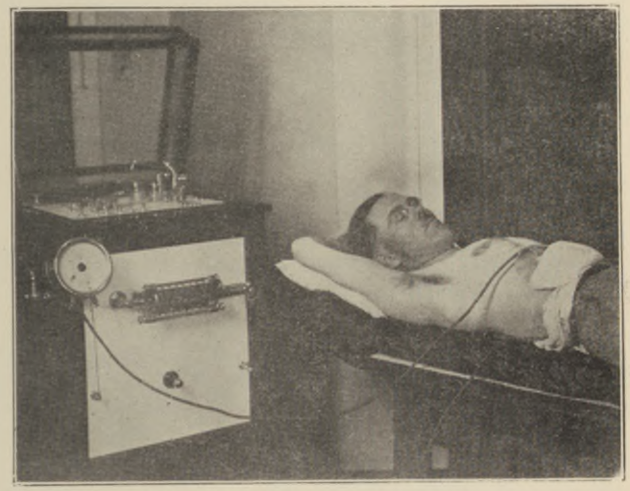


Fig. 59.—Diathermy of Liver.

CIRRHOSIS OF LIVER.

Treatment.—During the early stage of cirrhosis the liver is engorged with excess of blood and being the "clearing house" of the body toxins and unable to eliminate them, the host suffers more or less from toxemia.

As auto-condensation physiology is to eliminate toxic material from the blood it is indicated in this disease unless there be hypotension.

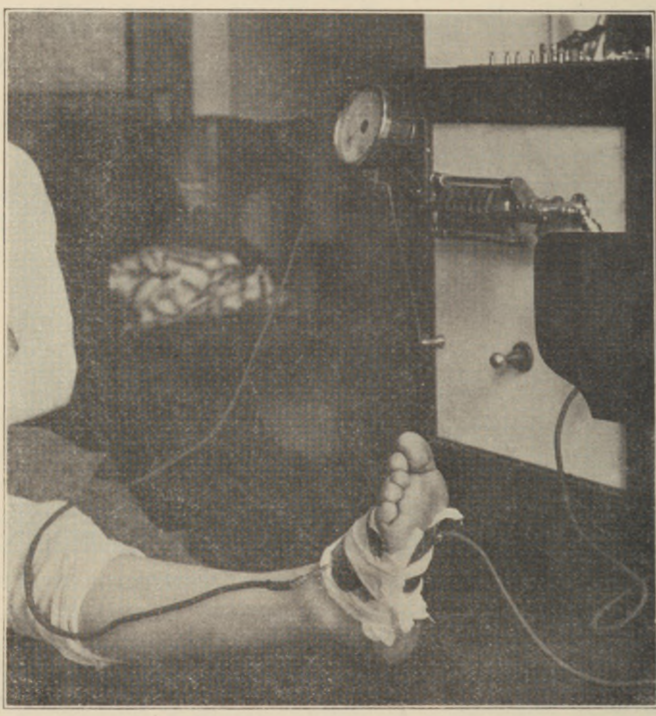


Fig. 60.—Diathermy to the Foot.

Diathermy may be employed in any stage and is of special service during the stage of atrophy when ascites and more or less edema have occurred; it floods the liver with new arterial blood and assists the liver in the performance of its function. While it does not cure the disease it is a source of relief to the patient.

Technic.—Place an electrode at least five inches in diameter over the 4th, 5th and 6th dorsal vertebrae. The other electrode should be smaller in area and placed over the anterior hepatic region. The current strength should be gradually increased from zero to the point of tolerance regardless of the meter reading. Time of treatment 20 to 60 minutes and repeated daily until results are obtained.

CHILBLAINS.

This aggravating condition may be promptly relieved by diathermy. Practically all cases yield to from one to three treatments.

Technic.—Heavy pads consisting of many layers of gauze saturated with a solution of common salt are placed on the dorsal and plantar surfaces of the foot over which small flexible metal electrodes are firmly secured. The diathermic current is turned on to point of toleration and continued for 15 to 25 minutes and slowly returned to zero.

This technic is also useful in ischemia, muscular spasms, Raynaud's disease, metatarsalgia and trench foot.

CHLOROSIS.

(See Anemia)

CHOLELITHIASIS (Gall Stones).

Gall stones may cause obstructive jaundice, cirrhosis and intenstinal obstruction.

Gall stone disease should be differentiated from pleurisy, neuralgia, gastric and intenstinal colic, duodenal ulcer and appendicitis.

Therapy.—While a well developed case of gall stone is essentially a surgical one, the condition known as gall-stone disease may in its early stages be relieved by applications of radiant light and diathermy. For technic of liver diathermy see "Cirrhosis of Liver."

Relief is also often obtained thru excitation of the liver reflex by unipolar application of the high-frequency current to the 4th, 5th and 6th dorsal spines.

CHOREA.

Acute chorea commonly called "St.Vitus' dance" is usually a disease of childhood during adolescence. It is more common in girls than boys. It may occur in adults. The disease is often associated with diseased tonsils. An attack may be precipitated by removal of the tonsils. The cause is probably of a bacterial nature.

Choreiform contractions occur in many hysterical as well as pathological conditions.

Therapy.—The successful management of chorea depends upon removal of the cause. The tonsils are first to be thought of as the possible home of focal infection.

If there be tonsillar infection associated with choreiform contractions the tonsils should be treated in accordance with the technic suggested under the head of Diseased Tonsils. It is quite absurd to expect favorable results from the general application of electricity in any form, when the condition is due to a focus of infection. In the hysterical form unipolar application of the high-frequency current to the upper dorsal spines is often beneficial.

It is well known that autocondensation quiets muscular unrest and its application in chorea is often followed by restful sleep.

COCCYX (Painful)

Painful coccyx, when due to injury, is promptly relieved by the application of diathermy. The technic is simple: Place a metal electrode within the rectum and the other over the painful area and employ a mild current—from 100 to 250 milliamperes being sufficient.

DIABETES MELLITUS.

True diabetes is characterized by a permanent condition of glycosuria. The urine is largely increased in amount, there is muscular weakness and marked thirst. As the disease advances acetone and diacetic acids appear in the urine. In the acute form any form of diet seldom influences the amount of sugar in the urine. The patient usually succumbs to the disease within two or three years.

Sugar in the urine may accompany many conditions such as hemorrhage, tumors, pancreatic disease, goiter, alcoholism, etc.

Chronic glycosuria.—This occurs in elderly subjects who have gouty tendencies. The urine is increased in amount but does not contain acetone. There is no wasting, little or no thirst and appetite not altered. A strict diet always benefits these cases.

Fig. 61.—Local auto-condensation in Diabetes.

Therapy.—To the dietetic management of chronic glycosuria we may add diathermy with profit.

Fig. 62.—Hands-to-feet Diathermy.

Technic.—Place the patient on an auto-condensation couch or pad, place a large non-vacuum electrode over the epigastrium and gradually turn the current on to toleration, allow the current to flow for ten minutes then gradually reduce the current to zero, then move the electrode to another abdominal location and repeat the maneuver until the entire abdomen has received treatment. Repeat every other day.

Hand to foot diathermy is an alternative which is often useful. The percentage of sugar in the urine is always decreased by diathermy. High-frequency effluve from a multiple-point electrode to the back and lower limbs is gratefully received by the patient and relieves the nervous symptoms which are present in many cases of diabetes.

Physiology.—The explanation of the *modus operanda* of this treatment is not clear. The benefits derived are probably due to the effects upon metabolism.

DYSMENORRHEA.

Dysmenorrhea is a term applied to difficult or painful menstruation. Several forms of this condition are recognized: (1) *Congestive* due to an intense congestion of the pelvic viscera: (2) *Intermediate,* pain occurring between the menstrual periods; (3) *Membranous,* a painful discharge of the menstrual decidua; (4) *Neuralgic* applied to neurotic dysmenorrhea; (5) *Obstructive* due to mechanical obstruction; (6) *Ovarian* the form in which the pain is confined to the ovaries and lumbar region; (7) *Spasmodic* due to uterine spasm.

Therapy.—The congestive and spasmodic forms of dysmenorrhea are promptly relieved by diathermy.

Technic.—One electrode should be placed over the sacrum, the other over the lower abdomen and the d'Arsonval current turned on gradually to comfortable

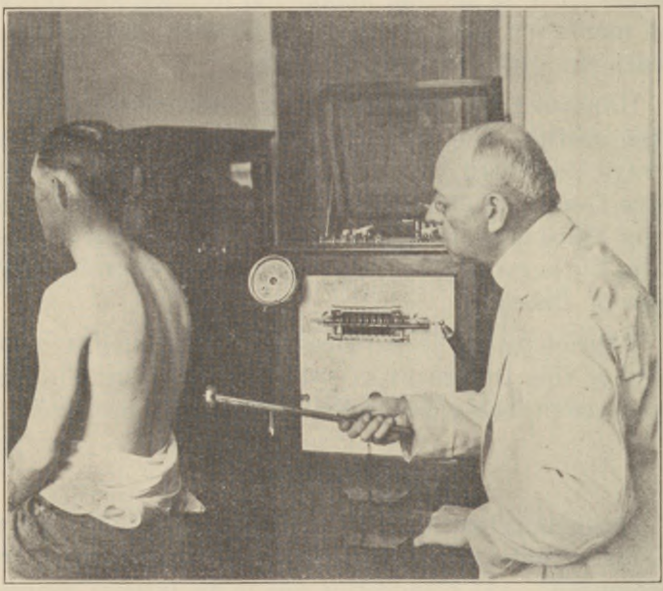


Fig. 63.—High-Frequency Effluve.

toleration of the patient, allowed to remain for 15 to 20 minutes then gradually reduced to zero. One treatment is usually sufficient to relieve the symptoms.

Another method is to apply one electrode to sacrum, one over the hypogastrium and both electrodes attached to one post of machine by means of bifurcated conducting cord. The third or active electrode being an insulated vacuum vaginal electrode attached to opposite post of the machine is placed in the vaginal fornix and a current of toleration allowed to pass for 7 minutes.

Physiology.—The heat induces rapid circulatory changes and relaxes spasm.

Membranous Dysmenorrhea is best treated by the softening effects of the negative pole of the constant current applied within the uterus.

Intermediate Dysmenorrhea is successfully treated by galvanism. The management of other forms depends entirely upon the causative factors.

The intrauterine application of the high frequency current in dysmenorrhea is an excellent one in cases where the cervical canal will admit an electrode covered with cotton which has been previously saturated with hot saline solution. A bare metal or glass electrode within the uterus with even a mild current may damage the uterine mucosa, but when wrapped as above described the salt acts more or less as an insulator and protects the mucosa. This technic admits the use of stronger currents which may be applied for a longer period of time, thus more effectually heating the entire pelvic contents. When an intra-uterine application is made the effects may be enhanced by the use of two indifferent electrodes, one over the sacrum, the other over the hypo-gastrium, both being connected by means of a bifurcated cord to one pole of the d'Arsonal apparatus. This method is known as modified diathermy.

ECLAMPSIA.

Eclampsia is a term denoting a sudden convulsive seizure in a woman prior to or during labor, or during puerpium.

Therapy.—The treatment of eclampsia is prophylactic, medical and surgical.

One of the earliest and most constant signs of a toxic condition is a gradual increase in the systolic blood pressure and will be noted for a month or more before albumin can be detected in the urine. When the systolic blood-pressure reaches 145 in a pregnant woman, otherwise normal, eclampsia is to be expected. The blood-pressure of every pregnant woman should be taken at least once in two weeks during the period of gestation. If the pressure is found to be gradually rising do not wait for albumin to appear in the urine, but give the patient the benefit of all doubts by instituting treatment by auto-condensation 300 to 400 milliamperes for 12 minutes at such intervals necessary to keep the systolic pressure near to normal. The saying, "An ounce of prevention is worth a pound of cure," was never more pertinent than in eclampsia.

ECZEMA.

Eczema is a term applied to acute, subacute or chronic inflammation of the skin, characterized by erythema, vesicles, papules, pustules or a combination of two or more of these lesions. The varieties are too numerous to be mentioned here.

Therapy.—While the unipolar application of the high-frequency current will often relieve the itching and the hyperemic effects prove useful, a cure of the disease should not be looked for.

The ideal treatment of all eczemas is found in the roentgen ray. Often one intensive treatment will clear up the lesion. However, the writer prefers fractional doses of 1/3H daily for 3 days, repeating the dose in three weeks if found necessary.

ENDOMETRITIS.

Endometritis is an inflammation or hyperplasia of the uterine mucous membrane, involving to a greater or less extent the uterine parenchyma. There are two forms, the acute and chronic. The acute form may be so mild as to be overlooked. The chronic form supervenes the acute form in a gradual manner.

A differential diagnosis between endometritis, carcinoma, sarcoma and fibroid should be made before treatment is instituted.

Therapy.—The acute form resulting from suppressed menstruation, over exertion, etc., is promptly relieved by diathermy, with one electrode over the hypogastrium, the other over the 1st to 4th lumbar vertebrae. A current of toleration should be passed for 20 to 30 minutes every other day.

A more pronounced effect may be induced with a well insulated vaginal or prostatic electrode in the vaginal fornix, the other electrode of metal over the hypogastrium, current strength of toleration for 7 minutes daily. Modified diathermy is also useful. See dysmenorrhea.

The uterus may be reached also with active prostatic electrode in the rectum with opposite electrode over the

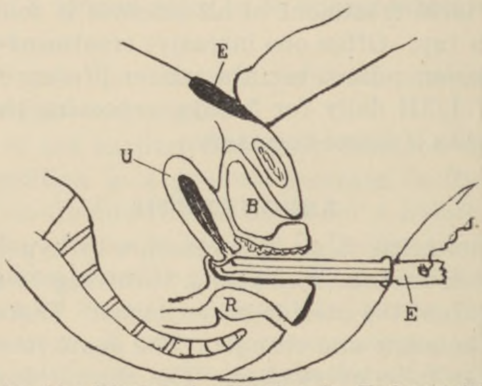


Fig. 64.—Bipolar Application in Endometritis. E, electrodes; U, uterus; B, bladder; R, rectum.

hypogastrium as in diathermy of the prostate (Fig. 83).

Uterine reflex of contraction may be induced by a strong unipolar current over the 1st, 2nd and 3rd lumbar vertebrae for a period of 5 minutes. This is of special value if there be uterine bleeding.

Physiology.—Dissipation of inflammatory products thru circulatory effects. See physiology of diathermy.

EPIDIDYMITIS AND ORCHITIS.

Therapy.—The early treatment of epididymitis by diathermy will limit the deposition of inflammatory products and will also hasten their elimination after they are formed.

Technic.—Owing to the peculiar anatomical contour of the parts it is advisable to employ several layers of gauze saturated with hot salt solution underneath the flexible metal electrode which is shaped to cover the inflamed area. The other electrode may be held in the hands of the patient and the d'Arsonval current turned on gradually to point of tolerance; the amperage should then be reduced slightly and continued for 30 minutes to one hour and repeated daily until satisfactory results are obtained. Acute cases should be aborted within four days.

Physiology.—Circulation of blood and lymph is hastened and tissues drained.

EPILEPSY.

Epileptiform attacks are probably due to spasm of the cerebral vessels producing a sudden anemia of the brain. If this theory be true, at least a temporary amelioration may be secured by inciting the reflex of dilatation by strong high-frequency application to the lower dorsal vertebrae.

Many reports have been made of favorable action of high-frequency currents in this disease, but as a rule the effects have been transient. However, Tracy has reported tentative cures of from 12 per cent in *grand mal* to 25 per cent in *petit mal.*

The writer's experience with high-frequency currents in this disease leads him to believe that with the exception of auto-condensation to relieve the existing toxemia, there is little to be gained by their use.

EPITHELIOMA.

Before metastasis takes place practically all basal cell epitheliomata envolving the skin may be removed by surgical diathermy with little or no fear of recurrence.

For technic, see Surgical Diathermy.

FISTULAS AND FISSURES.

Any fissure of the tissues that can be brought into view with or without the employment of a speculum is easily and successfully treated by desiccation.

Technic.—Bring the fissure well into view and with a needle electrode desiccate the entire tract, destroying all adventitious tissue. Fistulous tracts that can be reached with any shaped electrode are easily cured by desiccation. The difficulty encountered by tortuous tracts is more or less a barrier to successful management. Every portion of the pyogenic membrane must be destroyed in order to bring about the closing of the tract. The good judgment of the operator must be invoked to render a decision in regard to the indications present in each individual case.

The technic is essentially the same as in desiccation of fissures.

FRACTURES.

The time required for healing fractures may be shortened one-third to one-half, better results obtained and many deformities obviated by timely employment of electrotherapeutic measures. Atrophied muscles, adherent tendon sheaths and ankylosed joints result from improper after-treatment of fractures and dislocations.

The too common practice of allowing splints to remain from one to four weeks without removal is to be condemned. In nearly all cases the splint should be removed not later than the third day and at least twice a week thereafter, and diathermy applied for the purpose of maintaining nutrition.

Diathermy will reduce edema and promote absorption of exudates and consequently relieve pain.

Diathermy will hasten the formation of callus by increasing the metabolism of the part, thus shortening the time of disability. If muscular activity be maintained the muscles will be able to do their part as soon as sufficient union of bone has taken place. In cases where it is inadvisable to remove the splint (Pott's fracture) a little ingenuity on the part of the surgeon will enable him to apply the electrodes, above and below the splint in such a manner as to flood the parts with new blood.

GANGRENE.

A vascular disease of the extremities known as Raynaud's Disease is frequently arrested by physical measures such as radiant light from incandescent lamps and heat by diathermy. Radiant light should be applied every second day alternating with diathermy. The treatment must be continued for a long time—6 or 8 months.

Technic.—Same as for Chilblains. See Fig. 60.

GOITER.

The term goiter simply means an enlargement of the thyroid gland. There are several varieties of goiter, named in accordance with the pathology: *Parenchymatous, cystic, fibrous, exophthalmic* and *malignant.*

Therapy.—The writer desires to issue a warning against the indiscriminate use of high-frequency currents in this disease. While physical measures have been proven to be of great value in the treatment of the parenchymatous and exopthalmic varieties there are but few cases benefited by high-frequency currents. The parenchymatous or simple adolescent form may be treated by diathermy with hope for success in a few cases.

Technic.—Seat the patient on the auto-condensation pad, place a well-fitting metal electrode to the thyroid, turn on a current of 500 milliamperes for 5 minutes. This application may be repeated every third day. Care should be exercised not to overstimulate the gland.

While treatment of the exophthalmic goiter by the roentgen ray is successful in many cases it should not be undertaken by unskilled hands.

GONORRHEA.

With proper technic the treatment of gonorrhea in the female by diathermy is very successful. The temperature of the infected area must be raised to 108 F. and maintained for a period of three hours in order to kill the gonococci; this is easily accomplished with one electrode in the vagina, the other over the hypogastrium. Two or three hour applications with an intermission of three hours should be employed daily until no gonococci can be found. Three to ten days are usually required. The temperature is recorded by a thermometer in the rectum.

Fig. 65.—Diathermy in Goiter.

HEMIPLEGIA.

Hysterical hemiplegia may be differentiated from the organic form by one symptom, that of unconsciousness. Hysterical hemiplegia is not preceded by unconsciousness, while true organic hemiplegia is always preceded by a period, sometimes of only a few seconds of time, of unconsciousness.

Treatment.—Hysterical hemiplegia is readily cured by the application of almost any electric modality, the more spectacular the application, the more prompt the results. This form is often cured by suggestion.

In organic hemiplegia due to morbid processes such as embolism, thrombosis and atheroma which lead to local destruction there is little hope of restoration of function, but in some cases of small emboli much may be accomplished by the vascular dilatation and absorbent effects of autocondensation, 300 to 600 milliamperes for 15 minutes, applied three times a week for a period of 3 to 6 weeks.

HEMORRHOIDS.

A hemorrhoid is defined as a vascular tumor of the mucous membrane of the rectum, skin or both. There are two varieties, the external and internal. The symptoms are characteristic but should be differentiated from polypi, villous tumors, malignant growths and prolapsus.

Therapy.—The general condition of the patient should first elicit our attention. Patients with hemorrhoids are usually overfed, constipated and toxic. Nearly all cases have hypertension. Toxins must be removed and this is best accomplished by auto-condensation and diathermy. The liver should be diathermatized for 20 minutes three times a week with a current strength of 1000 to 2000 milliamperes. (See Fig. 59.) The food tube should be cleared and kept as clean as possible.

This line of treatment will relieve practically all cases of recent development. However, if there be chronic thickening or dilatation of the venous walls, I know of no surgical procedure that equals the desiccation method first brought to our notice by Dr. W. L. Clark. The advantages of the method are: No general anesthetic required; complete destruction in one treatment; little post-operative discomfort; no primary or secondary hemorrhages; less inflammatory reaction than when cautery is employed; no resulting cicatrices, hence no rectal strictures; external piles may be removed in the office and patient allowed to go about his business.

Technic.—For internal hemorrhoids a preliminary purgative and enema are given. The area about the anus is anesthetized with a 2 per cent solution of procain, the injections being made at points about one inch from the anus. The skin being anesthetized will allow of deeper injections to thoroughly block the nerves of the sphincter sufficiently to dilate the sphincter. After dilatation of the sphincter the hemorrhoid is pulled down, clamped and desiccated down to the clamp. The mass is then removed with scissors. The clamp is then removed without fear of hemorrhage. A soothing suppository is inserted into the rectum and may be repeated as circumstances dictate.

If the pile be external no clamp is used. The base of the pile is anesthetized with a 2 per cent solution of procain to which epinephrin may be added. If the pile be small the entire mass is desiccated until it changes in color to chamois or light yellow.

There is no rule for dosage. Apply the current until the color mentioned appears. This will require from 3 to 10 seconds according to the size of the pile. Piles with small pedicales need only to have the base desiccated and the mass cut away with scissors. No post-operative treatment required; complete healing takes place in a few days.

HERPES ZOSTER.

(Shingles).

Herpes Zoster is an acute inflammatory disease of the skin, appearing along the course of certain cutaneous nerves and is characterized by groups of papules. The eruption is preceded by intense pain in the neighborhood of the area attacked. The eruption may occur on almost any part of the body, its favorite site being along the course of intercostal nerves. The skin lesion is secondary to neuritis.

Therapy.—The unpleasant symptoms caused by the eruption are often relieved by high-frequency application thru a vacuum electrode. High-frequency effluve from a multiple-point electrode is soothing to the painful areas. Auto-condensation for its general effect upon metabolism is indicated. (See Neuralgia and Neuritis.)

HYSTERIA.

The effects of high-frequency currents in this disease are principally psychic in character.

IMPOTENCE (Sexual)

Patients suffering with sexual impotence require careful examination to ascertain the causative factor in each particular case and when found it should be treated with due regard for the indications present.

Most of the conditions which produce sexual incompetency are amenable to some form of physiotherapy.

In many cases diathermic applications are followed by relief of the incompetency. With a metal electrode within the rectum and another over the hypogastrium with a small amperage of current the arterial flow of blood will be increased in the parts affected and relieve the coldness in the parts and at the same time increase the glandular activity. A strong Oudin current applied over the lower lumbar region increases the activity of the nerves supplying the organs of generation.

INFECTIONS.

Superficial types of infection are best treated by radiant light and heat from a high wattage carbon filiment lamp. The heat produces an increased resistance to infection to a degree capable of overcoming the germ process. To be successful with this agent long exposures of one hour each must be made; at least three such exposures should be made during each twenty-four hours.

Where there is no closed accumulation of pus, diathermy will do excellent service.

INSOMNIA.

Insomnia is not a disease but a symptom common to many diseases and dysfunctions. The amount of sleep required varies greatly in individuals, some requiring but five hours' sleep while others require nine to ten to be able to perform the same amount of work. The normal average for men is seven and for women eight hours out of each twenty-four.

Classification.—Etiologically insomnia is divided into three groups: (1) Insomnia due to faulty habits and hygiene; (2) insomnia due to acute diseases; (3) insomnia due to chronic diseases.

Therapy.—The "hit and miss" application of high-frequency currents for insomnia cannot be too strongly condemned. When insomnia is a symptom of a condition in which high-frequency currents are indicated, it yields readily to such application. In chronic disorders due largely to toxemia the auto-condensation treatment is indicated to facilitate elimination. If there be no physiological indications for the high-frequency current it is illogical to apply it.

The unipolar high frequency current with an auto-condensation or glass vacuum electrode held in the patient's hands has a soothing effect upon the nervous system and is often followed by quiet sleep.

LEUKEMIA.

Leukemia is a disease characterized by an increase of lymphatic tissue in the body and an excess of white corpuscles in the blood.

Therapy.—High-frequency currents in the forms of auto-condensation and hand to hand diathermy increase metabolism and have a tendency to increase the proportion of red cells, consequently are indicated in this disease.

LICHEN PLANUS.

This disease is characterized by an inflammation of the skin with an eruption of papules that are broad and angular at the base, flat and glazed on top and slightly umbilicated. The lesion favors the flexor surfaces of the forearm, the flanks, around the waist and knees. Pruritus is quite severe.

Therapy.—High-frequency currents are of little service in this disease except for relief of the pruritus. The best treatment for this condition is roentgen radiations in semi-intensive doses and continued over a long period of time.

LUMBAGO.

Pain in the lumbar region may be due to any one of several pathological conditions. True lumbago is characterized by spasm of the lumbar muscles.

Therapy.—Apply radiant light and heat from a high power lamp for one hour and follow up with high-frequency sparks from a non-vacuum electrode.

Diathermy will also relieve the spasm.

Technic.—With patient reclining an electrode (6x6) is placed over the affected muscles; the opposite electrode (8x8) is placed upon the abdomen and held in place by sand bags. The d'Arsonval current is turned on to comfortable toleration of the patient and continued from 20 to 30 minutes then gradually reduced to zero.

Fig. 66.—High-Frequency and Light in Lumbago.

High-frequency effluve from a multiple point electrode held just outside of sparking distance is gratefully received by the patient.

LUPUS.

Lupus Vulgaris is a chronic disease of the skin characterized by nodules of connective tissue which terminate in ulceration or atrophy. The causative factor is the tubercle bacillus.

Therapy.—In the early stages the nodules are easily destroyed by desiccation. Later in the disease, when the nodules take on ulceration, the lesions may be removed by electro-coagulation with same technic as in epithelioma.

Fig. 67.—Diathermy in Lumbago.

MENORRHAGIA AND METRORRHAGIA.

High-frequency currents are more liable to aggravate than benefit uterine bleeding. However, when applied by the unipolar method to the 1st, 2nd and 3rd lumbar vertebrae to induce the reflex of contraction, amelioration of symptoms may result. See Endometritis.

MIGRAINE.

Cases of migraine are born, not made. The pain is usually confined to one fronto-temporal region. There is nausea and vomiting. These patients are always toxic. A course of auto-condensation consisting of 5 daily treatments and one treatment every two weeks thereafter will be of great service to these patients in warding off attacks.

MENOPAUSE.

The nervous phenomena from which many women suffer at the period of menopause are often relieved by auto-condensation.

MASTOIDITIS.

Mastoiditis is an essential infection of the mastoid cells and often occurs following an otitis media. Radiant light and heat applied early will often prevent suppuration.

High-frequency currents are contra-indicated in this disease.

MOLES.

It is the duty of the physician to recommend to their patients the early removal of all warts, moles and skin growths. Every mole does not take on cancer proliferation, but the tendency is to do so and an early destruction of all moles is advisable.

Therapy.—The ideal method of removal of all skin blemishes is desiccation.

Technic.—A local anesthetic may or may not be necessary, much depending upon the sensitiveness of the patient. A needle-point electrode is placed in a suitable handle and held about one-fourth inch distant from the growth. A mild high-frequency current is then turned on. Allow the short sparks to play until the color of the growth indicates dehydration. No application of a medicinal nature should be made. A crust should be allowed to form which will fall in 10 to 20 days leaving a clean pink surface. The pinkish color will disappear in a few weeks leaving no scar. If a scar results it is the fault of the operator. (See Fig. 31).

Another method may be employed known as the indirect or disruptive arc method, the technic of which is as follows: Seat the patient on an auto-condensation pad which is connected to one pole of the d'Arsonval machine and connect opposite pole to the ground. (See Fig. 30.)

Still another method is employed by seating the patient on the auto-condensation pad which is connected to the Oudin post of the machine, the operating electrode being grounded to a water or gas pipe: otherwise the technic is the same as in the direct method. For obvious reasons the direct method is to be preferred.

NEURALGIA AND NEURITIS.

Neuralgia is a term employed to designate nerve pain. It is often difficult to differentiate the former from the latter, the essential difference between them lying in the fact that neuralgia has no pathology and therefore is a symptom, while neuritis has a distinct pathology and, therefore, is a disease.

It is more or less common in practice to apply the term neuralgia to pains of an intermittent character, and neuritis to those of a more severe and constant character. The causative factors in neuralgia and neuritis are essentially the same. Exposure to cold may irritate peripheral nerves and cause neuralgia. If the patient's resistance be lowered thru constitutional conditions the same exposure to cold may set up a neuritis.

Neuritis is always due to pressure either from within or without the nerve sheath. When from within it is due to infection or poison, and when from without it is due to mechanical pressure from tumors, dislocations and the like or chemical activities.

Neuralgias are always unilateral. Neuritides are often bilateral. Superficial or deep pressure on an inflamed nerve always causes pain, while in neuralgia deep pressure often relieves the pain. The pain in neuritis is always associated with the nerve; neuralgic pains are often experienced some distance from the lesion.

Brachial Neuralgia.—This, like neuralgias elsewhere, is characterized by pain in the distribution of one or more nerves of the plexus. The pain may be referred to all or few of the branches of the brachial plexus, such as the musculospiral, ulnar or cutaneous branches. There is nearly always a tenderness upon pressure where the nerve lies near the surface and close to bone.

In cases of pain in any of the branches of the brachial plexus and not associated with vasomotor changes in the skin, sensory loss or muscular atrophy, the diagnosis is neuralgia. Brachial neuralgia is usually associated with some constitutional diathesis or specific toxic conditions such as malaria, influenza, etc.

Brachial Neuritis.—Pain in the distribution of the nerves of the brachial plexus when associated with vasomotor changes in the skin, sensory loss or muscular atrophy must be considered of neuritis.

In all cases of pain in the brachial plexus careful search for the cause must be made. Among the causes of neuritis may be mentioned servical rib, tumors in neck or axilla, malignant disease, cervical caries, spinal tumors. Many cases of neuritis follow slight trauma when the patient harbors foci of infection especially about the nasal sinuses, throat and mediastinum.

Neuralgia and neuritis must be differentiated from occupational neurosis. The diagnosis is usually easy because in a particular occupation certain muscles are overworked and the pain is associated with spasm of these muscles. The pains associated with bursitis, arthritis and tuberculous joint are of a neuralgic character.

Trigeminal Neuralgia (tic douloureux).—This is an essential disease the pathology of which is obscure. It is characterized by paroxysms of acute pain in one or more of the branches of the trigeminal nerve.

It is usually unilateral. There are all grades of severity from an occasional pain to one which is almost constant. In severe cases the pain is incited by the least movement of the facial muscle and often a slight breeze will excite an attack. The pain is probably the most excrutiating that mortal has to bear.

The diagnosis depends chiefly upon the following points: (1) age, usually after 35; (2) absence of relief after removal of possible causes; (3) presence of definite starting points; (4) the intense severity of the pain; (5) precipitation of attacks by slight peripheral stimuli; (6) the various trophic phenomena; (7) absence of definite lesions.

Trigeminal neuralgia simulating tic douloureux may be due to tumors at the base of the brain, tumors

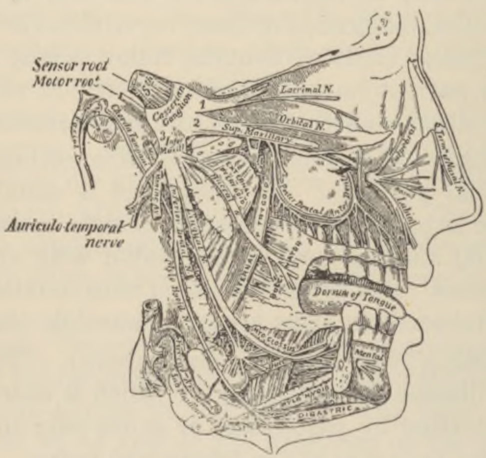


Fig. 68.—Trigeminal Nerve.

in the skull and in the cranial nerves, optic neuritis, gummas, etc. The neuralgic pain prior to the eruption of herpes zoster affecting the Gasserian ganglion simulates genuine tic.

Mild facial neuralgias are frequently associated with various diseases of the local structures of the face, such as decayed teeth and sinusitis. Facial neuralgia may be due to errors of refraction. The *pseudo-neuralgias* of neurasthenia are usually bilateral and the pain complained of is not of definite character like true neuralgia.

Sciatica.—Pain referred to the sciatic nerve may be either a neuralgia or a neuritis. In true neuritis if the inflammation is not soon subdued there are vasomotor skin changes somewhere along the course of the nerve. Sooner or later depending upon the severity of the disease, there will be evidence of muscular atrophy and sensory loss. Numbness on the dorsum of the foot frequently occurs in neuritis but not in neuralgia.

When a patient complains of pain along the distribution of the sciatic nerve the physician should make a painstaking examination of the hip, sacroiliac and lumbar joints, and if at all in doubt should make a thorough roentgen ray examination. Pain in the sciatic nerve is common in cases of prostatic disease, hemorrhoids and rectal tumors in men, and uterine disease and growths about the uterus and rectum in women. Every case of persistent sciatica demands a thorough examination of the pelvic contents. *Tuberculosis* and *syphilitic meningitis* of the lower portion of the spinal cord may give rise to sciatica. Lightning pains of *tabes dorsalis* may simulate sciatica. They may be differentiated by knee-jerk which is present in neuralgia and absent in tabes. The pains of tabes are bilateral and not referred to any particular nerve.

Anterior cruritis is sometimes associated with sciatic neuritis but seldom if ever accompanies sciatic neuralgia. Pains in the legs due to *intermittent claudication* which depends upon an insufficient blood supply are felt principally in the calves and do not simulate sciatica.

Metatarsel Neuralgia.—The pain in this type is of a paroxysmal character and has its inception at the base of one or more of the toes, extends upward thru the foot and may even be experienced as far as the body. Pain in the tarsal region of the foot when not due to trauma or acute rheumatism suggests gonorrheal bursitis.

Intercostal Neuralgia.—The pain in this condition is felt along the course of one or more intercostal nerves. There is marked tenderness over the branches of the cutaneous nerves. The pain is increased by breathing or movement of affected muscles. If it be unilateral it points to neuritis of herpes zoster. The pain may be due to spinal caries or tumors of the mediastinum. In influenza the pain may simulate that of pneumonia or pleurisy, but these conditions are usually easily differentiated.

Multiple Neuritis.—The pain associated with this condition is variable—great in some cases, little in others. Vasomotor and motor symptoms are always present. The reaction of degeneration may be complete or only partial; knee-jerk usually lost. The disease is usually caused by alcoholism but may be due to other poisons such as arsenic and lead. The writer has seen a few cases of multiple neuritis following intense treatments of salvarsan. It is not uncommon to see multiple neuritis accompany diabetes. It is often an heir to influenza. The chief symptoms of peripheral neuritis are tingling in the extremities, numbness of fingers or toes, crampy muscles and severe aching of limbs.

Therapy.—The success in treatment of neuralgia and neuritis depends upon an accurate diagnosis, removal of cause and application of proper remedy. The etiology and symptomology of these conditions have been concisely stated for the purpose of drawing the reader's attention to the diversified conditions which have their sequel in pain.

The ordinary medicinal treatment for these conditions in most cases is worse than useless. Such remedies as aspirin, acetanilid and opium simply cover up the symptoms. It must be admitted that the patient is not as keenly interested in the diagnosis as in the treatment of his affliction. He demands relief from pain, and when very severe the physician is impelled to administer some drug of analgesic properties. The analgesic route from neuritis to drug addiction is short, and, to change such routing to one less agreeable to the patient often taxes the physician's resources. In some cases the pain is of such severity as to require a sedative such as phenacetine, but this drug should be avoided if possible. Acute neuritis may be of a type that will require rest in bed, but absolute rest should be limited to a few days at most.

Fig. 69.—Diathermy to shoulder, direct method.

The physiology of neuritis demands the application of heat. The ordinary hot water bottle, electric pad or similar modes of convective heat is often soothing to peripheral nerves but falls short in penetration. Radiant light and heat from high voltage lamps penetrates sufficiently for superficial nerves, but the treatment *par excellence* is heat by diathermy.

Pain due to lesions and dysfunction of the brachial plexus is very common and most pronounced about the shoulder. The *technic* of diathermy to the shoulder will be best understood by reference to Figs. 69 and 70. The anatomical contour of the shoulder is such as to make close adaptation of metal pads to all points more or less difficult; and to facilitate contact pads of gauze wet with hot saline solution are employed. It must not be forgotten that salt pads modify the diathermic current. The electrodes should not be so large as to make the distance between their edges shorter than the distance thru the joint. High-frequency currents travel in a direct line between the electrodes, but the heat will be greatest where the tissue is smallest in diameter. If the edges of the electrodes come closer together than the distance thru the part desired to be heated, the heat will concentrate at that point and nullify the object to be attained. Electrodes with a diameter of from 2 to 3½ inches are best. The dose here as elsewhere should be one of toleration. The time should not be less than 30 minutes and one hour is better.

Fig. 70 illustrates an indirect method of applying diathermy and which is employed when the pain radiates from shoulder to forearm. In this case the pads may be greater in diameter. The forearm pad should cover the flexor side of the forearm for a space of at least 6 inches. There is no objection to the electrode entirely encircling the forearm.

Some operators treat brachial neuritis by seating the patient on auto-condensation pad and moving a small disc electrode along the course of the nerve. This method will do very well for superficial nerves but is inferior to heating the entire limb.

Trigeminal Neuralgia (tic douloureux).—This, fortunately, is not a common disease, and as its pathology is unknown the treatment must be empirical. Prior to the discovery of high-frequency currents the treatment

Fig. 70.—Diathermy to shoulder, indirect method.

of this condition was resection of the nerve or injections of alcohol to produce degeneration of the nerve. Neither of these treatments was successful for more than a short period of time when the pain would recur with all its severity. Intracranial neurectomy has recently come into vogue. The operation is said to be not a dangerous one and the results more or less gratifying. In the high-frequency current in the form of diathermy we have found a means of at least alleviating the excruciating pain, in many instances the relief lasting for months and even years.

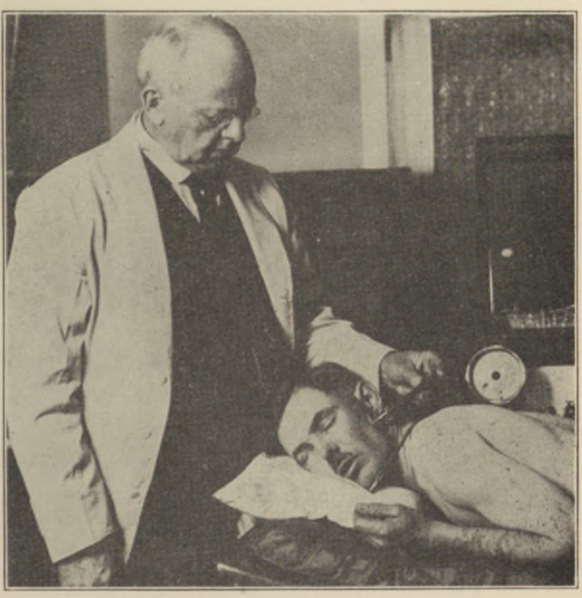


Fig. 71.—Diathermy in "Tic," direct method.

Technic (direct method).—Fashion a soft metal (block tin) electrode to fit the entire side of the face from lower jaw to temple, and from front of ear to side of the nose. This electrode being the indifferent one is placed on the face opposite the affected side. A small metal electrode 1½ inch in diameter as the active one is placed over the Gasserian ganglion of the affected side. If the contour of the face be such as to preclude perfect contact several layers of gauze saturated with hot salt solution may be placed between the electrode and the skin. However, the effects are better with bare electrodes.

Fig. 72.—Direct diathermy with clamp.

The patient should recline on the large electrode, the smaller or active one being held firmly in place with a sand bag or held in hand of operator. The current should be turned on very slowly, reaching about 700 milliamperes in a period of ten minutes then the cur-

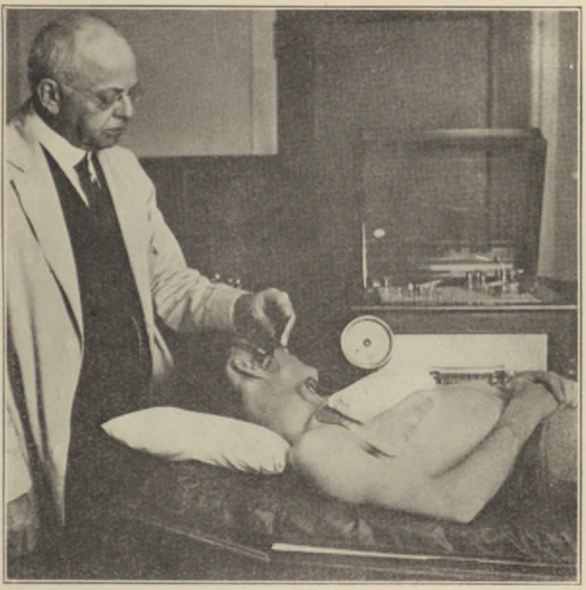


Fig. 73.—Diathermy in "Tic," indirect method.

rent is increased to a point just short of toleration which will be found to be from 900 to 1200 milliamperes. Continue this dose for 20 to 30 minutes longer. This treatment relieves the pain for several hours. In severe cases it may be best to repeat the treatment the same day, but one treatment a day is usually sufficient to assuage the pain. Cases of mild neuralgia will be relieved in 3 or 4 days while severe ones require a daily treatment for 4 to 6 weeks.

Another method in technic, known as the indirect method, is sometimes employed: A large (8x10-inch) electrode as the indifferent one is placed on the chest

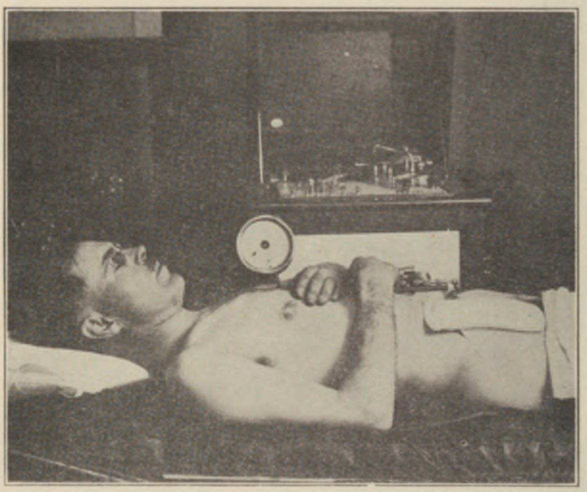


Fig. 74.—Diathermy in Sciatica.

near the shoulder of the affected side and held in place with sand bags. Otherwise, the technic is the same as in the direct method.

Sciatica.—Sciatic neuritis, like neuritis elsewhere, is treated by diathermy. Fig. 74 illustrates the proper position of the electrodes. A small electrode (2-inch diameter) is placed over the sciatic notch and held firmly in place by the patient's body. The other electrode (6x8-inch) is placed over the groin of the affected side and held in place with sand bags. Otherwise the technic is the same as in trigeminal neuralgia.

Vacuum electrode applications over the course of the nerve sometimes relieve the intense pain but the effects are not lasting. Cases of sciatica which do not yield to high-frequency currents should be exposed to X-rays. *Technic.*—Radiate over the sciatic notch every second day for three treatments. Each treatment should consist of one-third of an erythema dose. If a second seance is required it may be given after a period of 10 days. If the first radiation increases the pain it is a favorable omen.

Sciatic Neuralgia.—This condition points to lesions outside the nerve. While the same technic as in sciatic neuritis is often followed by relief of pain, the lesion itself must receive proper treatment in order permanently to relieve the neuralgia. If the cause of the neuralgia be tuberculous or rheumatic any electric modality will aggravate the condition.

Cruritis Anterior.—Diathermy is the proper treatment for this condition. *Technic.*—Place a 6x8-inch electrode over the anterior aspect of the thigh and weight down with sand bags; the opposing electrode (8x10) over the lumbar region and held in place by the patient's weight. Time and dose same as in sciatica.

Metatarsal Neuralgia.—The treatment in this condition is illustrated in Fig. 60. A current of toleration for 30 minutes should be employed.

Intercostal Neuralgia and Neuritis.—These conditions should be treated by auto-condensation, 500 milliamperes for 15 minutes, unless there are contraindications. A vigorous application of the unipolar current

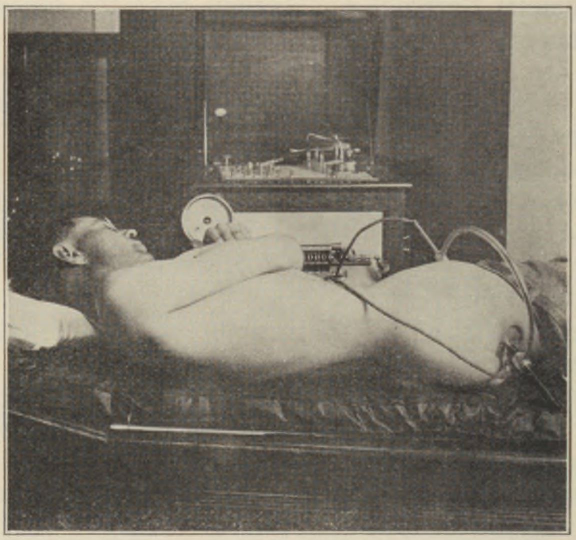


Fig. 75.—Diathermy in Sciatica with clamp.

thru a non-vacuum electrode over the dorsal spines should be made daily until relief is obtained.

Diathermy with electrodes of equal area, one over the dorsal region and the other over the sternum, with a current of toleration for 20 minutes is often followed by excellent results.

Multiple Neuritis.—The management of these cases taxes the resources of the physician to limitation. Owing to the multiplicity of the symptoms it is impossible to outline a treatment which will yield results in all cases. The first consideration is the removal of the cause; next in order, the preservation of affected muscles the nutrition of which may be preserved by efficient application of diathermy.

Auto-condensation is important in many cases. Diathermy directly to the affected portion of the spinal cord will limit the degeneration, and the favorable results obtained will be in inverse proportion to the destruction of nerve cells. These cases require the best hygienic management.

Other physiotherapeutic measures which will suggest themselves in each individual case may be employed with benefit: among these static electricity takes first place.

NEURASTHENIA, NEUROSTHENIA AND SPINAL TENDERNESS.

The term neurasthenia serves to designate many forms of neuroses as well as psycho-neuroses. *Neurosthenia* is a term applied to neurasthenia accompanied with "hypertension." *Spinal tenderness* is grouped with neurasthenia by reason of its persistence in that condition.

There is probably no disease or condition which presents such a symptom complex as the one we are pleased to call neurasthenia. There is no definite symptomatology of the condition unless it be a combination of all the unpleasant sensations derived from all the varied pathological states to which man is heir. The nearer the symptoms approach definiteness the greater the indefiniteness becomes.

In comparing the symptoms with symptoms of definite lesions there are always a few missing links in the chain of evidence. Each case must be investigated on its merits, and when all testimony is in, the physician becomes judge and jury and must decide the case in accordance with the facts presented, always making allowance for deceptive and perjured testimony, because a neurasthenic will always exaggerate and in many instances deliberately perjure himelf. While he often bears false testimony, to him the suffering is a reality. His nervous system is bankrupt, he loves sympathy and will lead his physician a merry chase to secure it.

There is always a cause, but being so covered with multiplicity of symptoms its discovery is one of the difficult problems in medicine. The patient's confidence can never be won by mirroring his false statements. He must be handled with the greatest *finesse,* and when his confidence has been won the physician is in a position to ferret out the etiological factor in the case, and it will be found under one of the following heads:

1. Toxemia.
2. Syphilis.
3. Hereditary psychoneurosis.

4. Perverted sexual function.
5. Americanitis.

The prognosis depends entirely upon discovery of the causative factor and skill of the physician to eliminate it. Often after the cause is removed some of the symptoms remain due to habit. These cases fuss and fidget thru life and die of old age.

Spinal Tenderness occurs in three different conditions: (1) trauma and disease of the fascia, muscles, nerves or bone in the immediate neighborhood of the spine; (2) disease of distant parts of the body; (3) obscure nervous disorders such as neurasthenia.

Tenderness when due to Local Disease is always accompanied with rigidity of the muscles (nature's splint). When the disease or injury involves the spinal cord additional symptoms are present, such as sensory loss, muscular atrophy, paralysis, etc.

Spinal Tenderness when due to Disease in Distant Viscera is found in many diseases, especially those of the heart, stomach, liver and genito-urinary organs. In diseases of the heart, especially those affecting the myocardium, the area of spinal tenderness will be found between the 6th cervical and 4th dorsal; in disease of the stomach, between the 3rd and 7th dorsal. In the female tenderness over the 4th lumbar spine suggests uterine disease; over the 3rd lumbar, ovarian disease; over the 10th, 11th and 12th dorsal, kidney disease; on the right side of the 2nd lumbar, appendicitis. Reflex pains from diseased viscera are often experienced in other parts of the body. (See Figs. 38 and 39).

Spinal Pain and Tenderness Due to Neurasthenia.—Traumatic neurasthenia may follow slight injuries to the head, spine or testicle, or more or less severe traumas and strains of fibrous and muscular tissues of the back. The so-called "railway spine" is a familiar example of traumatic neurasthenia. The ruling out of actual lesions in these cases is often difficult. When the symptoms continue for a long period of time and symptoms of definite lesions are absent we are quite safe in making a diagnosis of neurasthenia. The knee-jerk in neurasthenia is usually exaggerated, and in spinal lesions it is usually impaired or lost.

As a general proposition the spinal pain and tenderness of neurasthenia is more widely disseminated than when due to trauma or visceral disease: that is, it may be found on pressure at any point from the cervical to the sacral region.

In splanchic neurasthenia the point of tenderness is usually found between the 2nd and 8th dorsal vertebra.

Spinal pain due to diseased viscera will be increased by handling the affected viscus. The pain of local spinal lesions is increased by pressure. When due to diseased viscera or neurasthenia pressure usually relieves the pain.

Neurasthenics, as a rule, have a blood-pressure below normal (hypotension). However, a small per cent will be met who have a blood-pressure above normal (hypertension), to which condition the neonym, *Neurosthenia,* has been applied.

The term *neurosthenia* may be unfortunate as hypertension in these cases usually indicates some definite lesion of the vascular system. These cases usually have cardiac hypertrophy and albumin in the urine. Defective alimentation and intestinal stasis play an important role in nearly all cases of neurasthenia. All toxic cases are not neurasthenics, but practically all neurasthenics are toxic.

Dysfunction of the endocrine glands is very common in neurasthenia, supra-renal deficiency being the most common.

Therapy.—The treatment of neurasthenia always has been, and probably always will be more or less empirical, but as we progress in scientific attainment, together with the aid of modern methods of diagnosis, we hope to become more and more proficient in diagnosis of the etiological factors in this condition and be able to classify them and to relegate the term "neurasthenia" to the junk-heap of oblivion. In the present state of knowledge, however, we are compelled by force of circumstances to recognize and classify certain cases as neurasthenics.

In outlining a definite treatment of neurasthenia one meets with a proposition as difficult as the killing of a flock of blackbirds with one shot of a rifle. However, the management of this condition is rapidly being facilitated as we advance in knowledge of the application of physical measures in therapeutics.

It is to be assumed that all definite lesions have been eliminated; that the mode of living, diet, habits, etc., have been investigated and proper advice given, after which the most important thing to do is to clear the intestinal tract. The Abbott advice, "clean up and keep clean" is most apropos. If there be foci of infection they should be eradicated.

In a very large percent of cases in the male the focus of infection will be found in the prostate, seminal vesicles or deep urethra. In many cases in the female the focus of infection will be found within the pelvis. Posture and dress greatly influence the splanchnic circulation and must be corrected. Vicious habits must be overcome. Relaxation of abdominal muscles and ptosed abdominal viscera are common. The liver suffers from blood stasis and is unable to prepare existing toxins for removal. Whether splanchnic stasis be the cause or the result of the nervous insolvency it should be corrected. Diathermy to the liver will favorably influence the splanchnic circulation, as will also vibration of the 2nd to 8th dorsal vertebrae. High-frequency current from a double pronged electrode applied to the tender spinal area will also relieve splanchnic stasis and tone up the intestinal musculature. (Fig. 51). The high-frequency current is beneficial but less efficient than percussion or vibration in these cases. High-frequency from a vacuum electrode applied over the various intestinal nodes is of service but inferior to the static wave or sinusoidal current. The Morse wave current is of great service in these cases, not only in securing deep muscular contraction, but, when applied to the spine with one electrode over the cervical vertebrae and the other over the sacrum with a strong slow wave, by greatly assisting in draining the splanchnic vessels as well as toning up the peripheral nerves.

Neurasthenic symptoms accompanied with hypertension (neurosthenia) are best combated with auto-condensation. Some cases are benefited with patient seated on auto-condensation pad with a metal electrode over the epigastrium and passing a current of 800 milliamperes for 15 minutes.

A study of the physiology of high-frequency currents will enable the operator to choose from the different methods of application the one most suitable for the case in hand. Practically all physiotherapeutic measures in one way or another are beneficial in the neurasthenic condition, their success depending largely upon the proper selection and skillful application on the part of the operator.

OTITIS MEDIA.

Otitis Media is an inflammation of the middle ear and caused by infection. It may or may not be accompanied with elevation of temperature or earache.

Therapy.—Radiant-light-heat applied for one hour at a time four times a day will often prevent extension to the mastoid. If the infection has reached the mastoid cells electricity in any form is worse than useless. The writer's experience justifies the statement: Keep away from otitis media with high-frequency currents.

PARALYSIS

(Local Palsies).

Facial.—Facial paralysis or Bell's palsy is a term applied to partial or complete paralysis of the muscles supplied by the cranial nerve. This condition is usu-

Fig. 76.—Spinal Diathermy. Useful in circulatory disorders of the brain.

ally unilateral. The signs are usually characteristic: diffculty in closing the eye; cannot wrinkle the forehead; angle of mouth cannot be raised; cannot whistle; mastication more or less difficult, etc.

The causes of facial paralysis are: A lesion anywhere in the course of the pyramidal fibers from the cerebral hemisphere to facial nucleus; lesion of the facial nucleus; lesion anywhere in course of the nerve between the nucleus and its peripheral distribution. When the lesion is within the skull the paralysis extends to the tongue, and in protruding it moves to the healthy side and sense of taste is impaired. A lesion between the pons and auditory meatus will give rise to vertigo and impairment of hearing. A neuritis outside the skull may give rise to a herpetic eruption about the ear. Many cases of facial paralysis occurring in persons with lowered metabolism are excited by cold air blowing for some time on the neck and face.

Therapy.—While electrotherapeutic modalities other than high-frequency are indicated, the congestion about the nerve when outside the skull is best dissipated by diathermy with same technic as in "Trigeminal neuralgia."

Regular application of diathermy will often prevent muscular atrophy. After atrophy has commenced the muscles should be treated by electric currents capable of producing muscular contraction. Roentgen radiation over the mastoid region often abbreviates the attack.

When the lesion causing facial paralysis is intracranial spinal diathermy is indicated: one electrode over the cervical and the other over the dorsal region. After placing the well fitted electrodes the current should be turned on gradually reaching a maximum of 700 milliaperes in five minutes, the current strength remaining for 5 minutes, then gradually reduced to zero in five minutes—total time 15 minutes.

The treatment of palsies of the upper and lower extremities is virtually the same as of neuritis of these parts. Nearly all local palsies are accompanied by low blood-pressure. Common sense hygienic measures should be adopted in these cases. The general treatment of palsies is not within the scope of this volume. For electrotherapeutic management of these cases reference to standard works is suggested.

PARALYSIS INFANTILE.

(Poliomyelitis).

The essential feature of this disease is an inflammation in the anterior horns of the gray matter of the spinal cord. Not unlike inflammation elsewhere it is accompanied by edema and consequent pressure.

Often the use of certain muscles is impossible due to pressure on certain nerve fibers. If the edema subsides early in the course of the disease there will be a spontaneous recovery, but if stasis in the cord continues for a prolonged period of time the nerve fibers will degenerate and cause a permanent paralysis. The muscles deprived of nutrition soon atrophy and the patient becomes a helpless cripple.

The regeneration of nerve fiber takes place slowly during which time the muscle being inactive fades away into a mere band.

Therapy.—The orthodox treatment of this disease is directed to the prevention of deformity. The patient is placed at rest and splints and casts are applied to maintain normal position, but nothing is done for the relief of the causative factor, pressure. The writer believes this method of treatment to be entirely wrong. It is well known that a normal muscle when placed at complete rest will soon atrophy from inactivity. The treatment by fixation simply causes atrophy of not only the affected but opposing normal muscles and results in complete loss of function. This form of expectant treatment seems irrational and should be displaced by measures directed to the restoration of physiological function.

In some cases, the intensity of the infectious process is so great as to preclude all hope of recovery, but this knowledge should not prevent the employment of measures which at least will give the patient a chance to recover.

All medical men agree that in this disease there is a stasis in the circulation of the anterior horns of the cord and that the stasis is soon followed by inflammatory exudates which by pressure causes the dysfunction of the nerve fibers.

It is well known by workers in the field of physical therapy that the physiological action of diathermy is to relieve stasis and assist the dissipation of inflammatory products. Therefore, it would appear that the early application of diathermy to the affected area of the cord be a rational procedure. The earlier the institution of this treatment to prevent organized exudates the greater the hope of success.

Instead of muscle fixation and consequent atrophy the function of the muscles should be maintained by early application of diathermy directly thereto. Voluntary effort to move the affected muscle should be obtained thru the tact of the attending physician and nurse. Later on, if these measures seem to fail to prevent atrophy, the careful employment of the sinusoidal, Bristow coil or rythmic galvanic current will be efficient in keeping up muscular nutrition so that in the event of nerve regeneration the muscles will at once be capable of resumption of function.

Even the gravest cases are often improved by these currents, but to obtain their full effect the treatment must be persevered in for months and in some cases for years. Never despair of doing good in these cases.

PARALYSIS AGITANS.

Paralysis Agitans is a disease characterized by muscular rigidity and is generally considered incurable; but often much relief may be obtained by auto-condensation with moderately high milliamperage which will cause perspiration. The treatment should be repeated three times a week for many weeks.

PNEUMONIA.

In the near past much has been written about the jugulation of disease, and this is especially true in cases of pneumonia. Our best medical authors agree that pneumonia is a self-limited disease and runs its course uninfluenced by medication. Since the advent of high-frequency currents much has been accomplished in the jugulation of pneumonia when applied during the congestive stage. Even after hepitization has occurred much may be done toward relieving the dyspnea, cough, cyanosis, pain and nervousness.

In cases of unresolved pneumonia the alternation of diathermy and roentgen ray every third day will be followed with excellent results.

Technic.—Place electrodes having an area of 36 to 48 inches in such a position as to bring the involved tissue between them, one on either side of the chest. The electrodes must be so constructed as to make coaptation perfect, and in order to do this it may be necessary to employ several layers of gauze underneath the metal electrodes. The pads of gauze should be kept thoroughly saturated with a hot solution of sodium chloride (10%). See Figs 56 and 57. An electrode of metal mesh which conforms to uneven surfaces is ideal for chest application.

Begin with a low amperage, consuming 5 minutes in reaching point of toleration which should be between 1700 and 2000 milliamperes. When the toleration point is reached reduce the current to comfortable toleration and continue for 20 minutes, then gradually reduce to zero, consuming 5 minutes in so doing. The treatment should be repeated every 6 hours. If this treatment be instituted early in the stage of congestion a jugulation may be expected. If applied in the stage of hepitization an amperage of 1400 should not be exceeded but applied in the same manner as stated above. In this stage jugulation is not to be looked for, the pulse becomes softer and slower, respirations slower and deeper, the expectoration loses its tenacity, nervousness is reduced and patient often falls asleep during treatment.

PLEURISY.

High frequency vacuum electrode application soothes the pain from pleuritic affections but is scarcely a factor in controlling the disease. The best treatment for acute pleurisy is diathermy applied in the same manner as in pneumonia. The tissues are drained and cellular activity restored. Diathermy may be employed in pleurisy with effusion but should not be used if there be pus within the pleural cavity. Empyema is a case for the surgeon.

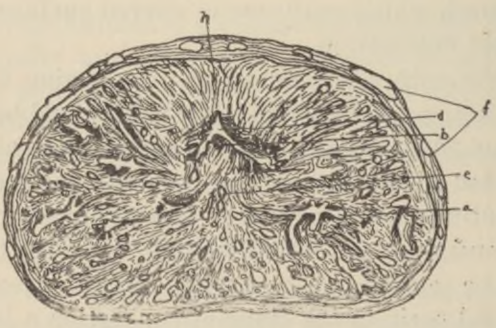


Fig. 77.—Normal Prostate.

PROSTATE.

The prostate is an important sexual organ of the male, situated behind the pubes and surrounds the neck of the bladder. It is pear shaped with base upward into which the neck of the bladder fits. It is about one and one-half inches wide, one and one-quarter inches from tip to base and three-quarters of an inch in thickness. It is pierced by the urethra slightly anterior to its center. It is a firm organ composed of glandular and muscular tissue. It contains upward of 20 acini thru which the secretion reaches the urethra.

Fig. 77 illustrates a transverse section of a normal prostate. This depicts the many glands and ducts which may harbor infection and the improbability of expression of their contents by simple massage.

Examination.—Not all abnormal conditions of the prostate are amenable to high-frequency currents, consequently the operator should be able to make a differential diagnosis on evidence produced by examination. There are two routes of access to the prostate, urethral and rectal. The urethral route will enlighten us on the size of the prostate. If the distance from meatus to bladder exceeds 8 inches, the prostate is enlarged. If a straight sound meets obstruction other than that of foreign bodies or strictures of the urethra, it is probably due to dislocated urethra due to prostatic enlargement.

The preponderance of information gained by examination comes from the rectal route. Visualizing the rectum will elicit but little, so far as the prostate is concerned, but the digital touch availeth much. Every operator prefers his own examination technic. More information will be gained as to size and contour of the prostate if the bladder be moderately filled.

In making examination per rectum, the writer prefers to have the patient stand firmly on both feet with the knees unflexed but body inclined by placing both hands upon the operating table. In gaining entrance haste should be made slowly, giving time for the sphincter muscles to relax. After gaining entrance what do you feel? The finger at once comes in contact with the prostate, and if normal it will feel smooth and firm but not tense. As the finger passes over the gland it will be found to be about one and one-half inches in transverse diameter and about one and one-quarter inches in its vertical diameter. If the bladder be moderately filled the seminal vesicles will be within easy reach and not tender.

What are the deviations from normal which we may see from the end of the finger? (1) *Anomalies*: there may be complete absence of prostate; congenital deformities, among which may be absence of one-half the gland and corresponding seminal vesicle, infantile prostate, etc. (2) *Enlargement* due to hypertrophy, a cyst, stone, abscess, malignant growth or inflammation. (3) *Diminution* due to atrophy or chronic atonic process from an old infection. (4) *Hardness* which may be due to fibrosis, malignancy, calculus, tuberculosis or intense inflammation. (5) *Softness* due to want of tone or abscess. (6) *Character of surface.*—A general bulging suggests a cyst; one lobe enlargement points to parenchymatous prostititis; hard nodules may be tuberculous, but more likely due to follicular inflammation; crepitation, if present, is due to calculus.

Prostatic Cysts.—Cysts of the prostate are quite rare and the diagnosis is not always easy, being confused with hypertrophy, distended bladder and bladder diverticula.

Prostatic Calculus.—Stone in the prostate is not difficult to diagnose. Embeded calculi may give rise to no symptoms, whatever, but their presence usually is accompanied by those of prostatitis. If there be several calculi, crepitation may be elicited by pressure of the finger. Calculi which give rise to prostatitis may be diagnosed with the aid of the X-ray.

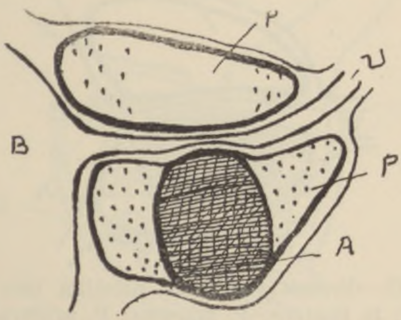


Fig. 78.—Prostatic Abscess pointing into rectum. A, abscess; B, bladder; P, prostate; U, urethra. (From Guiteras).

Prostatitis.—Inflammation of the prostate may be divided into three classes: acute, subacute and chronic.

Of acute prostatitis there are two varieties: The *follicular,* characterized by a marked acute inflammation of one or more follicles; the *parenchymatous,* characterized by inflammation of many follicles as well as the stroma, (one or both lobes may be involved).

The follicular variety usually results in the formation of small abscesses which eventually drain into the urethra.

The parenchymatous variety involves the follicles and stroma and tends toward the formation of one large abscess which may rupture spontaneously into the urethra, rectum, perineum or inguinal region, the majority, however, breaking into the urethra.

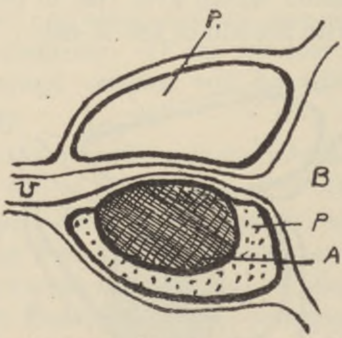


Fig. 79.—Prostatic Abscess pointing into urethra. A, abscess; B, bladder; P, prostate; U, urethra. (From Guiteras).

Subacute Prostatitis.—This form of prostatitis is usually due to an extention to the prostate of the infection of posterior urethritis and involves few follicles.

It is catarrhal in nature and milder in degree than the acute form and does not tend to abscess.

Chronic Prostatitis.—This form may follow any form of prostatitis but usually is of gonorrheal origin and follows the subacute or catarrhal form. The gland is enlarged and of soft consistence, the walls of the ducts are thickened, the acini dilated and filled with inflammatory products. See Fig. 79.

Hypertrophy.—Nearly all men past 60 years of age have hypertrophy of the prostate. Many cases are extremely troublesome while others are scarcely noticeable. There are many theories advanced regarding the cause of this condition, none of which is as plausible as "a provision of nature."

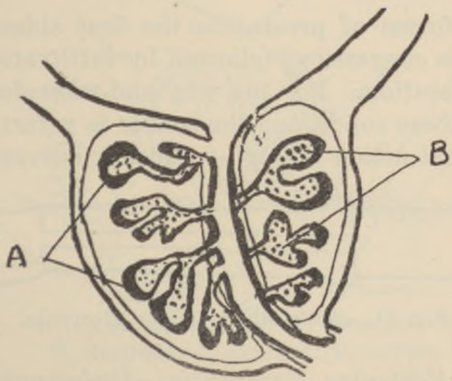


Fig. 80.—Chronic Prostatitis. A, walls of duct; B, acini. (Drawing from Guiteras).

There are two forms of prostatic hypertrophy, the *adenomatous*, when the glandular tissue enlarges at the expense of the muscular; the *fibrous*, when the muscular fiber takes on growth at the expense of the glandular portion.

Atrophy.—There are several forms of atrophy of the prostate: Congenital, senile and those due to pressure and inflammation. There are but few cases of atrophy due to retrogressive changes of old age. Pressure from calculi and destructive inflammation are the principal causes of atrophy. The symptoms are not unlike those of chronic prostatitis.

Therapy.—High-frequency currents are contraindicated in the following prostatic conditions: Cystic degeneration, calculus, tuberculosis, malignant growths and closed abscess.

In all forms of prostatitis the first sidestep from normalcy is congestion, followed by infiltration, stasis and degeneration. For the why-and-wherefore of relief from these conditions the reader is referred to the physiological action of high-frequency currents.

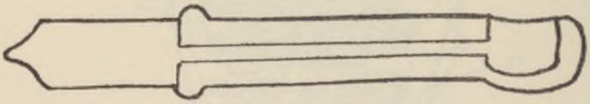


Fig. 81.—Willmoth Prostatic Electrode.

Acute Follicular Prostatitis.—Unfortunately this condition is not diagnosed until considerable infiltration and possibly pus formation have taken place. The follicles and ducts are soon filled with inflammatory products. Epithelium and pus are found in the urine quite early in the disease.

The physiological treatment of this condition is the application of heat. Rectal irrigation of hot water for this condition has been in vogue for many years. We are all familiar with the effects of convective heat in all inflammatory conditions and the comfort afforded by poultices. Not until the discovery of high-frequency currents were we able to apply a poultice directly to the prostate, but had to content ourselves with rectal irrigations of hot water.

While monopolar application of the high-frequency current will raise the temperature of the prostate, the bipolar application is more efficient in this condition. A better idea of its application may be gained by ref-

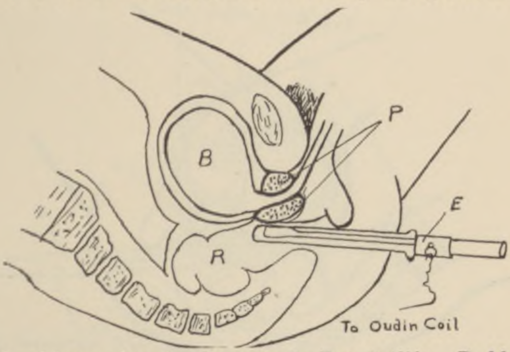


Fig. 82.—Monopolar Application in Prostatitis. B, bladder; E, electrode; P, prostate; R, rectum.

erence to the following illustrations than by any verbal explanation.

The above figure illustrates the Willmoth insulated electrode thru which heat may be conducted to the prostate.

The above drawing illustrates the position of the Willmoth electrode in its unipolar application.

In the above illustration it will be seen that the position of the prostatic electrode is the same as in the monopolar application, the indifferent electrode of flexible metal (4x6 inches) being placed on the abdomen immediately above the pubes. In either application the current should be turned on gradually, reaching point of comfortable toleration in one minute and maintained for 6 minutes, then gradually reduced to zero. The heat generated in the prostate will remain longer if radiant

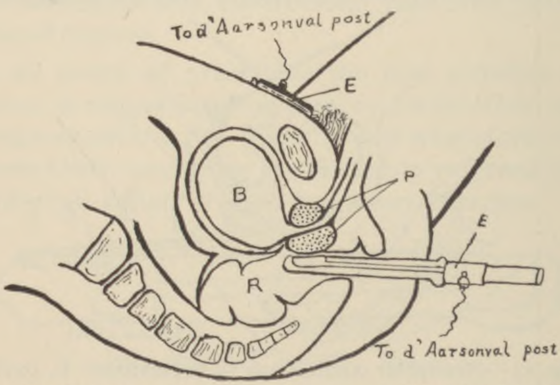


Fig. 83.—Bipolar Application in Prostatitis. B, bladder; E, electrodes; P, prostate; R, rectum.

heat and light be applied over the lower lumbar region during the application of diathermy and for one hour afterward.

In addition to the above the patient should be advised to employ heat from an ordinary 50-watt lamp directed to the perineum for two daily periods of one hour each. The greater number of hours the patient remains at home and in bed the shorter the course of the disease. Hot sitz baths are also efficacious. Alkaline laxatives should be administered daily. The urine should be made bland by the administration of potassium citrate and tincture of belladonna. While the deep urethritis should be properly treated with instillations of one or two per cent solution of mercurochrome it is well to forego urethral treatment for three or four days during the treatment by diathermy. Theoretically blad-

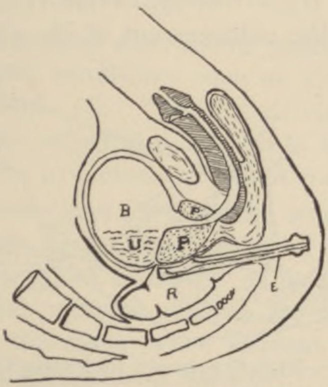


Fig. 84.—Unipolar Application to Enlarged Prostate. B, bladder; P, prostate; U, residual urine; R, rectum; E, Willmoth electrode.

der irrigation is indicated, but the good that might be accomplished is surmounted by the traumatic effects of urethral instrumentation.

Acute Parenchymatous Prostatitis. — During the stage before the accumulation of pus the same treatment as outlined for the follicular form is apropos. After abscess formation the case becomes one for the surgeon.

Subacute and Chronic Prostatitis.—While high-frequency currents are useful in these conditions there is not a therapeutic measure known that will so effectually clear the seminal vesicles and prostate of gonorrheal infection as the static wave current properly applied. I cannot advise the use of vacuum electrodes within the urethra for this or any other disease.

Prostatic Hypertrophy.—High-frequency currents are useful in the enlargement of the glandular portion

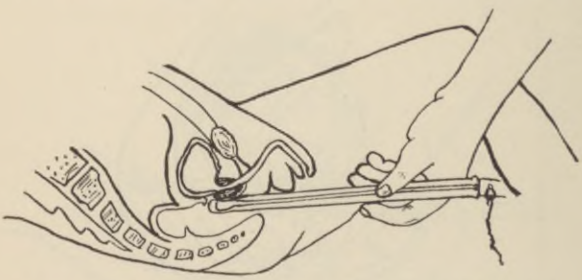


Fig. 85.—High-Frequency in Prostatic Atrophy.

of the prostate but are absolutely useless in the fibrous form. The fibrous prostate may be reduced by the roentgen ray and a follow up treatment of high-frequency or what is better the static wave current.

Prostatic Atrophy.—The symptoms of this condition simulate those of chronic prostatitis. While high-frequency currents are useful in flooding the parts with new blood, a dilatation of the prostatic urethra is necessary to relieve the urgent urinary distress. The urethra should be dilated gradually by steel sounds once a week and each dilatation followed by instillations of a one per cent solution of mercurochrome or a ten per cent solution of Argyrol. Two high-frequency treatments should be given between the dilations, employing the unipolar or bipolar application with same technic as for acute prostatitis.

PRURITUS ANI.

Pruritus ani, a most distressing condition, is present in many rectal conditions such as ulcers, fissures, fistulas, hemorrhoids, etc. Urethral stricture and prostatic atrophy are sometimes causative factors. The itching may be due to diseases of the skin or a neurosis.

Therapy.—Snow says: "Patients who have pruritus ani may often be promptly relieved by treatment with glass hemorroidal electrode as large as can be placed in the anus without causing too great discomfort, employing the static wave current followed by the wave current applied over the liver."

The unipolar high-frequency current may be used in the same manner with almost as good results.

Pruritus about the anus due to eczema is promptly relieved and most cases cured by fractional doses of the roentgen ray. Some cases are cured promptly by one intensive (3 H.) treatment.

Actinic rays have been proven of value in this condition.

PSORIASIS.

High-frequency currents have been employed in this disease with some beneficial results probably due to the general effects upon the nervous system. A cure should not be expected.

Technic.—A slight sparking effect as secured thru the ordinary light underwear is desirable. Employ a large vacuum or non-vacuum electrode attached to the Oudin coil. A current of sufficient strength for a one-inch spark should be employed, the application being made in sliding contact with the underwear.

It is said that actinic rays will cause a disappearance of the lesions, but they will recur.

The best results obtained in this disease are secured thru semi-intensive treatment by x-rays.

PYOSALPINX.

If electricity in any form be employed in this condition there must be adequate drainage. Such cases are benefited by diathermy, the technic of which is the same as in "Endometritis." (See Fig. 64). Even when there appears to be free drainage thru the uterus there is a possibility of existing closed pus pockets, making treatment by electric currents hazardous. Such cases require the service of a surgeon.

PYORRHEA (Riggs' Disease).

While high-frequency currents thru properly shaped electrodes combined with roentgen radiations are useful in controlling this disease, the patient will be better pleased with the service of a good dentist.

RHEUMATISM AND RHEUMATOID ARTHRITIS.

For discussion and treatment of these conditions see "Arthritis."

RHINITIS.

Hypertrophic rhinitis is promptly relieved by semi-intensive treatment by x-rays. The atrophic form is benefited by a mild high-frequency current thru an insulated vacuum electrode. The current stimulates the shrunken membrane, and if it is not entirely destroyed regeneration may be looked for. The application must not exceed 5 minutes in duration and may be employed three times a week. It should be unnecessary to state that the parts must be cleansed of all crusts and nasal secretions before the high-frequency treatment.

SCIATICA.

The term sciatica is commonly applied to pain along the course of the sciatic nerve and its branches. The pain may be due to neuritis or neuralgia, and a painstaking examination should always be made to differentiate neuritis from referred pain (neuralgia) due to some diseased joint or viscus.

Sciatic Neuralgia.—This has among its causative factors: diseases of hip and sacroiliac joints, bones of the pelvis and spinal column; disease of the prostate, malpositions of the uterus, pelvic inflammations, malignant or other tumors pressing on the pelvic plexus, hemorrhoids and other rectal diseases, tuberculosis of the sacroiliac joint and lower vertebrae and some lesions of the spinal cord.

Therapy.—The treatment of sciatica wholly depends upon whether it be a neuralgia or a neuritis. A serious mistake might be made in the application of diathermy to a diseased hip joint, believing the case to be one of neuritis.

After the witnesses are all sworn and a verdict of neuritis returned, the management of the diseased nerve should be similar to that in neuritis, elsewhere.

Diathermy if judiciously applied will relieve the congestion about the nerve and prevent infiltration which marks the beginning of muscular atrophy. (See Fig. 74.)

As in diathermy elsewhere, the current should be turned on gradually, consuming at least 3 minutes in reaching the toleration of the patient, then it should be reduced to comfortable toleration and continued for 20 to 30 minutes then gradually reduced to zero, consuming at least three minutes in the reduction.

While a high-frequency current from a vacuum electrode passed along the course of the sciatic nerve sometimes gives immediate relief, the pain will return and probably be more severe than before. The effluve from a multiple-point electrode is very soothing and is followed by no reaction. The effects of these spectacular applications are more fanciful than real.

In some cases the most painful area is between the sciatic notch and knee. *Wherever* the greatest degree of pain and tenderness may be, that is the point which should be diathermatized. The treatment of sciatic neuralgia should be directed to the disease itself rather than to the painful area.

SPRAINS AND STRAINS.

The superficial stasis resulting from sprains may be dissipated by radiant light and heat from an ordinary electric light lamp, followed by the unipolar application of high-frequency current thru a vacuum or non-vacuum electrode. For deeper effects diathermy should be employed. After the part has been thoroughly heated the infiltration may be dissipated by the blue pencil or spark discharge from a static machine or the proper application of the sinusoidal or Bristow coil current. The treatment should be employed twice a day. All mild sprains will yield to this treatment within 48 hours.

SYPHILIS.

Inflammatory deposits without regard to character are amenable to absorption by high-frequency currents when properly applied. While the specific infection is not directly influenced by these currents, their ability to promote reparative processes, stimulate phagocytosis and hasten elimination makes them ideal as an adjuvant in the treatment of syphilis.

The medicinal treatment of syphilis often fails in patients with faulty metabolism. In such cases auto-condensation will dilate the blood-vessels and permit a better diffusion of mercury, iodine and salvarsan thruout the entire body and aid materially in shortening the period of treatment.

TATOO, POWDER AND COAL MARKS.

The pigments of tatoo dyes, powder and coal may be removed by desiccation.

Technic.—The stained area is desiccated with a fine needle by cross-lines one-eighth inch apart. The dehydrated epidermis is scraped away and the desiccated surface macerated for three days with salt solution, after which the pigment is removed by a curette. The wound heals rapidly. Care should be exercised not to overheat the true skin as keloid may result.

TONSILS DISEASED.

Infected teeth and tonsils are frequently, though not always, concerned in the etiology of arthritis, endocarditis, neuritis, etc. The experience of the physicians of John Hopkins Hospital shows that even after the nose, throat and teeth have been put in normal condition by operative measures these diseases may recur. Their experience further shows that the removal of the tonsils in an interval free from symptoms can be justified only on the plea of preventing further cardiac lesions which may result from subsequent tonsilitis. It is also their experience that tonsillectomy rarely benefits chronic deforming types of arthritis and often does more harm than good.

Diseased tonsils may be treated by actinic rays, roentgen rays, surgery or desiccation.

Advantages of Desiccation:

No surgical shock.

No primary or secondary hemorrhage.

No embolism.

No secondary infection.

No trauma to adjacent tissues.

Complete sterilization .

Very little post-operative discomfort.

No contracting cicatrix.

A safe procedure where a general anesthetic is contraindicated.

Normal portions of tonsils may be retained.

Disadvantages:

Constitutional effects of cocaine.

Children require a general anesthetic making the treatment difficult.

It is better to avoid treatment during the acute stage of tonsillitis. The most favorable time is during the stage of quiescence. The thoroughness of the treatment required, from light desiccation of the crypts in follicular tonsillitis to complete destruction of the tonsil in cases of widely disseminated infection, depends upon the degree of infection. Desiccation is the ideal treatment for tubercular ulcers of the tonsil. (Due credit should be given Dr. Wm. L. Clark for the name "desiccation" as well as for the technic of application.)

Technic.—The purchase of expensive electrodes for desiccation of the tonsil is unwarranted. They may be made from steel knitting needles six inches long and bent at convenient angles for the work, the bending being easily accomplished by heating over a flame. These needles will fit into the ordinary so-called fulguration handle. The home-made electrodes may be insulated by slipping on the needles a small rubber catheter or they may be wound with adhesive plaster. Neither rubber nor adhesive plaster will completely insulate them, but will sufficiently so for a careful operator. No foot switch or assistant to turn the current on and off is necessary. Some form of a suction bottle is convenient to clear the pockets of pus. A good tongue depressor may or may not be needed.

The unipolar current from a standard high-frequency apparatus is employed, so regulated that the degree of heat will desiccate and not cauterize, the object being to dehydrate rather than burn the tissues. If the tissues are not cauterized there will be no resulting cicatrix.

The first step is the complete anesthetization of the tonsils and tonsillar pillars, base of the tongue, pharynx and soft palate by cocaine. Often a 5 to 10 per cent solution of cocaine applied topically will suffice; however, some cases require the injection of the solution when a weaker one will answer the purpose.

Seat the patient in a chair with a good head rest. Either natural or reflected artificial light may be used. The next step is to insert the needle into that portion of the tonsil to be destroyed, care being taken to see that no portion of the conductor or electrode except the active point touches any part of the patient. The current is turned on for sufficient time to do the work. The needle may be forced into the deeper portion of the tonsil while the current is still on. When steam is seen coming from the tonsil dehydration has taken place. A whole tonsil may be destroyed in this manner. One operation if thoroly done is sufficient; however, it is better in some cases to sterilize only a portion of the

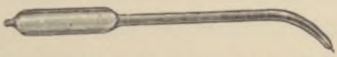


Fig. 86.—Special Tonsil Electrode.

tonsil at a sitting. This must be left to the judgment of the operator. The completeness of the treatment depends upon the skill of the operator.

It is possible to shrink enlarged tonsils by the indirect application of the high-frequency current. The patient is seated on the autocondensation chair pad which is connected to the Oudin coil of the machine. The operator employs an ordinary vacuum throat electrode held in his hand, the connection being made through the operator's body to the ground. The electrode is placed in contact with the tonsil and rapidly passed over it. The application may be repeated at weekly intervals until the desire result is obtained.

TUBERCULOSIS.

There are some points in blood-pressure worthy of note in tuberculosis. It is well known that a condition of hypotension prevails in advanced cases, and as the case becomes farther advanced there is a gradual reduction in pulse pressure. Hypotension is often observed before any clinical signs are manifest. This is especially true if no other cause of impaired health is found. Hypotension is always present in the so-called pretubercular stage. Tuberculosis is often suspected, but if hypotension is not present we may be almost certain that our suspicions are groundless.

A reversal of pressures without clinical signs of other disease points to tuberculosis. Early pleurisy with effusion is sometimes difficult to differentiate from tuberculosis. If blood-pressures are normal or above, pleurisy is suspected; if hypotension is present it points to tuberculosis. Hypotension always puts us on our guard, and in absence of infectious and wasting disease points to tuberculosis.

It is possible in cases of nephritis combined with tuberculosis that the effects of the nephritis on the vasomotor mechanism may offset the hypotension of tuberculosis, but a case of nephritis with low blood-pressure suggests a tuberculous kidney. A gradual rise in the systolic pressure in a case of tuberculosis points to an arrest of the disease.

Therapy. — High-frequency currents have been proven to be of great value in the treatment of pulmonary tuberculosis. The disease always has its complications and we are compelled to treat the patient instead of the disease.

There are cases of pulmonary tuberculosis which should not be treated by diathermy; however, the selection of cases for its application is not difficult to one experienced in treating pulmonary affection.

Technic.—Apply a large electrode anteriorly and one posteriorly in such a manner as to bring the affected area between them. If the contour of the chest be such as to preclude perfect coaptation of the electrode, several layers of gauze previously soaked in hot salt solution should be placed between the electrode and the skin. When the electrodes are in position and connected to the d'Arsonval apparatus turn on the current to the point of comfortable toleration which will be found between 1000 and 2000 milliamperes. (See Figs. 56 and 57).

The current should be continued for 20 to 60 minutes, depending always upon the effect produced on the patient.

The treatment in some cases should be repeated daily, while in others three times a week is best. In some cases the cough and expectoration will be increased for several days; the patient may be inclined to believe that he is made worse by the treatment, therefore, he should be advised of this probable effect before beginning treatment. The treatment must be persisted in for a period of from one to three months.

Physiology.—The effects upon the blood are: Increase in the number of red cells, hemoglobin and lymphoctyes and a decrease in the polymorphonuclears. The increased hyperemia induces an increased flow of lymph and a consequent increase of expectoration. The expectoration, however, after from one to three weeks gradually becomes less, the appetite improves and there is a general feeling of well-being; the ashen hue of the skin is replaced by natural color, temperature falls to normal and a progressive increase in weight results.

Hypotension is the rule in the tuberculous. Under treatment by diathermy all metabolic functions are increased, and thru cardiac stimulation there is a gradual increase of all blood-pressures.

Precautions.—There is always a chance of lung diathermy being followed by a hemorrhage, but I have never seen a case where it became serious. If there is a previous history of hemorrhage the first few treatments should consist of a low amperage and short time until there is an assurance of no likelihood of hemorrhage. Diathermy always increases the body temperature and should not be employed in cases with a temperature over 100 degrees F.

Vesical Tuberculosis.—Tuberculous ulcers of the bladder usually yield to desiccation.

Joint Tuberculosis.—Diathermy should not be employed except there be free drainage.

Kidney Tuberculosis.—Diathermy is of inestimable value if there be good drainage.

TUMORS OF THE BLADDER.

In the management of tumors of the bladder we have at our command four methods of treatment: The knife, desiccation, electrocoagulation and radium. The choice of these methods depends upon the character and extent of the growth. Benign tumors without or with little basal infiltration yield promptly to desiccation. If the papilloma is large and seems to have a deepy infiltrated base, electrocoagulation is the method of choice. All tumors that are histologically benign disappear with astonishing rapidity under either of these methods. When, however, the growth is malignant the response to treatment is slow and often discouraging. There is a marked tendency to recurrence of all malignant tumors of the bladder when operated upon by any method, the frequency of recurrence being in the following order: (1) the knife; (2) desiccation; (3) electrocoagulation; (4) radium. Electrocoagulation followed by radium offers the best insurance against recurrence at the original site or by metastasis. Whenever the bladder wall shows considerable involvement relief only can be expected from any method of treatment.

All benign tumors of the bladder are amenable to surgical diathermy thru the natural channel, the urethra, the opening of the bladder by incision being necessary for drainage only in cases of extreme urosepsis.

Therapy.—In all cases of papilloma there is more or less hematuria, and this should be controlled before desiccation or electrocoagulation is attempted. If the hematuria does not clear up from rest in bed for a few days, the bladder may be irrigated with a weak solution of silver nitrate (1 to 5000) or a solution of adrenalin. The clearing of the urine is absolutely essential in order to have a clear vision of the operative field. A ureteral catheter carrying cystoscope is employed. After the urine has been cleared fill the bladder with a solution of boric acid.

An electrode made from a ureteral catheter which fits the cystoscope can be easily made by passing a steel wire thru the lumen of the catheter in such a manner that the wire will protrude about one-eighth inch. Having placed the electrode in position an assistant will

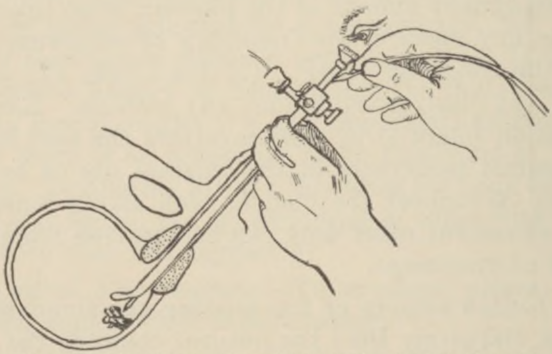


Fig. 87.—Position of cystoscope in desiccation of papilloma of bladder.

operate the current in the same manner as in desiccation of neoplasms elsewhere. The current should be directed into the base of the tumor and continued until destruction has taken place. The patient should be placed in bed and hexamethylene administered. There should be no further hematuria. The mass will slough in a few days and be voided with the urine.

VAGINITIS.

The human vagina in a normal state harbors many types of bacteria. When it becomes infected with specific germs an inflammation of its mucous surface results and the condition is known as vaginitis.

Therapy.—The first step in treatment is to remove by douching or swabbing any discharge that may be present. A large vacuum electrode, insulated where it comes in contact with the vulva, should be chosen. The electrode is connected to the Oudin post and inserted into the vagina. A current of toleration is employed for 5 to 7 minutes every day.

Physiology.—Increased temperature to a point incompatible with germ viability; glandular stimulation and consequent drainage.

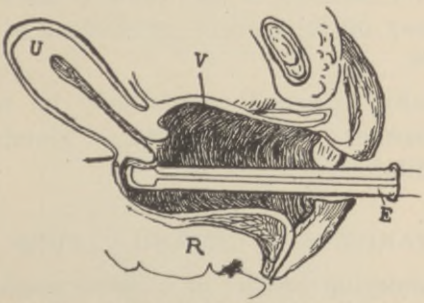


Fig. 88.—Unipolar Vaginal Application.

URETHRAL GROWTHS, ETC.

There are many pathological conditions of the urethra which are amenable to treatment by high-frequency currents.

Fig. 89 illustrates three forms of polypoidal growths which are more or less common. (a) Pedunculated polyp; (b) sessile polyp in the bulbar portion; (c) polyp on edge of crypt of Morgagni.

These growths are easily destroyed by desiccation. The technic is simple. After anesthetization by a four per cent solution of cocaine the urethroscope is introduced in a manner to bring the growth well into view. An electrode for this purpose consists of a small needle of sufficient length inserted into the ordinary fulguration handle. Care should be exercised during treatment not to allow the electrode to touch any part of the urethroscope as the current will be dissipated. Plunge the point of the needle into the base of the growth and turn on sufficient current to blanch the tumor. Usually no after treatment is required. If the reaction be intense it may be relieved by irrigations of hot boric acid solution.

Chronically inflamed crypts may be relieved in the same manner. Cysts of Littre's glands are best treated by dilatation.

VARICOSE VEINS AND ULCERS.

The stimulating effects of vacuum application are sometimes useful but high-frequency currents are inferior to actinic and x-rays in varicose ulcers.

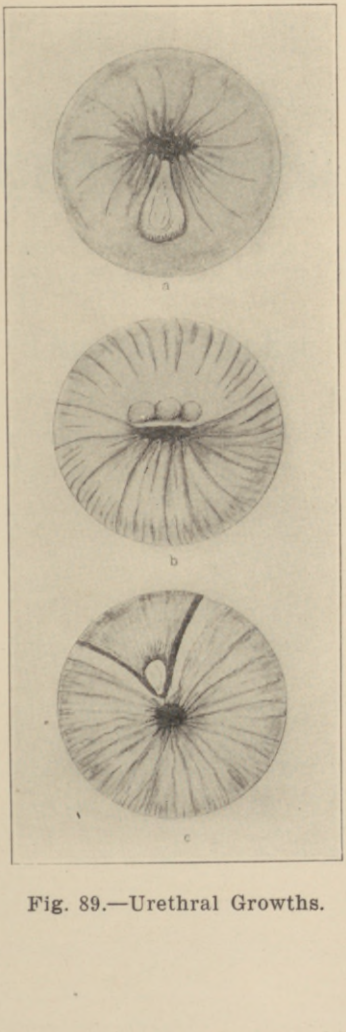


Fig. 89.—Urethral Growths.

CHAPTER VIII.

Diseases of the Eye

CHAPTER VIII.

DISEASES OF THE EYE.

Conjunctivitis. Granular conjunctivitis. Diseases of the cornea. Iritis. Opacities of the vitreous. Chorioiditis. Glaucoma. Retinitis. Cataract. Atrophy of the optic nerve. Toxic amblyopia. Amblyopia ex anopsia. Hermeralopsia. Nervous asthenopia. Hysterial amblyopia. Muscular dysfunction. Ptosis. Diseases of the lids.

The electrotherapeutic management of diseases of the eye is of quite recent date and is employed by opthalmologists and general practitioners in a more or less perfunctory manner. The author knows of no book devoted to the subject, and current literature is very meager.

I would that it be definitely understood that whenever electric modalities are herein mentioned in the treatment of ocular conditions they are to be considered as adjuncts to other well known measures ordinarily employed by opthalmologists; that electricity is not being heralded as a cure-all, but rather as a helpmate to other well recognized methods.

The treatment of ocular diseases by electricity mentioned herein, not only is based upon the established physiology of the orbital contents, the pathology of the conditions present and a knowledge of the fundamental principles of electricity and its physiological action upon living tissues, but reflects a collation of experiences of eminent opthalmologists.

While this work is intended to be a treatise on the use of high-frequency currents, the part played by other electric modalities in the treatment of ocular conditions is of such importance as to make the consideration of these modalities an important matter.

The direct constant, sinusoidal and high-frequency currents are employed, each having its particular field of operation. The high-frequency current in the form of vacuum-tube application, for the induction of superficial hyperemia; the bipolar application for thermo-penetration; surgical diathermy for the destruction of growths are all important in the management of the diseases under consideration.

In addition to the above mentioned modalities, radiant-light and heat reflected from an incandescent lamp also the vacuum electrode energized by the static machine play important roles in the therapy of ocular disease.

As a result of the application of high-frequency currents inflammatory exudates irrespective of their character are absorbed. The hyperemia induced by these currents increases local reparative processes thru increased blood supply thereby increasing the number and activity of the phagocytes. The nutrition of the cells is enhanced which plays an important part in raising the resistance to bacterial invasion.

Inflammation anywhere is usually due to invasion of bacteria of some kind. The important thing to be done, therefore is to increase the resistance thru the blood supply. When the inflammatory process is very acute and painful the application of cold compresses is indicated, but this procedure should soon be followed by heat.

Where drainage is good, the value of high-frequency currents is firmly established in the treatment of local streptococcic and staphylococcic infections. However, it should not be forgotten that closed accumulations of pus are positive contraindications to the use of high-frequency currents.

CONJUNCTIVITIS.

In conjunctivitis the entire ocular conjunctiva is red, rough, and painful. The arteries and veins are distended and tortuous; the tears soon lose their salinity on account of excessive secretion; the mucous glands soon cease to functionate leaving the eye dry with a sensation as though full of sand. This condition if not corrected will soon destroy the cornea thru maceration.

Mechanical irritants such as dust may carry along with them pathologic bacteria which soon change the active hyperemia to a purulent inflammation. The lids soon become edematous red and thickened. In some cases a grayish pellicle is seen and in others it is rolled into strings and shreds. The eyes are acutely painful.

Practically all cases of conjunctivitis are contagious.

CHRONIC CONJUNCTIVITIS.

Chronic conjunctivitis is probably the most frequent of all diseases of the eye. Its duration is usually prolonged; many people suffer from it for many years.

Often these cases present thickened lids, stunted lashes scattered along the margin of the lid. The secretion from the glands is thick and abundant, the tears are excessive and epiphoria occurs upon exposure to wind and changes in temperature. The mucous membrane is more or less palid in color, not as smooth as normal, is often covered by viscid mucus and at other times is dry and burning. The cornea is sometimes discolored by scars and lowered in luster by maceration of the epithelium. The papillae of the retrotarsal folds are very large.

Cases of chronic conjunctivitis of long standing are often accompanied by chronic rhinitis, nasal granulations, polypoid growths and post-nasal adenoids which must be removed before the condition of the eye is relieved.

TREATMENT.

The duration of conjunctivitis while often self limited may be considerably shortened and development of the chronic form prevented by institution of suitable treatment.

The first indication to be met in acute or chronic stage of the disease is to clear the entire ocular field which is best accomplished by mild irrigations of hot (110 F.) water; ordinary antiseptics are of little avail.

Pages 305-320 missing

Technic.—The technic of local application is simple, and is practically the same as previously given in the treatment of conjunctivitis.

Some cases are benefited by negative galvanism with a current of toleration for ten minutes, cathode to closed lids and anode to the cervical region, followed by pneumo-massage. Myotics should be used in conjunction with the electric treatment.

Conclusions.—Quinine will not cure all cases of malaria, neither will electricity cure all cases of glaucoma, but in recent cases much can be done toward relief. In cases far advanced little can be done with high-frequency currents except to alleviate pain. Some cases can be kept in a state of quiescence. In late cases when blindness has occurred there is no benefit to be expected from any electric modality.

RETINITIS.

Retinitis as a purely local lesion is very rare; in most cases it is a symptom of some general disease such as albuminuria, diabetes, syphilis, gout and cardiovascular disorders, therefore the treatment should be directed to the causative factor. Cardiovascular conditions accompanied by hypertension are generally benefited by auto-condensation. Albuminuria with kidney inefficiency is best treated by kidney diathermy alternated with static insulation. Gout and syphilis are greatly benefited by heavy auto-condensation and diathermy to the liver.

Hemorrhagic Retinitis.—After the acute stage has passed the high-frequency current may be employed with a reasonable expectation of clearing up the field by stimulating the process of absorption. These cases are often accompanied with high blood-pressure which may be greatly reduced by auto-condensation.

CATARACT.

"Since cataract seems to be a failure of nutrition of the lens, we would naturally expect it to be one of the diseases most especially adapted to treatment by the electrical current; yet we are forced to admit that, thus far, all attempts in this direction have been attended with negative results; but I do not feel that we are justified in saying that further experimentation may not be attended by more happy results."—Alleman.

The above was written by Alleman when but little was known of the physiological action of the high-frequency current. During the few years just passed considerable experimentation has been made with the hope that some benefit might be derived thru this agency in the treatment of cataract.

Reports of investigators along this line are widely at variance. Occasionally enthusiastic reports of cures by this method appear in medical literature, while a much larger number of reports agree that after trials extending over long periods of time no appreciable benefit could be observed.

The variance of reports is probably due not so much to the result of the application of this modality as to the actual condition existing in the many cases in which it has been tried. Cataract being frequently complicated by some disease of other portions of the light-receiving apparatus in which an improvement of vision may result from any or no treatment, makes the claim for beneficial results for any method of treatment appear more or less fallacious. However, the number of favorable reports justify further trial of this method of treatment. If there is any benefit to be derived from this treatment, it must come thru the effects produced by hyperemia of the parts about the lens.

It is well known that bone is the last tissue to become heated by diathermy and when heated will hold the heat for many hours, therefore, it is but logical, not only to produce hyperemia of the soft tissues but to heat the surrounding wall of bone, which will slowly give up its heat to the adjacent tissues and maintain the hyperemia for a considerable period of time. This may be accomplished by passing the current from temple to temple. The bones composing the orbit being situated almost immediately underneath the skin can be thoroughly heated in a few minutes. The current from a perfectly constructed d'Arsonval machine is turned on at zero and gradually increased, consuming 5 minutes in reaching the point of toleration, when it is allowed to remain for a period of 10 minutes, then slowly returned to zero, consuming at least 2 minutes in the reduction. This application should be alternated with the high-frequency vacuum application on alternate days.

Some investigators report favorable results from the galvanic current in 2 to 5 milliampere doses alternated or followed by the vacuum tube application.

ATROPHY OF THE OPTIC NERVE.

Atrophy of the optic nerve develops either as a primary affection or secondary to a previous neuritis or retinitis. Among the causes of primary atrophy may be mentioned cerebrospinal diseases including tabes; progressive paralysis and disseminated sclerosis; brain tumor and focal infection. In the acute stage of inflammatory atrophy the veins are distended, but this condition is soon followed by contraction of both arteries and veins.

TREATMENT.

Atrophy of the optic nerve especially in the primary form is generally considered incurable; hence any promise of remedial benefit from any therapeutic measure is usually taken *cum grano salis.*

While in the treatment of this condition, the observations of different investigators are most widely at variance, the probability and possibility of improvement, or at least a cessation of the process by the employment of electrical modalities may more or less be assured.

First of all if possible the cause must be ascertained. While syphilitic infection is the most common cause, foci of infection may exist in the body especially in the para nasal sinuses and should be treated *secundem artem.*

The consensus of opinion of the majority of those who employ electric currents in this disease is that in the early stage there is hope at least of inhibition in about 20 per cent of cases. Any form of remedial application which promises even less favorable results should receive our consideration. Of course, the greatest benefit is to be expected from treatment of the secondary form of the disease.

The first step in treatment should be directed against the lesion which causes the atrophy. There is no treatment of so much avail in neuritis as heat by diathermy and there can be no objection to its application in optic neuritis.

Technic.—Bare metal electrodes 1½ inches in diameter are applied to the temples, being best held in place by means of the Universal Diathermy Clamp. The electrodes are connected to the poles of a d'Arsonval machine. The current is turned on very slowly reaching the stage of toleration on the patient in 5 minutes, then the current strength is slightly reduced and allowed to remain for 15 minutes then slowly returned to zero. The treatment is employed daily until the acute inflammation subsides, when the modality is changed to the direct constant (galvanic) current. The negative pole is placed over the closed lids, the positive pole over the cervical region. A current strength of toleration (1 to 4 milliamperes) is allowed to flow for 10 minutes.

This treatment is employed daily for 10 days then every other day for two or three months. After a rest of 2 or 3 weeks is taken treatment is resumed twice a week alternating with intervals of rest and thus continued for 2 or 3 years.

While the general application of all electric currents promotes metabolic changes, the most useful are the high-frequency and static. If there be no contraindication to auto-condensation its application 2 or 3 times a week will materially aid the elimination of toxins and the excitation of cellular activity.

Static insulation alternated with auto-condensation is an excellent procedure. The application of the vacuum electrode, energized by the static current, to the temples will also be found useful. Spinal diathermy stabilizes the cerebral circulation and should be of service in this disease.

TOXIC AMBLYOPIA.

Amblyopia due to poisoning from nicotine or alcohol is greatly benefited by high-frequency and static currents.

There is no measure known to the writer that will so promptly and efficiently remove nicotine from the body as auto-condensation, hand to hand diathermy and static sparks. In auto-condensation the current must be heavy (800 to 1500 milliamperes) and sufficiently prolonged to raise the body temperature at least one degree F. Profuse diaphoresis will materially aid in the elimination of nicotine. Subsequent to each treatment by heavy auto-condensation or hand to hand diathermy a dose (at least one ounce) of castor oil must be administered to carry off the products of increased combustion.

Alcoholic amblyopia which is often accompanied with multiple neuritis is greatly benefited by daily treatments of static insulation.

If alternated on alternate days with hand to hand diathermy a successful termination of the alcoholic poisoning may be assured. When not accompanied by neuritis a course of 30 daily treatments is usually sufficient. In multiple neuritis an occasional static sparking of the spine and legs by the indirect method in addition to static insulation and diathermy will usually result in a cure of the neuritis in from one to six months. The amblyopia should disappear with the removal of the other effects of the alcohol. The local application of the high-frequency current by means of a vacuum or non-vacuum electrode directly over the closed lids will stimulate local metabolism and materially assist in restoring the sight. Spina diathermy will also be useful in this condition.

Amblyopia ex Anopsia.—It is the experience of many observers that in many cases of amblyopia ex anopsia vision can be brought up to normal and with aid of correction of the refraction remains there by the aid of local application of the high-frequency current.

Hermeralopsia (Night Blindness.)—The disturbance of nutrition of the retina calls for increased cellular activity and as one of the effects of the high-frequency current is to increase metabolic activity it is indicated in this condition.

Nervous Asthenopia.—A condition which occurs both in hysterical subjects and neurasthenics, consists of an incapacity of the eye for any continuous exertion, in spite of good visual power.

Therapy.—Not only should local application of the high-frequency current be made to the eyes, but a general application, by means of a large body electrode, to the spine should also be made. These cases are more or less toxic due to intestinal ptosis and stasis. The Morse wave current is very efficient in restoring to normal position the displaced viscera as well as toning up the intestinal musculature and overcoming the stasis.

Hysterical Amblyopia.—A condition characterized by dimunition of the visual acuity, a contraction of the field of vision and a diminution in the color and light sense.

The treatment of this condition is essentially the same as that of nervous asthenopia.

MUSCULAR DYSFUNCTION.

Dr. Samuel J. Harris, Boston, says: "The cases of muscular im-balance form a most interesting group for they vary from the slight case of which the patient is often not aware to the various phorias where there is binocular vision to where only minocular vision exists. These cases sometimes cause a train of reflex symptoms which make diagnosis difficult. I have seen many cases where treatment has been given for many different conditions which were really only cured by relief of the muscular strain. In cases where there is binocular vision the inability to focus properly may lead to a nervous condition which often becomes alarming."

His treatment of these conditions depends upon the degree of im-balance. Ionic medication of iodine is used for a few days then followed by the sinusoidal current. He says: "The binocular cases are the ones which are most troublesome. Many cases where proper correction has been made still suffer great inconvenience and it is necessary often to give prolonged treatment."

The technic of iodine ionic medication is as follows: A pleget of cotton saturated with a two per cent solution of potassium iodide (or Glyodine) is placed in a cup-shaped electrode which is placed over the closed lids. This electrode is connected with the negative pole of a galvanic battery.

The inactive or positive electrode may consist of metal with several layers of gauze which have been previously saturated with hot salt solution intervening the metal and skin. This electrode is attached to the positive pole of the battery and placed at some indifferent point of the body, usually over the cervical region. A current strength from 2 to 5 milliamperes is gradually turned on, the current being allowed to flow for 10 minutes, then gradually returned to zero.

(Alypin, cocaine and halocaine may be introduced into the tissues in order to anesthetize them for operation, the technic being the same as in iodine medication, except that they must be placed on the positive pole.)

Not all patients will tolerate a current strength of 5 milliamperes but the milliamperage should approximate this strength in order to ionize the iodine and drive it into the tissues. This treatment should be given daily or twice daily provided the condition of the skin will allow, for a period of a week or ten days then followed by the sinusoidal or Morse wave current every day for ten days. The same electrodes as employed in ionization minus the iodine, may be used in application of the sinusoidal current. Usually a sinusoidal with about 22 alternations per minute is best. If the tissues be thoroughly warmed by the vacuum tube application prior to the ionization application, the effects are enhanced.

It is claimed by those who are familiar with high-frequency application that this current alone often corrects mild cases of muscular im-balance.

The sinusoidal current does good service in spasm or paralysis of the obicularis: it is also of service in ptosis, but too much should not be expected in paralysis of the eye muscles. The benefit derived is not thru muscular contraction as it is doubtful if the eye muscles can be made to contract thru the agency of any electric current; but cellular activity is increased by the application of the galvanic, sinusoidal or high-frequency currents. As a general proposition muscles deprived of their nerve supply soon undergo atrophic changes, but their nutrition may be maintained for months by the proper application of diathermy. Whether diathermy to the muscles of the eye will restore them to normal function in case of paralysis is doubtful.

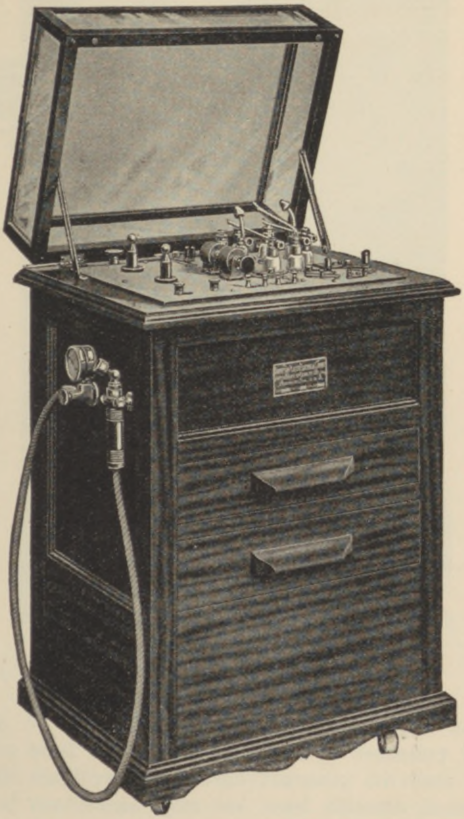


Fig. 91.—Eye, Ear, Nose and Throat Cabinet. This apparatus fulfills all the demands of the specialist in high-frequency work.

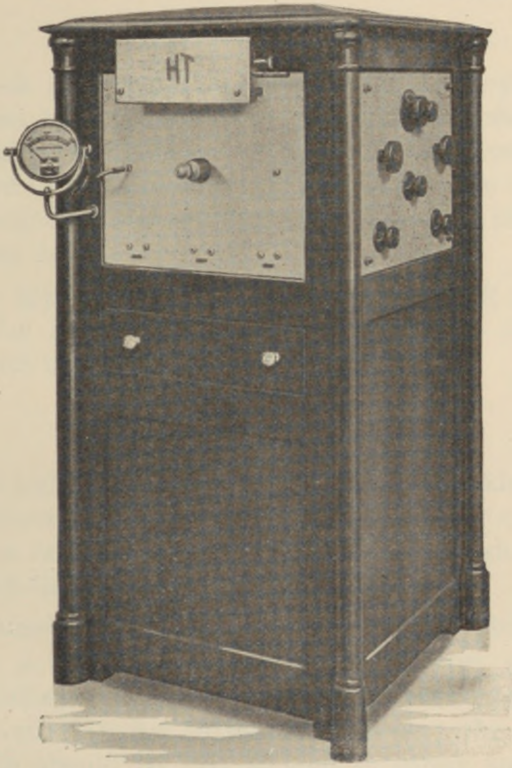


Fig. 92.—High-Tension "Standard." This machine has been built to embody the features necessary for the scientific employment of high-frequency currents with a range of usefulness from the most delicate desiccation current to heavy diathermy and auto-condensation.

It is equipped with an auto-transformer control of six selections with an additional voltage regulator, giving six intermediate points of adjustment, thus making the machine adaptable for all forms of treatment work.—High Tension Transformer and Equipment Company.

PTOSIS.

Ptosis is a condition that frequently responds to electrical stimulation. The affected part should be thoroughly warmed by the vacuum tube application followed by the sinusoidal current at the rate of about 22 alternations per minute. The treatment should be repeated daily.

The application of the galvanic current, 2 milliamperes for 10 minutes may be alternated on alternate days with the sinusoidal, with benefit.

DISEASES OF THE LIDS.

Not unlike other parts of the body the skin of the lids suffers from diseases amenable to electric currents. For the removal of benign and some malign tumors surgical diathermy is especially indicated.

Chalazion a chronic affection of the Meibomian glands is amenable to desiccation. After complete anesthetization a needle electrode is passed into the sac and a mild Oudin current turned on; the current strength should be just enough to effect superficial stimulation to obliterate the sac; too strong a current will destroy considerable tissue resulting in a large slough and consequent cicatricial contraction which should be avoided. However, the resulting contraction will be much less and of a softer nature than that following the knife. After operations with the knife the desiccation of the field of operation will prevent a recurrence.

Herpes Zoster is an essential neuritis accompanied by a herpetic eruption.

The treatment should follow the lines of that of neuritis elsewhere. The affected branch of the nerve should be brought under direct influence of diathermy and the parts thoroughly heated after which a mild constant current is applied for ten minutes. The treatment should be repeated twice daily for 3 days when all active symptoms should cease.

Partial Trichiasis.—When there is but a limited number of cilia growing in the wrong direction and irritating the eye, they may be successfully removed by electrolysis. The operative technic being the same as that of hypertrichosis.

Benign Tumors such as Xanthelasma, molluscum simplex, molluscum contagiosum, warts, moles, cutaneous horns, vascular tumors are all amenable to surgical diathermy.

Epitheliomata especially when superficial are amenable to electrocoagulation, radium and x-ray.

EPIPHORA.

Dr. William Benham Snow says: "The use of vacuum eye electrodes with the static current is of great value in the treatment of epiphora when the tear duct is closed, but not stenosed; if a vacuum electrode is held against the canal and a short spark gap employed, it will remove the infiltration and open the canal."

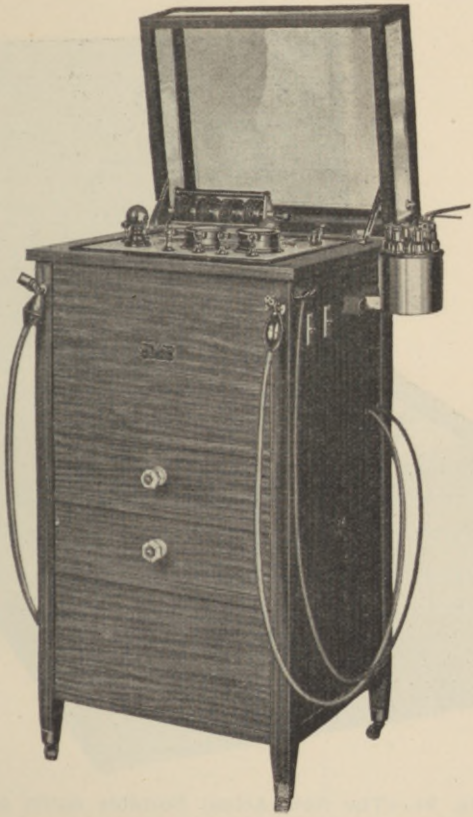


Fig. 93.—In this new high-frequency machine called "DYNELECTRON" the spark gap is of the quench type and can be run continuously without harm,

High-frequency, diathermy, autocondensation, electrocoagulation, from separate transformer taps, makes each modality especially efficient.

The cabinet also contains tankless air features. Manufactured by Liebel-Flarsheim Company, Cincinnati, Ohio.

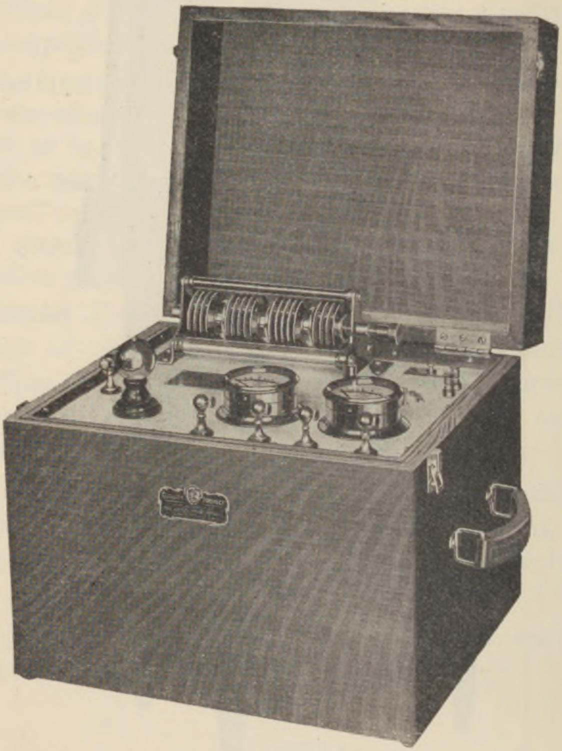


Fig. 94.—The New Actual Portable outfit of high power, embracing high-frequency, diathermy, auto-condensation, and electrocoagulation, adaptable for both office and hospital use. Separate taps from the transformer for each modality give the desired current.

Extra fine control, high and low reading meters, quench type gap, for continuous service, are some of the advantages. Manufactured by Liebel-Flarsheim Company, Cincinnati, Ohio.

APPENDIX "A"

Questionnaire

APPENDIX "A."

QUESTIONNAIRE.

This questionnaire is appended for the purpose of allowing the physician to examine himself. He, who can answer these questions promptly and accurately is sufficiently informed to undertake high-frequency practice.

What is meant by high-frequency?

From what source is a high-frequency current obtained?

What is an alternating current?

How does it differ from a direct continuous current?

What is understood by an alternation?

What does the word cycle mean?

What is a period?

How may the number of cycles be changed?

What is the best source of supply for high-frequency currents?

What is necessary to change a low to a high frequency?

What is a transformer?

What is its function?

What are the requisites for a high-frequency current?

What is a condenser and its function?

What is a spark gap and its function?

What is understood by the word induction?

How are induced currents produced?

What is a primary coil?

What is a secondary?

What is a core and how made?

What is meant by closed and open cores?

What is a volt? An ampere? An ohm?

What is meant by current strength?

How should a transformer be constructed to increase voltage?

What effect has the voltage of a transformer upon the amperage?

Why is a current coming from the secondary of a transformer dangerous to handle?

What is a solenoid? A d'Arsonval solenoid? Its function?

What is a resonator and how constructed?

What is an oscillating current and how does it differ from an alternating current and how is the modification brought about?

What is understood by a Tesla current and how is it produced?

What advantage has the Tesla current over other currents in medical work?

What are its disadvantages?

What is understood by an Oudin current?

What are its advantages, if any, over other currents?

What is understood by monopolar and bipolar applications?

What is a d'Arsonval current and its advantage over other currents?

Name some forms of spark gaps?

What are the requisites for an efficient spark gap?

Why does a spark gap get hot?

How are high-frequency currents applied to the body?

What is an electrode?

What kind of electrodes are preferred in high-frequency work?

Describe a vacuum electrode?

What is a non-vacuum electrode and its advantages?

For what purpose are vacuum electrodes used?

What kind of electrodes are used on mucous surfaces?

What are the contraindications for the use of vacuum electrodes on mucous surfaces?

What is the object of insulating a vacuum electrode?

How can a dose from a vacuum electrode be estimated?

What is a cataphoric electrode?

What phoretic effect has a high-frequency current?

What are the objections to the use of a vacuum electrode in the male urethra?

Name the principal physiological effects of the high-frequency current.

Name some contraindications for its use.

What preparation of the patient is necessary in the application of high-frequency currents?

Does a vacuum electrode emit ultra-violet rays?

What is a violet ray?

How may the degree of vacuum of a tube be estimated?

Name some indications for the use of high-frequency vacuum electrodes.

When should bare metal electrodes be employed?

What effect upon high-frequency currents has padded electrodes wet with salt solution?

Under what circumstances should salt pads be used?

What is understood by auto-condensation? Describe it fully.

What are the physiological effects of auto-condensation?

How is the current measured in auto-condensation treatments?

What amperage should be used and why?

What precautions should be exercised in auto-condensation treatments?

What is understood by local auto-condensation? How is it applied?

What is auto-conduction? How applied? Its advantages and disadvantages compared with auto-condensation?

What is understood by medical diathermy?

What are the physiological effects of medical diathermy?

What is the relative resistance offered by the tissues of the body to the passage of high-frequency currents?

How does the resistance to high-frequency current differ from that of the direct continuous current?

What is understood by current density? What is its importance?

What precautions should be taken in the application of diathermy?

What is understood by surgical diathermy? How applied?

What are the indications for its employment?

What are its advantagės over the knife? Its disadvantages?

Mention some types of diathermy electrodes.

Upon what does the dose of diathermy depend?

What effect does diathermy have on the body temperature?

What is understood by fulguration? When and for what purpose is it employed?

What is meant by desiccation? When, where and how is it applied?

What are its physiological effects?

What is electrocoagulation? What are its effects? When and where is it indicated?

How do fulguration, desiccation and electrocoagulation differ in effects?

APPENDIX "B"

The Doctor's Duty

APPENDIX "B."

THE DOCTOR'S DUTY.

BURTON BAKER GROVER.

(Presidential address, third annual meeting of the Western Electro-Therapeutic Association, Kansas City, Mo., April 21, 1921.)

Fellow Members of the Western Electrotherapeutic Association: Again we are assembled for the purpose of exchanging ideas of how best to care for the afflicted who are submitted to our charge and keeping.

Last year's meeting was an occasion of universal profit and pleasure to the members who attended its sessions. The papers presented by our invited guests and the interest with which they were received will never be forgotten. For a society so young the papers presented at the meeting were remarkable for their excellence.

In choosing a subject for this address it occurred to me that, instead of a scientific paper on some branch of physiotherapy, a plain talk about ourselves and the duties we owe to our profession and the public might prove as profitable. I want to emphasize that we who employ physical measures when indicated are making no effort to set up a government outside of our profession nor are we in a single instance antagonistic to it.

Our efforts should be considered evolutionary rather than revolutionary. Physiotherapeutic methods are entitled to recognition by our national association, but until that time comes we must be organized in such associations as this. The highest degree of co-operation should exist between the physiotherapist and the regular physician, and the day is not far distant when every physician will be using physical measures and the words "skeptic" and "unethical" be consigned to oblivion.

Bombastic pretense on one hand and superstitious credulity on the other which controlled medicine for hundreds of years gave way to ultra-scientific theories which, not being understood by the laity, gave an impetus to many isms and quackery.

Times are changing rapidly; the physician of today is rapidly separating himself from exhibiting his patients as case numbers and is becoming attached to modern methods of treating them as human sufferers.

There is an old saying "no great loss without some gain." The losses incurred by the late war were almost beyond calculation, but advancement along many lines has been the result. The advance made in medicine along therapeutic lines has made greater strides than during the same time of any other known period. The medical profession has been awakened from its dreamy stupor of therapeutic neglect by the penetrating rays of physio-therapeutic light. The war furnished the material and the military hospitals furnished the means in the way of physiotherapeutic apparatus for restoration to service of thousands who otherwise would have become subjects for charity. The profession is aroused to the conviction that there is something after all in physiotherapy.

Last year I made an appeal for facilities within the profession to teach these methods in our medical schools. I take no credit for what has been accomplished, but it is very gratifying indeed to be able to announce that physiotherapy is receiving recognition from the leading medical universities of America. Harvard University through the efforts of Dr. Frank E. Granger has established a department of physiotherapy. Jefferson Medical College has as instructor, Dr. W. L. Clark, one of the leading men along these lines. Dr. Wm. T. Johnson has been chosen as head of the department of Physiotherapy in the University of Pennsylvania. The University of Indianapolis has established a department of physiotherapeutics.

As the avalanche has started in the right places we may confidently expect other schools to follow and organize departments of rational therapy. The pioneers of the movement are to be congratulated for their untiring efforts to bring about this recognition.

The honest-to-humanity physician is suffering from therapeutical hunger. His *alma mater* has impressed upon his mind the necessity of a correct diagnosis, and to this end has led him along labyrinthmal channels of investigation without end and has dropped him at the threshhold of therapeutics. When a physician has arrived at a diagnosis satisfactory to himself he turns to his volume on therapy there to find at his dismay nothing positive or tangible. All is palliative, symptomatic and empiric and treatment becomes a personal choice in experimentation.

The physician suffering from therapeutical hunger is most naturally driven to drug nihilism. If he will but investigate the positive capabilities of physiotherapy, his hunger, to a certain extent, may be appeased. The old stereotyped saying "the disease is self limited" will no longer remain as a pillow on which to fall, for if he be up and doing he will find to be completely subservient to physical measures many conditions which heretofore have been treated expectantly.

The persistent mystery of electricity, its intense modernism and its unlimited possibilities make it the most interesting and fascinating study of this progressive age. The more one studies the marvelous movement of electrons of matter the greater his profound belief in the scientific creation of the universe and his respect for the one great universal law which regulates the creation of material things.

To one interested in physics the study of electricity affords not only a broader grasp of tangible things but a view into the chest of speculative phenomena and a realization of some of the things of which he has dreamed. When once aboard the ship of electrical investigation he becomes anxious to sail with the hope of landing in the harbor of scientific attainment and there to taste of the fruit of knowledge of creative phenomena.

The mysticism and assumption of yesterday are capable of demonstration today. The world's labyrinths which heretofore have been unfathomable are becoming easy of access and an understanding of creative phenomena is becoming more and more a possibility.

We are under the greatest obligation to those men who are burning the candle of investigation to the wick and who will, in my opinion, be able in time to raise the curtain and expose to view the mystery of life itself.

With the aid of the X-ray tube and the ultra-microscope the theory of electricity being a condition has been exploded and the proof that it is a definite substance realized. We now know that a current of electricity consists of the journey of electrons over and through a conductor.

When one views the wonderful achievements in commerce that man has been able to accomplish with an electrical current, he is appalled by its stupendous magnitude. We all recognize the usefulness of electricity in a commercial way, but comparatively few realize its possibilities as a therapeutic measure.

The medical profession is conservative and rightly should be so. The medical man comes in contact with more failures of things to fulfill promises than those engaged in any other line of human endeavor, so it is not uncharitable to say that the medical man is more or less a skeptic. Having seen so many complete failures in drug therapy he comes to disbelieve in therapeutic promises, yet is often the most gullible to the promises of visionary promoters.

When he went forth from his *alma mater* to fight disease he was full of enthusiasm and confident that he would be able to cope successfully with the afflictions of mankind; but gradually one by one, his idols fell to earth and were crushed by the heel of experience. There have been so many unfulfilled promises of what electricity would do in a therapeutic way, made by honest but over-enthusiastic men, that not only distrust but disgust has seized hold of the medical profession. Then again a physician may become interested in the promises made, and being willing to make a trial of its efficiency, purchases an apparatus, the workings of which in a few minutes are explained by the salesman who gives a glowing account of its wonderful capabilities, gives him a cordial handshake and bids him a friendly adieu. The physician knowing little or nothing of the fundamental principles of electricity must perforce apply it in the scientific manner of the Indian *voo-doo.* He fails to secure results and decides that he is *stung* again.

Allow me to say to the prospective employer of electricity as a therapeutic agent: do not attempt to erect a structure without a proper foundation. No one would employ a man to wire his house unless he believed that man to understand the fundamentals of electricity. How much greater the necessity for a physician to understand the fundamental principles of electricity in wiring the human body. Can anyone know anything about the action of drugs without a study of materia-medica? Yet you will undertake the employment of electricity after a few instructions from a man who makes no pretensions of a knowledge of medical subjects.

One of the important duties of the physician is his obligation to the public in matters of public health. Health is civic. Sound men eliminate poverty, which fact should make us all sanitarians. Both employers and employees need to be convinced of the fact that the sound man is the most efficient as well as the cheapest employee and that any reasonable expense to maintain him in health is a profitable investment.

Every 3½ minutes someone dies of tuberculosis. Every 5 minutes someone succumbs to cardiovascular disease. Every 4 minutes someone is taken away by disease of the nervous system. Every 7 minutes someone's suffering is ended by cancer. I am within the limits of conservatism when I say that 60 per cent of the deaths mentioned are preventable and under ideal conditions all are preventable. The life of some pupil of our public schools goes out every minute from some preventable disease. There are in our public schools over 20 million pupils, 14 million of them being in some way defective. Practically all these deficiencies can be corrected. A debt we certainly owe to humanity is to teach the parents of these defectives how to correct existing conditions to the end that these children may become useful citizens.

As the world advances in this wonderful epoch of intellectual development and physical betterment there is a constant requirement for better things. The individual feels that requirement and heeds it or fails in life's endeavor.

Modern medicine realizes that it is not enough to build hospitals for the sick; it is not enough to cure those already ill; it is not enough for the doctor to relieve the pain of those actually suffering. All this is a part of modern medicine, but a still greater part lies in the prevention of illness, in creating favorable conditions to health and in so dealing with the problem of public health that there shall be a minimum of disease, a minimum of ill health and a minimum of suffering.

The duty of the family physician of the near future will be, not so much the administration of drugs as the teaching of the family how to keep well. His services will be needed more and more in this new line of duty and less and less as a pill peddler. His relations to the family will be even more sacred than in the so-called "good old days." He will be expected to keep the babies well; he will be called upon to examine children of school age from time to time, to give advice as to their work and play; he will be called to give advice to boys and girls who are coming into manhood and womanhood and he must keep track of father and mother to see that they do not fall ill and advise them how to live better and get more out of life which under such conditions is bound to be prolonged.

It is through physical measures that the greatest good must come to preventive medicine. Allow me to urge you at every opportunity offered in your medical society discussions, to present the advantages of physical methods in therapeutics as well as in preventive medicine. Invite the physicians of your town to your office and prove to them that physical measures have a place in medicine. The advantages of physical therapy over other methods are numerous enough to convince any physician. There are so many conditions called functional which may be restored to normal before organic changes take place, that make the methods under consideration of great value in restoring health to the individual.

The sphygmomanometer is the physician's Paul Revere in cardiorenal disturbances. It brings him a message of danger to come to the individual who has hyperpiesia. Every progressive physician is anxious to know about the virtues of any remedial agent, but he has seen so many promises fail to make good that he is skeptical. Invite him to your office and show him how arterial tension may be reduced and with the aid of hygienic measures a normal tension be maintained. Show him how to unload an engorged liver. Show him how physical measures will relieve myalgias and muscular spasm; show him the advantages of electrolysis over the knife in stricture; how to cure diseased tonsils without tonsillectomy; how to remove warts, moles, facial blemishes, epitheliomas and neoplasms as well as papilloma of the bladder. Show him how inflammatory engorgements in any part of the body may be effectually drained and exudates absorbed. Show him how to relieve pain without analgesic drugs; how to prevent ankylosis of joints after accidents and operations. Show the specialist how to abort an otitis media. Show him how to treat abscesses by ionization. Show him the advantages of diathermy in neuralgia, neuritis, bronchitis and selected cases of pulmonary tuberculosis. Show him how to relieve any one of the conditions mentioned and another convert is added to physical medicine. Do not stand aloof from the profession and make exaggerated claims. There is no method of therapy known but what rightfully belongs to the medical profession. The shortest route to destruction of quackery and isms in medicine is through the channel called "show me" which wends its way through the possessions of the medical fraternity. There is nothing about electricity or other physical measures one-half as mysterious in effects as drugs. Calomel is prescribed almost daily for so-called biliousness. Just why the patient is benefited is not easy of explanation. One of the most important drugs in the materia-medica in acute respiratory affections is ipecac. Is its physiological action easily explained? As a matter of fact we know it to be beneficial in certain conditions without asking ourselves the whys and wherefores, but when physical measures are suggested for this or that, we want to be shown. Ipecac relieves bronchial spasm through its effects on the vagus. We accomplish the same result by physical methods, minus the nausea. Every effect has its cause, but the fact is not always easy to explain. Nevertheless the relation of effect to cause of physical measures is easier of explanation than that of drugs.

The charge that physiotherapists are drug nihilists will not stand. We all believe in the efficacy of drugs, but we have learned that physical measures will relieve many conditions where drugs signally fail and we also have learned that many conditions are relieved more easily by physical methods than by drugs. Let us all be true to the tenets of our profession; while we need all laboratory methods to aid us, let us not forget that the proper study of mankind is man and that a true clinical picture, after all, is more important to us than one taken in the laboratory.

Every time a physician ignores or berates physical measures in therapeutics he is placing a stone in the structure of unethical practice. He who thinks that physiotherapy is all that is necessary in treatment of disease is building air castles; he who thinks there is nothing worth while in physical therapy may still believe that the world is flat; but he who believes that electricity and other physical measures are potent agents in the treatment of disease is safe and sound.

We are not asking the profession to drop one single useful method of therapy, but we do ask the privilege of allowing reason to triumph and be recognized as honest toilers in the field of constructive medicine.

Our banner is not of reddish hue but red, white and blue, the symbol of unity of purpose, submission to law, fidelity to a trust and charity to all.

My duties as presiding officer of this association are drawing to a close and I desire to thank you one and all for your loyal support and co-operation. As I take my place in the rank and file I feel no better than the best of you; no worse than the worst of you but just one of you who believe that physical measures in therapeutics are of extreme importance as an adjuvant to other well known methods of relieving human suffering, and I hope that I will not be found wanting in the great work of dissemination of the gospel of physiotherapy.

JUST A WORD TO MY SUCCESSOR

As your presiding officer I am about to go.

May you who take my place my troubles never know.

Some things that I have learned I'd like to pass them on

To you who'll succeed me after I am gone.

I've only a bunch of work to leave and cares for you to face

And few cheering words to speak to you who'll take my place.

The trials that I have had, may you never share;

May the members help to carry the load you have to bear.

There will be criticism on which so many dote,
But if it be constructive it will not get your goat.
I leave a task unfinished and you must take it on
And keep alive the society after I am gone.
Of all the dreams I've ever had but few have come true,
But may all your happy dreams be realized by you;
And when your time comes to count the battles lost
May I then share with you the tears they have cost.
Where I have failed may you succeed and at an early dawn
Our work be appreciated after we both are gone.

GLOSSARY

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A. C.—Abbreviation for alternating current.

ACROCYANOSIS.—A term employed for localized hypertension.

ACTINIC.—Having the property of actinism; applied to the quality in the sun's rays whereby chemical changes are produced.

ACTINIC RAY.—Invisible radiant energy which can induce chemical action; ultra-violet ray. Artificially produced by quartz lamps.

AIR GAP.—An open space in an electric current.

ALPHA RAYS.—One of the three types of rays emitted by radio-active substances; positively charged electrons.

ALTERNATING CURRENT.—A current which rises and falls in strength of flow alternately in opposite directions at regular intervals; abbreviated A. C.

ALTERNATING CYCLE.—A cycle begins with zero current which rises to a positive maximum, falls to zero again, thence to a negative maximum and returns to zero; the completion of the cycle is called a period.

ALTERNATION.—One-half period of an alternating current cycle.

AMPERAGE.—The strength of an electric current measured in amperes.

AMPERE.—Unit of strength of the electric current; it is the current produced by an electromotive force of one volt in a current having a resistance of one ohm.

AMPERE HOUR.—It represents the quantity of electricity passed by one ampere of current in one hour.

ANION.—An acid radical or ion which appears at the positive pole in and electrolytic cell.

ANODE.—The positive pole of an electric cell or battery; the positive or anti-cathode electrode of a vacuum tube.

ARC.—A flashing occurring between the terminals of an electric circuit when the current has been in terrupted.

ARC LAMP.—A device for producing light by a voltaic arc.

ARMATURE.—The keeper of a magnet; in a dynamo, a core of metal around which is a wire winding constructed to rotate near the poles of a magnet.

ARMATURE CURRENT.—The path followed by the electric current thru the windings of a dynamo or motor armature.

ARMATURE of a DYNAMO.—A metallic body made up of coils of wire wound around an iron core in which electric currents are induced by its rotation in a magnetic field.

ASTATIC.—Deprived of direct power; a neutralized magnetic needle.

ATMOSPHERIC ELECTRICITY. — Free electricity always found in the air.

ATOM.—The chemical unit: a small particle of matter made up of electrons.

ATOMIC WEIGHT.—A relative weight assigned to atoms of the various elements as compared with that of an atom of hydrogen; the specific gravity as compared with hydrogen when in a gaseous state.

ATOM OF ELECTRICITY.—The electric charge of an alpha particle.

AUTOCONDENSATION. — Condensation of electricity within the body of a patient by reason of his being a part of the condenser.

AUTOCONDUCTION.—A treatment where the patient is placed within a solenoid attached to a d'Arsonval apparatus.

AUTO-INDUCTION.—Self induction of magnetic coils.

AUTO-TRANSFORMER. — A variable compensator in which a choke coil is introduced across an alternating current supply circuit so that varying currents can be obtained from different points on its windings. Employed on x-ray machines.

BACK INDUCTION.—An induction acting upon a magnetic field tending to demagnetize or weaken it.

BETA RAYS.—One of the three types of rays emitted by radioactive substances; negative charged electrons; their movement is slower than alpha rays.

BIPOLAR.—Having two magnetic poles.

BOBBIN, ELECTRIC.—A spool wound with insulated wire for conducting electricity.

BROWN AND SHARPE GAUGE.—The American wire gauge adopted as standard for wires for electrical purposes; abbreviated B. & S. W. G.

BRUSH ELECTRODE.—An electrode resembling a brush for application of electricity.

BRUSH DISCHARGE.—The removal of a charge from an electrical conductor, in the form of a brush.

CAGE, AUTOCONDUCTION.—A solenoid large enough for a patient to stand or recline in for treatment by high-frequency currents. Useful in hypertension.

CALORIE.—The unit of heat in the C. G. S. system equivalent to the amount of heat necessary to raise the temperature of a gram of water from 0 to one degree Centigrade.

CANDLE POWER.—The standard candle by which all lights are measured; a sperm candle consuming 120 grams of wax per hour; a white light visible at a distance of one mile.

CAPACITY.—The quantity of electricity which a condenser is able to store. The unit of capacity is called a *farad*. A *microfarad* is one millionth of a farad.

CATAPHORESIS.—The act of transferring remedial agents into the tissues by means of positive electricity.

CATHODE.—The negative pole of a voltaic cell.

CATHODE RAYS.—Radiations eminating from the cathode of a vacuum tube.

CATION.—The ion which appears at the negative pole in an electrolytic cell; a kathion.

C. G. S. UNITS.—Abbreviation for centimeter, gram second units.

CHARGE.—The amount of electricity present upon any substance which has accumulated static energy.

CIRCUIT.—The course followed by an electric current from its source thru conductors and back again to its starting point.

CLOSED CORE TRANSFORMER. — A transformer having a core which makes a closed magnetic circuit.

COIL.—Successive turns of insulated wire which create a magnetic field when an electric current passes thru them.

COLLECTING BRUSHES. — Conducting devices which make sliding contact with the surface of the commutator of an alternator so as to draw off the current from the armature coils.

COLLOIDS.—Non-crystalline semi-solid jelly or glue like bodies.

COMMUTATOR.—A device for reversing the direction of electric currents; that portion of a dynamo which collects currents from the armature and delivers them to the outside circuit.

CONDENSER.—An accumulator of electrical energy; a Leyden jar is a simple form of a condenser.

CONDUCTOR.—A substance thru which currents of electricity flow easily.

CONSTANT CURRENT.—An electric current of continuous and uniform strength which flows in a direct course.

CONTINUOUS CURRENT.—A steady, non-pulsating direct current as opposed to an alternating current.

CONTROLLER.—A magnetic device for the regulation and control of an electric current.

CORE.—The mass of iron forming the interior portion of an electro-magnet and around which the coils are wound.

COULOMB.—The unit of electrical quantity; the quantity of electricity delivered by a current of one ampere maintained for one second of time.

CURRENT DENSITY. — Current concentration; the density of a current increases in inverse proportion to the square of the surface of the electrode.

CURRENT ELECTRIC.—The flow of electrons over or thru a conductor from a higher to a lower potential.

CURRENT STRENGTH.—In a continuous current, the relation of the electromotive force to the resistance of the circuit.

DAMPING.—Retarding swinging vibrations.

d'ARSONVAL A.—A French physicist noted for his scientific researches.

d'ARSONVAL CURRENT. — A high-frequency current of low voltage and high amperage produced by specially arranged coils.

D. C.—Abbreviation of direct current.

DIATHERMY.—The passage of a high-frequency current thru the tissues of the body for the purpose of raising their temperature; Thermopenetration; endothermy; transthermia.

DIALECTRIC.—A non-conducting medium like air which admits the passage of an electric current.

DIFFUSION.—The power of a current to extend its influence in all directions.

DIRECT CURRENT.—An electric current constant in direction; abbreviated D. C.

DIRECT INDUCED CURRENT.—The current induced in an electric circuit by breaking of the circuit.

DISCHARGE.—The sudden equalization of electric potentials.

DISPERSING ELECTRODE.—A large electrode for diffusion of currents over a wide area. Employed in surgical diathermy.

DRY TRANSFORMER.—A transformer employing air in the place of oil as a cooling agent.

DYNAMIC ELECTRICITY.—A term applied to electricity in motion as distinguished from static electricity.

DYNAMO.—A machine for converting energy in the form of mechanical power into electrical energy by means of electromagnetic induction.

ELECTRICITY.—The modern theory is that electricity is a substance composed of electrons and is made manifest by its magnetic, thermal and chemical effects.

ELECTRO-ANESTHESIA.—Loss of sensibility to pain by application of electricity.

ELECTROCOAGULATION.—Cooking tissues by means of high-frequency currents; surgical diathermy.

ELECTRODE.—A device attached to an electric terminal for the purpose of delivery of electricity to the body.

ELECTRO DIAGNOSIS.—The application of electricity to the tissues of the body as an aid in diagnosis.

ELECTROLYSIS.—The decomposition of a chemical compound in solution into its constituent elements by the passage of an electric current thru it.

ELECTROLYTE.—The liquid decomposed in electrolysis. The exciting fluid of a voltaic cell.

ELECTROLYTIC COPPER.—Copper that has been freed from impurities by electrolysis. It is 98 per cent pure copper.

ELECTROMAGNET.—A magnet produced by passing an electric current thru an insulated wire conductor coiled around a core of soft iron as in the field of a dynamo or motor.

ELECTROMOTIVE FORCE.—The force which starts and maintains a current of electricity thru a conductor. Its unit is called a *volt.* Abbreviated E.M.F.

ELECTRON.—The smallest conceivable amount of electricity. Atoms of all substances are composed of electrons. The basis of all fundamental matter.

ELECTROPHOBIA.—Unreasonable fear of electricity.

ELECTRO-NEGATIVE. — Possessing negative electrification; the element in electrolysis that appears at the positive pole.

ELECTRO-PHYSIOLOGY.—The science of electric phenomena in animal and vegetable systems.

ELECTRO-POSITIVE.—Possessing positive electrification; the element in electrolysis that appears at the negative pole.

ELECTROSCOPE.—An instrument used to detect a positive from a negative charge.

ELECTROTHERAPEUTICS.—The use of electricity in the treatment of disease; electrotherapy.

ELECTROTHERAPEUTIST.—One skilled in electrotherapeutics.

ELECTROTONUS.—The altered state of a nerve or muscle resulting from the application of an electric current.

ENDOSCOPE.—A lamp for illuminating internal cavities of the human body.

ENDOTHERMIC.—Relating to the absorption of heat.

ENERGY, ELECTRIC.—The work done in a circuit or conductor by a current passing thru it.

EXCITATION.—The stimulation of muscular or nerve tissue in the body.

FARAD.—The unit of electrical capacity.

FARADAY MICHAEL.—An English scientist, famous for his discoveries in chemistry and electricity. Born 1791; died 1867.

FARADIC.—Relating to induced electric currents.

FARADIC COIL.—A medical induction coil; a faradic battery.

FARADIC CURRENT.—An alternating current produced by a faradic coil.

FIELD.—A term employed to the space occupied by magnetic or electric lines of force.

FIELD COILS.—Coils of insulated wire wound upon the field magnets of a dynamo.

FRANKLINIC ELECTRICITY. — Frictional or static electricity.

FREQUENCY.—The number of periods made by an alternating electric current per second of time.

GALVANI LUIGI.—An Italian physician and physiologist famous for his discovery of current electricity; born 1737; died 1798.

GALVANIC BATTERY.—A name given to a series of primary cells.

GALVANIC CAUTERY.—A method of burning the flesh in medical treatment by heat of a continuous direct current.

GALVANIC ELECTRICITY.—A name commonly employed for a direct continuous current of electricity.

GAMMA RAYS.—One of the three types of radiation from radioactive substances. They accompany beta rays and are regarded as a part of x-rays. The shortest known ray of the solar spectrum.

GAP.—An air space in a magnetic circuit.

GENERATOR.—A machine for the transformation of mechanical into electrical energy.

GRID.—The lead plate of a storage cell.

GROUND.—The earth as an electric conductor.

GROUND WIRE.—A conductor which makes connection with the earth.

HEAT, ELECTRIC.—The heat produced in a conductor by the passage of an electric current thru it.

HEAT UNIT.—The amount of heat required to raise the temperature of a unit mass of water one degree.

HELIX.—A conducting coil or solenoid.

HENRY.—The unit of self induction.

HERTZIAN WAVES.—Electromagnetic waves or frequencies first observed by Hertz, a German physicist; the longest known rays of the solar spectrum.

HIGH-FREQUENCY. — A periodicity exceeding 10,000 per second.

HIGH-FREQUENCY TRANSFORMER.—An apparatus for raising or lowering the frequency of an alternating current.

HIGH TENSION.—A term applied to high voltage currents.

HIGH VOLTAGE.—A term applied to an electromotive force exceeding 600 volts.

HOT WIRE METER.—An ammeter or milliamperemeter depending for its action upon the expansion of a wire under influence of heat produced in it by the passage of an electric current to be measured.

HYPERTENSION.—A sustained blood pressure above normal.

HYPOTENSION.—Sustained blood pressure below normal.

HYPERPIESIA. — Hypertension without cardiovascular changes.

IMPEDENCE.—The opposition offered to the flow of an alternating current.

IMPEDENCE COIL.—A choke coil.

INDUCED CURRENT.—A Current caused by electromagnetic induction.

INDUCING COIL.—The primary winding of a transformer.

INDUCTION.—An electric or magnetic state produced without contact with an electrified or magnetic body.

INDUCTION COIL.—A transformer with open magnetic circuit in which a pulsating direct current in the primary induces an alternating current in the secondary.

INSULATE.—To safeguard a body against escape of electricity from it or a conduction of electricity to it.

INSULATOR.—A non-conductor.

INTENSITY OF CURRENT.—Current strength.

INTERRUPTER.—A device for the opening and closing of an electric circuit.

IONIZATION.—A breaking up of a compound into positive and negative ions.

IONS.—The charged bodies of an electrolyte which appear at the poles of a primary cell. They are called "travelers" or "tramps" because they travel toward the poles.

JOULE'S LAW.—The quantity of heat developed in a conductor by the passage of an electric current is proportional to the resistance of the conductor to the square of the strength of the current, and to the duration of the flow. Heat equals current 2x resistance x time.

KATHION.—A cation.

KATHODE.—Cathode.

KILO-VOLT.—One thousand volts.

KILOWATT.—Electric power of 1,000 watts; abbreviated K. W. One thousand watts equals 1.34 horse power.

KILOWATT HOUR.—The work performed by one kilowatt of electric power during one hour.

KINETIC ENERGY.—The energy possessed by a moving body distinguished from potential or energy at rest.

LABILE GALVANIZATION.—The application of galvanic electricity from an electrode sliding over the parts treated.

LEAK.—Dissipation of electricity thru faulty insulation.

LEYDEN JAR.—A glass jar coated inside and out to a certain height with tin foil. It is the simplest form of condenser. It receives its name from the city of Leyden where it was first made.

LEYDEN JAR BATTERY.—Several Leyden jars grouped together. The battery employed in the construction of some high-frequency machines.

LINES OF MAGNETIC FORCE.—Lines or paths along which magnetism acts.

LOAD.—The output in watts of a dynamo; the resistance offered to a motor by the machinery it drives

LOW TENSION.—Low voltage.

MAGNET.—A body possessing the property of attracting to itself particles of iron.

MAGNET CORE.—A bar of iron or steel about which a magnet coil is wound to form an electromagnet.

MAGNETIC FIELD.—The space surrounding a magnet thru which magnetic forces act.

MAGNETIC GENERATOR.—A machine for generating electricity by the use of permanent magnets; a magneto.

MAGNETIC POLES.—The ends of a magnet called north or positive and south or negative pole.

MAGNETISM.—The property possessed by certain substances in virtue of which they exert forces of attraction or repulsion according to fixed laws.

MAGNETO.—A device for generating electricity by electromagnetic induction produced in the field of a permanent magnet.

MAGNET WIRE.—Fine insulated wire.

MAIN.—One of the principal conductors in an electric light or power system.

MAKE AND BREAK.—Alternately opening and closing a circuit.

MEDICAL ELECTRICITY.—Electrotherapeutics.

MILLI.—One-thousandth part.

MILLIAMPERE.—One-thousandth of an ampere.

MILLIAMPEREMETER.—A device for measuring the strength of an electric current in milliamperes.

MOTOR.—An electric motor is a machine for transforming electrical into mechanical power.

MULTIPLE-POINT ELECTRODE.—An electrode consisting of many points from which electricity is discharged; the discharge is called effluve.

MYRIA.—A prefix meaning ten thousand times as great.

NEURASTHENIA.—A complex condition of unknown pathology characterized by symptoms of nervous insolvency.

NEUROSTHENIA.—Neurasthenia associated with hypertension.

NON-CONDUCTOR.—A substance which allows but a very small amount of electricity to pass; an insulator.

OHM.—The unit of electrical resistance. It receives its name from George S. Ohm, a German physicist.

OHM'S LAW.—The amount of current in amperes is equal to the electromotive force in volts divided by the resistance in ohms.

OIL TRANSFORMER.—A transformer which is kept insulated by being immersed in oil.

OPEN CIRCUIT.—An interrupted electrical continuity; a broken circuit.

OSCILLATING CURRENT.—An electric current consisting of a series of waves, decreasing in amplitude in constant proportion; an oscillatory current.

OUDIN COIL.—A resonator attached to a d'Arsonval solenoid.

OUDIN CURRENT.—A unipolar high-frequency current of high voltage and low amperage.

OZONE.—A gas produced by passing an electric current thru air, changing oxygen into ozone.

PARALLEL CONNECTION.—A method of connecting up an electric system in which all the positive poles are joined to one conductor and all the negative poles to another; multiple connection.

PERIOD.—The time taken to execute a complete cycle of an alternating current.

PHOTOTHERAPY.—The treatment of disease by application of light.

PLANT ELECTRICIY.—Electricity exhibited in vegetable life.

POLARITY.—Possession of magnetic poles.

POLE.—An electrical terminal.

POLYPHASE.—Having more than one phase or period of alternation.

POSITIVE ELECTRICITY.—The kind of electricity which flows from the point of an electrified body.

POSITIVE POTENTIAL.—The higher potential which causes electricity to flow toward a lower or negative potential.

POTENTIAL, ELECTRIC.—The power possessed by a charge of electricity for doing work.

POTENTIAL ENERGY.—Power at rest; inherent energy; ready for work but not working.

PRIMARY CELL.—A device for transforming chemical action into an electric current.

RADIANT HEAT.—Heat waves passing thru space with the velocity of light (186,000 miles per second) and giving the sensation of heat only when absorbed by the body thru which they are passing.

RADIOACTIVITY.—That property of a substance by which it spontaneously emits rays which are capable of penetrating opaque substances, exciting phosphorescence in certain substances and ionizing the surrounding air.

RAYS.—Lines of radiant energy emitted by sources of light, heat and radioactive substances.

RESISTANCE.—The property of a substance that opposes the passage of an electric current thru it. It is measured in ohms.

RECTIFIED CURRENTS.—Alternating currents which have been changed into direct pulsating currents.

RESONATOR.—A circuit tuned to oscillate in synchronism with another oscillating current.

RHEOSTAT.—A device for varying the resistance of an electric current.

ROTARY CONVERTER.—A dynamo for generating both direct and alternating currents; rotary transformer.

ROTOR.—The part of a machine which rotates.

R. P. M.—Abbreviation for revolutions per minute.

RUHMKORFF'S COIL.—A coil consisting of two insulated coils, the primary having few turns of coarse wire, the secondary with many turns of fine wire, wound upon a hollow cylinder enclosing a core of soft iron wires; the primary is joined to a battery and includes an interrupter and commutator.

SECONDARY.—A term used for secondary coil.

SECONDARY CURRENT.—The current induced in the secondary of a transformer or induction coil.

SERIES CONNECTION.—The connection of cells one after another, the positive of one to the negative of the next and so on thru the battery.

SHUNT.—A branch conductor for the purpose of dividing the current allowing a part to flow thru the main circuit.

SINE CURVE.—A wave like curve used to represent the changes in strength and direction of an alternating current.

SINUSIODAL CURRENT.—An alternating current which starts at zero and gradually increases to its limit of strength and back again to zero, then to the opposite polarity and back again to zero.

SOLENOID.—A spiral of conducting wire wound cylindrically so that when an electric current passes thru it, it acquires magnetic properties.

SPARK GAP.—The space between two electric terminals brought to a difference of potential, filled with the dialectric thru which the spark discharge takes place.

SPIRAL.—Wire coiled in one plane.

SWITCH.—A device for opening and closing a circuit.

TESLA COIL.—A form of induction coil designed by Nikola Tesla for obtaining high potentials and frequencies; it consists of few turns of wire in the primary and many in the secondary, and immersed in oil. Tesla transformer.

TESLA CURRENT.—A high-frequency current of extremely high voltage and medium amperage.

TRANSFORMER.—A device similar to the induction coil for the purpose of transforming alternating currents from a higher to a lower or a lower to a higher potential. When the primary consists of few turns of wire and the secondary many turns it is known as a "step up" transformer. In a "step down" transformer the conditions are reversed.

ULTRA-VIOLET RAYS.—Rays existing beyond the violet of the visible spectrum having an exceedingly high rate of frequency ; *actinic rays.*

UNIDIRECTIONAL CURRENT.—An electric current of uniform direction; a direct current.

UNIPOLAR.—A term used when one electrode is applied to the body.

VOLT.—The unit of electromotive force; it is that E. M. F. which will produce a current of one ampere against a resistance of one ohm.

VOLTAGE.—Electromotive force measured in volts.

VOLTAGE DROP.—The reduction of potential in an electric circuit due to the resistance of the conductor.

VOLTAIC BATTERY.—A group of primary cells.

VOLTAIC CELL.—A primary cell.

VOLTAIC ELECTRICITY.—Current electricity.

VOLT METER.—A device for measuring differences of potential in volts.

WATT.—Unit of electrical power; the power due to a current of one ampere flowing under pressure of one volt.

WATT HOUR.—One watt of power expended for one hour.

WIND, ELECTRIC.—A stream of electrons communicating its momentum to the air.

ZERO POTENTIAL.—The earth's potential.

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