Testing Physical Fitness with the Camera

The Mensurgraph a New Aid to Photographic Measuring

By Robert G. Skerrett

IT is dawning upon us that the physical well-being of every American is a matter of national concern. Likewise is it essential that we have at our command facilities by which our bodily state may be checked up, verified, from time to time. This applies to those of adult years as well as to infants, and especially to our youthful citizenry during the period of adolescence. The question is, how can records be made at suitable intervals which shall satisfy the eye in arriving at external indices of development, of debility, or of retarded growth?

Science has furnished a variety of means and apparatus designed to serve these ends, but it is probably not an exaggeration to say that the art of physical appraisement is to a marked degree in a state of flux. We are literally feeling our way toward the goal of precision; and day by day it is becoming plainer that the outward aspect of the body has much to tell us if we are keen enough of vision to read aright.

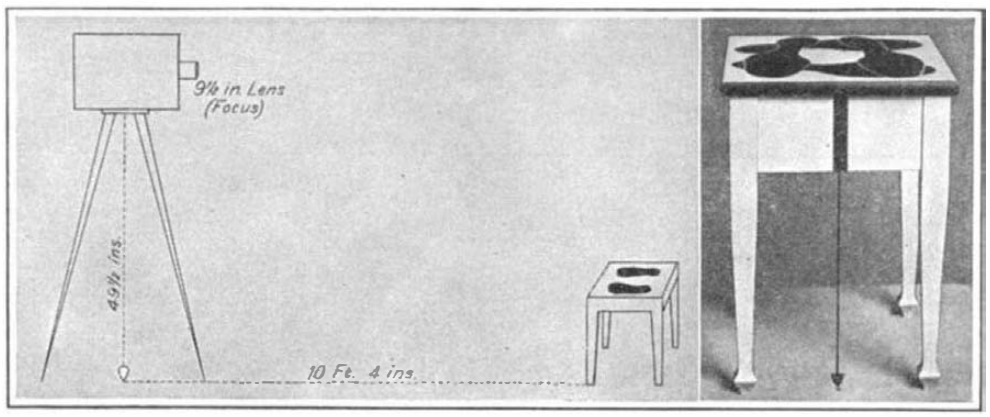
The trouble up to now has been the lack of a convenient system that would give us positive data of all phases of our superficial contours and surfaces at any moment and which could again be measured during a series of prescribed observations. Sufficient nourishment or a lack of it is plainly indicated by the outward appearance of the physique. Similarly, muscular upbuilding, due to stimulating exercises, will tell its own story outwardly; and a lack of developmental balance, any deficiency that has an exterior reflex—and there are many of these—can be noted by the trained observer. But the principal difficulty to successful interpretation in the long run is a succession of records which will lend themselves to really nice comparison.

The labor laws of certain of our States specify that children between prescribed ages shall not be employed in gainful pursuits unless they have received qualifying certificates as to their fitness for any work in which they may be properly engaged. That is to say, boys and girls from 14 to 16 years old cannot join the ranks of our army of workers unless they have been found sound enough bodily to meet the stresses thus imposed upon them. The burden of establishing this status rests upon duly authorized examining officials. These officers exercise a large discretionary power; and offhand personal impression plays a conspicuous part in the decision. This invited error for which the child, first, and then the parents or the community must pay.

These youngsters, of which there are a great many thousands, are recruited annually to our industrial ranks; and that they may be a source of strength, not subsequent weakness, it is vitally essential that their taking up of life's burdens and their assumption of any particular line of effort shall be consistent with their bodily capabilities. The ordinary physical examination does not in itself suffice in many cases to place the juvenile worker in the right category as to fitness or unfitness, and a subsequent examination may be made by another official who has not any knowledge of just how the child looked when previously rejected or accepted. Thanks to the work of a New York physician, Dr. Theron W. Kilmer, this handicap to correct judgment has been very considerably reduced.

Dr. Kilmer has brought photography to his aid, and he has made it practicable to utilize the camera so that successive pictures will give correct superficial records of the external phases of the physique from all sides. Not only that, but because of the way in which the plates are made one scale of evaluation will answer for a series of prints taken at different dates—thus permitting very close comparisons of intervening bodily changes. There is nothing fundamentally new in this recourse to photography—others have used the camera before for the same purpose, but their procedure has been faulty in important respects.

These drawbacks have been eliminated by Dr. Kilmer, and today he makes it possible to take any number of photographs at suitable intervals and to do so under circumstances that are practically identical. That is to say, the light is always the same because he uses a powerful mercury-vapor lamp. The focal distance is unvaried because the camera and the stool upon which the subject stands are just as many feet and inches apart, and the lens is at a certain height above the common floor level. Finally, the person to be pictured places his heels or toes upon limiting footprints which are painted upon the top of the stool or stand.



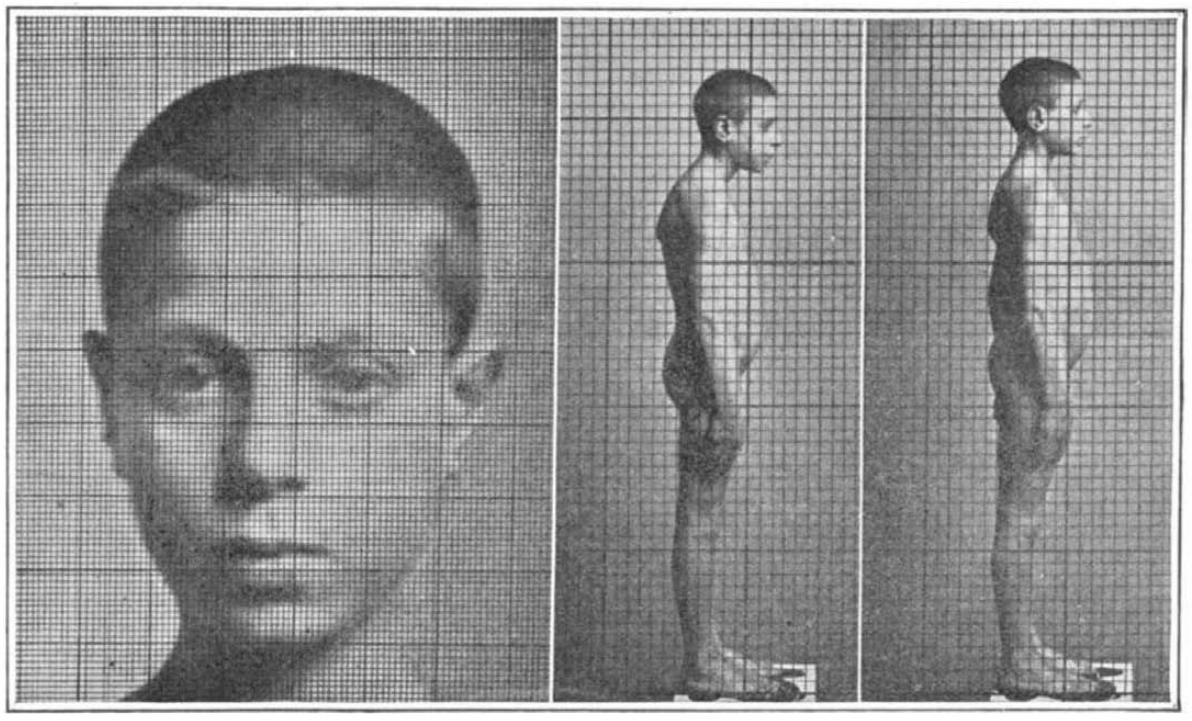
Arrangement of apparatus for taking mensurgraphs and enlarged view of the stool on which the patient stands

So far, Dr. Kilmer has introduced no feature of precision which is outstandingly novel in the realm of photographic exactness, but his method does insure of picturing the subject from time to time in the same focal plane and from the same point so that any superficial alteration will be registered in fixed proportions upon successive negatives. But how does he make it practicable to measure these contours and surfaces to a nicety and thus to evaluate properly any changes which may occur? Here is where he has introduced something decidedly new.

On the front of the stool are two heavy black lines—one horizontal and one vertical. These lines form a T-like registering mark at the bottom of each photograph taken. On his printing paper, before it is exposed, Dr. Kilmer stamps a similar symbol, and then lays his picture negative upon the paper so that the two T-marks—one on the paper and one on the negative—coincide. Next, the paper is exposed to light and the negative removed. Another plate, opaque and ruled in measuring squares, is substituted, and the paper is once more exposed to light. In this case, too, a T mark on the negative insures proper registering. When the doubly exposed paper is developed there is produced a picture seemingly lying beneath a screen of lines which represent feet and inches or, if so scaled, inches and fractions thereof. If the paper is developed after exposure under the figure negative only the screen, of course, is not reproduced.

In this way, Dr. Kilmer can secure a vivid photograph which shows every superficial detail of his subject and this he can examine without having his eye affected by intervening lines, or he can obtain the same picture overlaid with a series of measuring lines. The latter the inventor calls a "mensurgraph." The two photographs thus give him all of the information that he may desire for purposes of analysis; and a number of these, taken at suitable intervals, furnish a comparative record of the utmost value. The measuring scales apply with equal precision in each case, and any physical modification can be detected and given its due weight. Finally, these photographs will tell their story to any qualified observer, whether it be he or someone else who took them.

The mensurgraph method devised by Dr. Kilmer will lend itself to many useful applications. It will undoubtedly prove of importance in the military services for purposes of identification and, similarly, be an aid to police administration. The mensurgraph system will find a field of fascinating adaptation in the study of the changing modelling of the face and head from year to year, and be of particular value in watching these changes from time to time in the cases of resident children, either of domestic or foreign birth, of alien parentage. It is said that the American environment tends to blend racial features into a general native type. Dr. Kilmer has provided means by which these modifications can be recorded with illuminating precision. Further, mensurgraphing will be a great help hereafter in all X-ray work, and will tend to reduce to a minimum the errors which are all too common in reading or adjudging the revelations of the radiograph.



A mensurgraph of a boy's head

Development of a boy as indicated by the camera

Reclaiming Barbed Wire

THE problem of retrieving the buried and broken barbed wire on the battlefields of Flanders and Northern France is being tackled by the British War Office Salvage Committee, and a machine for the purpose has been invented and built which is thus described.

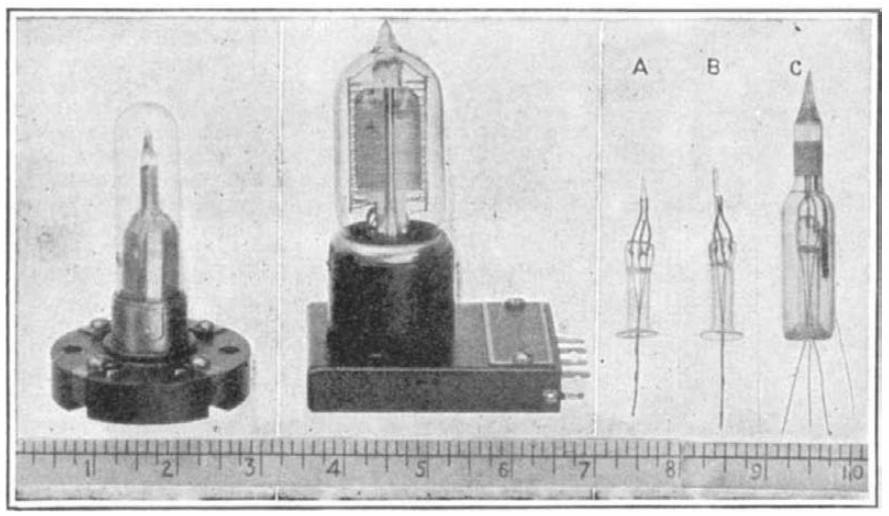
One trunk and trailer carries the whole of the plant, which can work on the most uneven ground. A stout wire rope with a number of hooks is worked by a winch. As the barbed wire is drawn up it passes through two sets of rollers, and the salved metal appears in blocks from one foot to 18 inches square, and weighing from 70 pounds to 80 pounds. For smelting it sells for about $25 a ton. The staff in charge of the scheme thinks that there are 100,000 tons that can be removed, and if that is the aggregate weight the cost of the 40 outfits said to have been ordered should be amply justified.

Some Startling Electrical Phenomena Obtained with New Form of Vacuum Tube

AN enthusiastic wireless experimenter was at work in his laboratory, when, by chance, he happened to touch the glass bulb of his vacuum-tube detector. Immediately he detected an amazing result by means of his telephone receivers. His curiosity was aroused. He wondered why he had obtained that result, and in his quest for the reason he came across a new form of vacuum tube for wireless and other purposes.

That enthusiastic wireless experimenter was none other than H. P. Donle, now the radio engineer of a large electrical company at Meriden, Conn. When he filed his patent papers at Washington, D. C., the patent examiners came back with the blunt statement that his invention was impracticable. Whereupon Mr. Donle went down before the examiners with a complete laboratory equipment, gave a demonstration before the expert electrical men of the patent office, and secured a basic patent on his invention.

Vacuum tubes, as will be recalled from the numerous descriptions of such devices and their application in these columns, are modified electric lamps used in wireless telegraphy and wireless telephony, as well as for land-line telephony. Such vacuum tubes can be used for detecting high-frequency electric currents, such as radio waves, for modifying or modulating or relaying purposes in wireless communication and in telephone work, for generating high frequency current for wireless purposes, and for amplifying or building up weak currents to powerful currents.



New type of vacuum tube at the left as compared with a standard vacuum tube in the center view. At the right are depicted the various steps in making the new tube

What Donle discovered was that it is possible to pass ionic currents through the glass walls of an incandescent lamp. In fact, by placing a metallic coating on the exterior walls of any ordinary lamp, it is possible to pass several microamperes between filament and this exterior coating, with a potential of 20 volts. In order to determine if it were possible to construct a thermionic rectifier in this manner, Donle set to work constructing several tubes containing a metallic filament and a metallic coating on the external walls. It was found entirely practical to pass currents of considerable magnitude between the incandescent filament and the external anode, the operation being about as follows:

After the filament has been heated for a sufficient length of time to warm the walls of the tube, the electrons emitted from the filament strike the walls and the current is conducted through these walls in the manner described later on. This current passing through the glass increases its temperature considerably and as the conductivity is a function of the temperature the current will increase for a short time after the connection is established.

The anode current will, therefore, depend upon several factors: First, the temperature to which the glass is raised by heat from the filament; second, the anode potential, besides such factors as thickness of glass, distance from the cathode, and so on.

Thus we have glass which is heated by the radiation from the filament to a sufficiently high temperature to allow a small amount of current to pass, and by the passage of this current, the temperature is raised considerably.

The results from tests of this tube showed some very peculiar characteristics, one being that the operation depends to a large extent upon what metal is used for the anode. A series of experiments on glass samples demonstrated at once the cause of this phenomena.

Samples were prepared from a short length of tubing with an electrode fused in each end. Later many other arrangements were tried, but each gave substantially the same results as the first arrangement. These tests gave most satisfactory results. Conduction through the glass when heated was of quite a different nature from that which might have been expected. It exhibited all the characteristics that occur in conduction through an electrolyte. The three most noticeable phenomena were: 1. Polarization; 2. Increase in resistance due to the formation of non-conducting layers on the electrodes; 3. The deposition of the products of decomposition on the electrodes.

With like electrodes of proper material, polarization takes place in hot glass precisely the same as in an electrolytic cell containing, for instance, a diluted solution of sulphuric acid and having platinum electrodes.

The second effect, increase in resistance, was in the construction of a practical detector, of the greatest importance. This effect depends entirely upon the material of the electrodes; for example, in a sample of lime glass with nickel electrodes, heated to say 400 degrees C., and an applied E. M. F. of 20 volts, when the circuit was closed the current might amount to five milliamperes, but in five seconds this current decreased to less than one-tenth of one per cent of its initial value. With silver electrodes this effect is almost entirely absent; and with a tube having one electrode of silver and one of

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A Successful Type of Anti-Noise Transmitter and Loud-Speaking Telephone

TWO years ago it was the common belief that telephony aboard an airplane was impossible. How could one talk into a transmitter with one or more unmuffled engines roaring but a few feet away? How could one hear with the thundering engines and rush of air and the many other sounds incidental to airplane travel? Frankly, the problem seemed almost impossible of solution.

At first, when the call for telephone apparatus for airplane use became imperative not only for intercommunication between members of the crew but for wireless telephony, inventors set to work on various schemes for barring out engine and other sounds, while confining the voice to a small chamber containing the telephone transmitter. Such schemes, however, were not successful. The roar of the engines still persisted despite attempts at sound-proof mouthpieces. One scheme which has been worked out to a relative success consists of a telephone transmitter provided with a mouthpiece having three small holes The action of this transmitter is based on the fact that the direct impact of the speaker's voice passes through the small holes and operates the diaphragm, while the sound waves of the roar of the engine cannot pass through the holes because the sound waves are not in line with them. However, when transmitters of that design have been applied to multi-engined planes such as the NC Naval boats, they have proved unsatisfactory; and in the long run they have only proved satisfactory on smaller single-engined planes.

It has remained for two inventors, E. S. Pridham and P. L. Jensen of San Francisco, Cal., to develop a really successful and universally practical transmitter for airplane use. At first these inventors, like most others at work on the problem, attempted to muffle their transmitters so as to exclude engine noise. They made most of their experiments in the testing room of an airplane engine manufacturer, where dozens of engines were being tested at one time. Then one day the inventors decided on a daring move; they gave up the idea of muffling the transmitter and, instead, made it absolutely open or stripped of casings of all kinds. They permitted all noises to come in contact with the transmitter—at the front and at the back, all round, so as to allow the sound waves to act equally free on both sides of the diaphragm. The result has been the balancing of all extraneous sounds since the waves strike the diaphragm with equal force on both sides, hence neutralizing each other; while the voice waves strike the diaphragm on one side only, temporarily destroying this balance and therefore affecting the circuit.

The latest form of anti-noise transmitter designed by Pridham and Jensen consists of a diaphragm and a transmitter button. The button is set at an angle with

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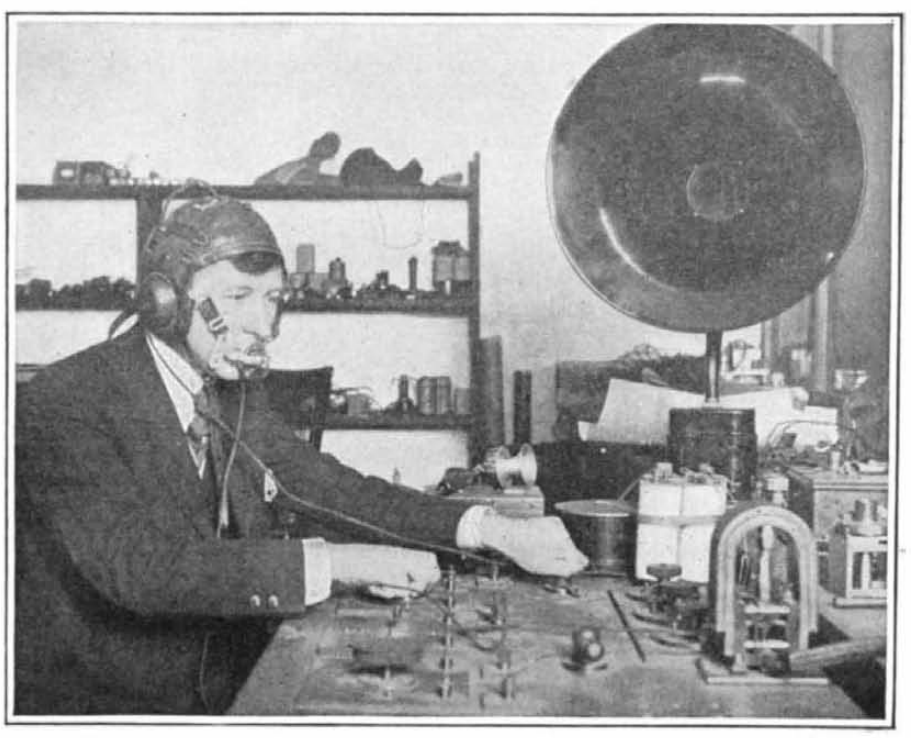
How the anti-noise transmitter is applied to regular telephony. The receiver mechanism, in this case, is located in the base of the hand set



How the aviator wears the anti-noise transmitter, and the special loud-speaking telephone which operates on a new principle

How long it will all take only the future can say. There are so many problems all to be tackled at once, and France is not a country nor are the French a people apt to find at once the most efficient and the quickest way. France, perhaps more than England, clings to the old idea. The French are thrifty to the point of absurdity; to the average French mind to throw away is to waste, even if what is thrown away is in itself wasteful to use. Much time is going to be wasted on fruitless attempts to repair and remake what is far better scrapped.

But it is not for the onlooker to criticize. Indeed, after having wandered through these death-like regions and seen the absolute negation of civilization, the complete destruction, and the magnitude of the problem, one is not tempted to criticize. One feels indeed that results would come quicker were there perhaps less fear of the loss of trade which would come by admitting foreign products at once. What France needs is material, tools, and transportation; to keep any of it away with regulation tariff, or import duty is, apparently a mistake. But the French know their own business best, doubtless, and whatever else he has or has not, your apparently ruined French peasant, storekeeper, manufacturer, miner or producer has courage.

In the little town of Belleau, at the foot of the slope which rises to Belleau Wood, just west of Chateau Thierry has come back one lonely inhabitant. Belleau had but a dozen houses and they are now but walls. But the lonely inhabitant is not daunted. With hammer and saw he is industriously patching a piece of a roof for a piece of a house, and he whistles while he works. And that is, after all, the spirit of France today and the answer to all critics who find her reconstruction program somewhat small for the task, and her progress very slow. Whatever her methods, nor how they may be criticised from an American standpoint, she has the stout heart, and in time, and with American machinery, some foreign credit and the lightheartedness which comes from a beaten Hun and Alsace and Lorraine "home" once more, she is sure to conquer in the end and heal her wound, mend her scars and be once more what she has for so many centuries taken such pride in being, La Belle France.

And having seen the hack-saw mark of the Hun across this land and the smile on the face of his victims, having listened both to Paris trying once again to sing and the lonely victim in Belleau town whistling at his hopeless task of remaking a home, one American observer at least is quite, quite willing to lift his hat and cry with all his heart, "*Vive la France!*"

Some Startling Electrical Phenomena with New Form of Vacuum Tube

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nickel, there is an increase in resistance only when the nickel is made positive, but not when it is negative.

It is known that glass at or near its melting point becomes a good conductor. This property of becoming strongly conductive when heated to a semi-fluid state is probably shared by all other so-called dielectrics, but it is obvious that it would be absolutely impossible to operate a vacuum tube at such a temperature. The glass walls of the tube would collapse at about 425 degrees C. The glass will not, however, attain red heat until heated to about 600 degrees C. Electrolytic conduction of glass is observed at far lower temperatures than these. In actual operation the temperature of this electron tube never exceeds 140 degrees C.

The third effect both assists and retards the operation of the detector. It has been found that while conduction is taking place in the glass the products of decomposition are deposited on the electrodes. The second effect is really part of this third effect, it being probably a deposit or an emission of some of the products of de-

composition at the anode which causes its surface to become non-conductive. In the operation of one of these tubes as a detector, some of the products of decomposition are emitted from the inner walls of the tube and are deposited on the cooler portions of the tube. This action is of a beneficial nature, as it would probably aid in cleaning up some of the gases which might be emitted during the operation.

After exhaustive research work Mr. Donle developed the tube to its present forms, which are shown in the accompanying illustrations. Here we have in each case a filament surrounded by a controlling electrode within an evacuated tube, the exterior walls of the tube being coated with a metallic deposit. The static characteristic curve of these two forms shows that there is practically no variation for various tubes. The tube, in effect, is a vacuum, surrounded by an electrolyte, and it is probable that most of its peculiar characteristics are due in a large measure to electrolytic action in the glass walls.

The results obtained with these tubes as plain detectors and as oscillating detectors have been quite remarkable, according to persons who have used them. As a simple detector the response is reported to be greater than that which is obtained with any of the usual types of vacuum tubes; but as a detector oscillating on spark signals, its performance is extremely gratifying, the strength of signals being many times greater than that given by most tubes in general use.

The construction of Mr. Donle's tube is simplicity itself. As will be noted from one of the accompanying illustrations, it consists of a stem, which is shown at *A*, and which contains a diminutive hairpin filament, while at *B* the "control," consisting of a small spiral, is placed over and about the filament and connected with the middle lead-in wire of the glass stem. The glass stem is then placed in a glass container as shown at *C*, after which the air is removed by means of a vacuum pump. The mass of the inner structure is so extremely small that it is a very simple matter to drive the gas from it. The usual procedure is to light the filament and then bombard the control by the application of a sufficient potential between it and the filament, the entire operation requiring less than one minute. The nickel supports are freed from gas before assembly. The outer surface of the glass container receives a narrow band of silver paint which is then melted into the glass, so as to form the "plate."

Mr. Donle states that the alinement of the filament and "control" is not at all critical, it being only necessary to see to it that the filament is placed as near the center of the "control" as possible. The position apparently makes no difference in the operation as long as the control does not touch the filament. The structural advantages of the new tube are quite obvious, when compared with standard tubes. Instead of having an area of metal inside the tube of several square centimeters there is hardly as many square millimeters. In order that the tube be held at a fairly constant temperature during operation, an outer shell of glass is slipped over the tubes proper when it is cemented into its socket. This shell is provided with two small holes near its base which prevent the temperature from becoming excessive. With this shell removed the operation is quite satisfactory, if there is no draught. The shell protects the tube from draughts and mechanical injury.

The uniform operation of the Donle tubes is most remarkable. It was at first expected that commercial variations in the glass thickness, and so on, would materially affect the operation. Such, however, is not the case, and made under ordinary conditions they run entirely uniform; so much so, in fact, that tubes may be interchanged in any circuit without the necessity of readjustment. In short, the tube described possesses not only certain superior electrical characteristics, but is readily and cheaply produced in any quantity.

A Successful Type of Anti-Noise Transmitter and Loud-Speaking Telephone

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relation to the diaphragm, in order to prevent it from being held horizontally at any time. Other transmitters, when used by airmen, are apt to be held horizontally when looking over the side of the airplane, with the result that the carbon granules fall away from the front member of the button and the transmitter becomes inoperative. With the button at an angle, however, it is impossible to bring it into the horizontal position unintentionally. The transmitter is held in a perforated casing which permits all sounds to reach the front and back of the diaphragm, while a push button permits the transmitter to be cut into circuit when desired.

Aside from the anti-noise transmitter, which, it is interesting to note, is employed on the Navy NC planes and other multiple-engined machines, the same inventors have developed a loud-speaking telephone of novel design. Instead of the usual heavy diaphragm attracted by a pair of electromagnets, they have made use of a pair of powerful electromagnets with right-angle pole-pieces between which vibrates a coil. The coil is fastened to the diaphragm by means of a wire, and moves up and down across the lines of the magnetic flux. The electromagnets are connected in circuit with a powerful storage battery, while the telephone current is passed through the fine winding of the coil.

Highly interesting results have been obtained with this saturated-field electrodynamic type of loud-speaking receiver. Indeed, sounds have been transmitted over distances of several miles, and during one of the tests the sound waves were heard some seven miles away. President Wilson's Victory Loan message was read by Lieut. H. E. Metcalf, a radio officer, while flying over Washington, D. C., at an altitude of 2,600 feet, and was distinctly heard by 15,000 persons assembled on and about the south steps of the Treasury. Every sound but the voice speaking through the transmitter was eliminated. Instead of over a hundred loud-speaking units as were used on Victory Way, New York city, this loud-speaking telephone emitted all the sound waves from one source, thus making for more realistic and more understandable speech.

The anti-noise transmitter of Messrs. Pridham and Jensen has been used on all the airplanes of the United States Navy, and on many of the airplanes of the French and British armies. The instrument is now being installed on the vessels of the United States Shipping Board. And with the apparatus released for commercial purposes, there should be some interesting developments in telephony and public speaking. The new desk telephone employing the anti-noise transmitter has a receiver for each ear and looks like a physician's stethoscope greatly enlarged, while the transmitter has the appearance of a young collender fitting closely to the mouth. The inventors assert that the only proper way to use a telephone is to listen through both ears. With this desk telephone set, the circuit is automatically made by removing the hand set from the double hook, and broken by restoring the instrument to place.

The Heavens in June, 1919

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of the equator, and remains visible until after 11 P. M. by the clock all through the month.

Mars is a morning star in Taurus, but will be very hard to see, even at the end of the month, as he rises only an hour earlier than the sun.

Jupiter is an evening star in Gemini, and now sets before Venus, at about 11 P. M. on the 1st and 9.30 on the 30th.

Saturn again is an evening star, in Leo, and sets a little after midnight in the middle of the month.

Uranus is in Aquarius. He crosses the meridian at 5.30 A. M. on the 18th, and is