(looking through the hole in the mirror) from the observed eye, or (ζ) the larger the concave mirror.

The conditions favorable to a strong illumination of the pupil of the observed eye are then, (α) wideness of its pupil, (β) a fairly large pupil on the part of the observer, (γ) a high grade of myopia of the observed eye, (δ) a high grade of hypermetropia of the observed eye, (ε) a short-observing distance, and (ζ) the use of a large concave mirror. Of these conditions, the first (α) may be secured when necessary by resorting to artificial mydriasis; the second (β) is best attained by observing with relaxed accommodation, the observer correcting the far-point of his own eye for the distance of the pupil of the observed eye by means of a suitable lens mounted behind the hole in the mirror. A short observing distance (ε) may be tried whenever the condition of the observed eye (*e.g.*, exceptionally dark pigmentation of the fundus, narrowness of the pupil from extensive synechiæ, imperfect transparency of the media, etc.) is unfavorable to good illumination of its pupil. The use of a concave mirror of large diameter (ζ) is also a possible resource in cases of exceptional difficulty.

(*d*) The rapidity of the shadow movement (other things being equal) varies inversely with the diameter of the visible circle, over which the image of the flame passes as the mirror is rotated; the smaller the visible circle, the less will be the time occupied in this passage, consequently the more rapid will be the movement of the shadow across the pupil. The darkening of the pupil occurs most quickly in myopia of the particular grade in which the far-point of the observed eye lies at the distance of the pupil of the observer's eye—Case V.; the passage of the "shadow" is progressively slower in higher grades of myopia, also in lower grades of myopia passing through emmetropia and the lower and medium grades of hypermetropia to hypermetropia of high grade.

(*e*) The form of the "shadow" is determined by the form of the image of the source of light. If this is approximately circular the shadow outline will be correspondingly curvilinear, and the shadow will have the form of a crescent. When an Argand burner is used the shadow outline appears as a somewhat ill-defined straight line (see Fig. 4269.)

When the shadow test is made with the concave mirror, the direction of the shadow movement is in every case the opposite of that observed when the plane mirror is used. But with this exception there is no essential change in the reactions. When the observer is stationed at a fixed distance, of say one metre, the concave mirror has the advantage of affording a stronger illumination; when the test is made at a shorter and varying distance, the plane mirror is to be preferred.

The complete theory of the shadow test as applied to the investigation of astigmatism is too complicated to be adequately presented in an elementary paper.

The shadow test is, on the whole, the most exact method which we possess for the objective determination of the refraction of the eye. As compared with the determination of the refraction with the ophthalmoscope by the direct method, it is both more accurate and easier of execution; and this is especially true in the higher grades of myopia, in which measurements made with the ophthalmoscope are always very unsatisfactory. In the measurement of astigmatism it has an advantage over the ophthalmometer of Javal-Schiötz, in that it reveals the total astigmatism of the eye and not merely the corneal asymmetry. On the other hand, the shadow test affords almost no information regarding the condition of the fundus of the eye under examination, and none as regards its acuteness of vision. The true value of the shadow test is therefore as supplementing, not as superseding, other methods of examination.

The technique of the shadow test is comparatively easy to acquire, and it calls for almost no special apparatus; an ophthalmoscope furnished with a concave and a plane mirror and a Rekoss disc, or a clip for holding a correcting glass, and a short tape measure graduated to fractional parts (½, ⅓, ¼, etc.) of a metre, make up the list of essentials. *Carl Koller.*

SHANNONDALE SPRINGS.—Jefferson County, West Virginia.

POST-OFFICE.—Charlestown. Hotel.

ACCESS.—Viâ Baltimore and Ohio or Norfolk and Western Railroad to Charlestown, thence five miles by carriage to springs.

This delightful old summer resort is situated in the bend of the Shenandoah River, at the foot of the Blue Ridge Mountains. Shannondale was formerly one of the most noted of the Virginia watering-places. The large hotel was burned during the war, and no other was built for a number of years. The present hotel has accommodations for upward of one hundred guests. It is pleasantly located and overlooks the Shenandoah River, where excellent boating and fishing may be had. The place is much frequented during the summer by visitors from Washington, Baltimore, Philadelphia, and other localities. It is highly esteemed for its fine scenery and for the beneficial character of the mineral waters. The springs are three in number. An analysis by Dr. Stewart showed the presence of two hundred and forty grains of solid ingredients to the United States gallon. They consisted chiefly of the sulphate and carbonate of calcium and the sulphate of magnesium. There is also a small proportion of the sulphate and the carbonate of iron, and an undetermined quantity of carbonic acid and sulphureted hydrogen gas. The water has laxative, diuretic, and tonic effects. It may be classed as a saline-calcic-chalybeate. There are several bath-houses at the resort. *James K. Crook.*

SHARON SPRINGS.—Schoharie County, New York.

POST-OFFICE.—Sharon Springs. Hotels, boarding-houses, and cottages.

ACCESS.—Viâ Albany and Susquehanna Railroad direct to the springs; also viâ New York Central Railroad to Palatine Bridge, and thence by stage nine miles to springs.

The village of Sharon Springs is situated in a valley about eleven hundred feet above the sea-level; the streets are provided with good sidewalks, and are well shaded with maple-trees. The air is pure and bracing and free from malarial influences. Even in the warmest of summer weather the nights are cool and pleasant for sleeping. The springs are easy of access within the village limits on the edge of a natural forest abounding in pleasant walks. The surrounding country is hilly and affords interesting drives and pleasant scenery. Excellent accommodations, conformable to any taste or grade of expenditure, may be obtained in the village. Sharon is one of the well-established old resorts of New York State, its waters having been used for medicinal purposes since early in the last century. The old bathing buildings were destroyed by fire a few years ago and have been replaced by the present spacious establishment, believed to be unexcelled for its purposes anywhere in the country. There are several valuable springs at Sharon, the most important being the White Sulphur, the Magnesia, and the so-called Eye-water Spring. The waters of the White Sulphur Spring are used both internally and for bathing purposes. The water is clear and bright as it issues from the spring, of an agreeable temperature for drinking (48° F.), and free of the roughness and acerbity which so often characterize sulphur waters. It is conducted to the bath-house and heated to any desired temperature for bathing. This spring yields fourteen hundred or fifteen hundred gallons of water per hour, so that the supply is always fresh and abundant. The Magnesia Spring is also valuable for drinking purposes. The third spring is used extensively as a lotion for inflammatory conditions of the eye, which fact has led to the designation of the Eye-water Spring. A chalybeate spring is also found within the village limits. The following analyses of three of the springs were made a number of years ago:

ONE UNITED STATES GALLON CONTAINS:

Solids.	White Sulphur Spring. (Lawrence Reid.) Grains.	Gardner Magnesia Spring. (J. C. Ayer.) Grains.	Eye-water Spring. (Lawrence Reid.) Grains.
Sodium bicarbonate	.....	0.54	.....
Calcium bicarbonate	.....	9.70	.....
Magnesium bicarbonate	24.00	1.36	32.00
Calcium sulphate	85.40	93.50	77.50
Magnesium sulphate	34.00	19.68	7.50
Sodium chloride	2.70	1.23	2.50
Magnesium chloride		.44	
Calcium chloride	.....	.16	.....
Calcium sulphide	3.00	.63	.....
Magnesium sulphide			
Silica	.....	.40	.....
Total	149.10	127.64	119.50
Gases.	**Cu. in.**	**Cu. in.**	**Cu. in.**
Sulphureted hydrogen	20.50	6.00	.....
Carbonic acid	.....	2.22	.....
Atmospheric air	.....	3.00	.....

The sulphur baths here have a wide reputation in the treatment of gout, rheumatism, and certain forms of paralysis. They are also serviceable in cases in which exudations are to be absorbed, *e.g.*, in old gunshot wounds, stiff joints, glandular enlargements, etc. It is said that many of the consequences of high living, such as congestion of the liver, abdominal plethora, and hemorrhoids, are quite certain to be benefited by a course of the Sharon waters. They are useful also in metallic poisoning and in ridding the system of chronic syphilitic infection, etc. The methods of employing sulphur waters at the well-known French spas, Aix-les-Bains, Challes, and Allevard, were adopted at Sharon Springs in 1884, and have been in successful operation since that time. The sulphur water of Sharon is also used commercially.

James K. Crook.

SHEBOYGAN MINERAL WELL.—Sheboygan County, Wisconsin.

POST-OFFICE.—Sheboygan. Hotels.

ACCESS.—Viâ the Ashland division and also the Fond du Lac division of the Chicago and Northwestern Railroad; also viâ steamers on Lake Michigan. The city of Sheboygan is beautifully located at the entrance of the Sheboygan River into Lake Michigan, at an elevation of about 650 feet above the level of the Atlantic Ocean. The mineral well is located in Fountain Park, and is 1,475 feet in depth. It was bored in 1875, and extends down to the granite bed-rock. Abundant water was discovered, the pressure, as indicated by the gauge, being 52.5 pounds to the square inch, or sufficient to raise a column of water to the height of 115 feet. The well was carefully tubed. The water is pure, bright, and sparkling, and entirely free from all surface contamination. The following analysis was made by Prof. Charles F. Chandler, of New York, in 1876:

One United States gallon contains (solids): Sodium chloride, gr. 306.94; potassium chloride, gr. 14.48; lithium chloride, gr. 0.11; magnesium chloride, gr. 54.91; calcium chloride, gr. 27.82; sodium bromide, gr. 0.19; calcium sulphate, gr. 16.98; calcium bicarbonate, gr. 13.66; iron bicarbonate, gr. 0.59; manganese bicarbonate, gr. 0.17; calcium phosphate, gr. 0.04; alumina, gr. 0.13; silica, gr. 0.47; organic matter, sodium iodide, baryta sulphate, and sodium biborate, traces. Total, 436.49 grains.

This water is seen to be very highly mineralized, and is closely allied to those of Kissingen and Kreutznach, in Germany. It contains, however, in addition to all the mineral constituents of those waters (except the nitrate of soda in Kissingen), traces of sulphate of baryta and biborate of soda, and a small quantity of bicarbonate of manganese. It has practically the same therapeutic properties as those waters, and is applicable to the same conditions. The most pronounced effects are laxative, diuretic, and tonic. It seems to act as a stimulant to the mucous membrane generally, and promotes the secretions. It is highly recommended as a remedy in chronic constipation. It is further applicable to a large class of morbid conditions depending upon a deranged circulation and defective secretion, such as dyspepsia, functional disturbances of the liver, hemorrhoids, anæmia and chlorosis, rheumatism, etc. The water is bottled and sold all over the country. *James K. Crook.*

SHELDON SPRINGS.—Franklin County, Vermont.

POST-OFFICE.—Sheldon. Hotels.

ACCESS.—Viâ Vermont Central Railroad to St. Albans; thence viâ Missisquoi Valley Railroad to Sheldon.

Persons going to Sheldon Spring, one of the group, should buy tickets for Congress Hall Station, eight miles east of St. Albans. These springs are charmingly situated along the banks of the Missisquoi River, at an elevation of about two thousand feet above the sea-level. Within sight are Mount Mansfield and others of the Green Mountains. The springs are four in number—the "Central," within the village; the "Vermont," half a mile from the village; the "Missisquoi," one mile and a half northward; and the "Sheldon," two miles from the village. So far as I have been able to ascertain, the "Sheldon" is the only spring of which the water has been analyzed; and this analysis shows it to be very feebly mineralized. Notwithstanding this fact, the "Sheldon" water has been found to possess a very useful action in uric-acid gravel, gout, and catarrhal states of the bladder. The waters of the Missisquoi Spring are found on the market. *James K. Crook.*

SHOCK. (SURGICAL.)—Shock may be defined as a condition of general vital depression or a state of general exhaustion of the nervous system coupled with a dilatation of the peripheral arterioles and a loss of the normal blood pressure.

Shock may be the result of an accidental injury, an operation, a profound emotion, or an overpowering fear. It is a condition in which the motor, sensory, and sympathetic nervous systems as well as the cerebral cortex are profoundly affected, and their action, for the time being at least, more or less arrested or destroyed.

Shock the result of an injury, an emotion, or of fear, follows very closely upon the action of its cause. When the result of an operation it may become manifest during any of its stages or only at its close. Shock may make its appearance suddenly, or it may come on gradually and be slowly progressive in character.

SYMPTOMS.—The symptoms of shock will depend upon its severity. There may be as the result of some trivial injury a slight faintness, a pallor of the face, and a feeling of nausea which pass off in a moment, or the traumatism may be so severe and so sudden that the heart's action is arrested and the patient succumbs at once. In a well-developed case of shock the patient's sensibilities are lessened and his mental faculties held more or less in abeyance. The pulse will be quickened, feeble, thready, and perhaps irregular. The respirations are increased in frequency, labored, and often irregular. The face and visible mucous membranes are pale, the eyes sunken and listless. The face, hands, and often the entire body are bedewed with a cold, clammy perspiration. The patient is usually torpid and indifferent to his surroundings, the mental faculties are depressed, and occasionally there is complete unconsciousness. The tone of the muscular system is so lessened that it is capable of only feeble contraction, the patient manifesting little disposition to move hand or foot. The sphincter muscles are at times completely relaxed. The temperature of the body may be reduced one, two, or even three degrees. Nausea and vomiting occur in many cases. In the so-called erethistic form the patients are excitable, restless, often incoherent, and even delirious.

DIAGNOSIS.—Shock must be differentiated from fat embolism, from hemorrhage, and from the effects of ether or chloroform. With each or all of these it may, however, be associated. Fat embolism most frequently occurs in injuries to the skeleton, and makes its appearance as a rule about thirty-six to seventy-two hours after the injury, while shock occurs at once. In fat embolism there are restlessness, anxiety, dyspnœa, accelerated respiration, and a quickened heart action with fat globules upon the surface of the urine. Hemorrhage is very frequently an associated factor with shock and aggravates the latter condition, but the two may be, and often are, entirely separate. Shock presupposes an injury. A patient may die from hemorrhage without suffering in any degree whatsoever from shock, while, on the other hand, a patient may receive a blow on the epigastrium, upon the head, or have his limbs crushed off and suffer the loss of scarcely a drop of blood and still die almost instantly or within a few hours from shock. Loss of blood when external is readily to be seen. When it occurs within closed cavities, as the abdomen, thorax, or skull, it will have to be diagnosed by the symptoms produced. These will be accompanied by those characteristic of the sudden or more or less gradual loss of blood. The symptoms of hemorrhage are not always those which are most typical of shock, in that in the former there is more of restlessness and nervous excitement, more acuteness of intellect, far greater pallor of the skin and visible mucous membranes, greater dilatation of the pupils and alæ nasi, and often a decided rise in temperature. There will also be a lowering of the hæmoglobin. It will be impossible, at least as a rule, to separate the effects of chloroform and ether from those of shock. Either of these substances when given incautiously or to excess interferes with respiration, lowers blood pressure, and materially aggravates the condition of shock.

PROGNOSIS.—This will depend upon the degree of shock, upon the organ or organs injured, and also upon the presence or absence of sources of irritation which will maintain or aggravate the existing condition. The prognosis will also depend very largely upon the treatment. It may be said that if shock be not immediately fatal, if the traumatism has not produced irreparable injury to vital organs or exhausted the vaso-motor nervous system, and the conditions are such that shock is not constantly added to, the prognosis will be good. The injury may be to the brain, heart, or some other organ of vital importance, and be of such a character or produce such an exhaustion of the nervous system that recovery is an impossibility.

Reaction from Shock.—With proper treatment and under ordinary conditions reaction will become manifest in a few hours. The patient then becomes restless and changes his position. The cold perspiration disappears, slight color comes to the lips and cheeks, the eyes seem less sunken and the face less pinched. The pulse gains in volume and loses something in its frequency, the respiration is deeper, more regular, and less frequent. The patient now seems to realize his injuries. He is less drowsy and perhaps asks questions concerning his condition. This state may progress uniformly until the temperature has reached a point above normal, when the pulse becomes full and strong, a flush comes to the cheeks, restlessness is increased, and reaction is fully established. If the injury has been such that the irritation is maintained for a time reaction may be delayed or prevented, or the condition may oscillate between reaction with improvement and an aggravation of the condition or shock.

The Pathology of Shock; the Mechanism of Blood Pressure.—The condition of vital depression known as shock seems inseparably connected with three pronounced conditions. One of these, and perhaps the most important, is the decrease of blood pressure, the second is the loss of muscular force, and the third a lessening of the mental phenomena of the patient, including the intellectual, emotional, and volitional. For the proper circulation of the blood, a condition which is essential in the maintenance of the functions and health of the individual, a certain degree of blood pressure must be maintained. If this fall to any considerable degree the capillary lake and venous system are flushed, the pulse becomes weak and thready, the arterial system is depleted, the venous system congested, and the functions of the body disturbed or even arrested. The blood pressure is maintained in part by the vaso-motor system of nerves whose centre is in the gray matter of the floor of the fourth ventricle. There are also certain subsidiary centres in the spinal cord. In health these nerves acting upon the muscular tissue in the walls of the blood-vessels and especially upon that in the arterioles, maintains an equable and constant tonic contraction, in consequence of which the heart is able to maintain the blood pressure throughout the general arterial system at a certain definite standard. A stimulus imparted to the vaso-motor system, either directly through the splanchnic area or indirectly through a sensory nerve, increases the action of the vaso-motor system, the contraction of the peripheral arterioles, and augments the blood pressure. If this stimulus is continued for an indefinite period or is excessive in character, then and in that case the vaso-motor system becomes exhausted, the peripheral arterioles dilate, and the blood pressure is lowered. There are three factors, however, which are responsible for the maintenance of a normal blood pressure. One of these is the forceful rhythmic action of the heart, another a suitable quantity of fluid in the vascular system, and a third a proper tonic contraction of the peripheral arterioles. If any one of these three conditions is disturbed the blood pressure will be effected. A diminution in the force, with an increased frequency of the heart's action, a lessening in the amount of circulating fluid within the vessels or a dilatation of the arterioles, each and all will lessen the blood pressure. That the blood pressure is very markedly lessened in cases of serious shock is the testimony of all observers.

The mechanism of the lessening of blood pressure in shock is the following: An injury to a peripheral sensitive nerve, if of mild degree, acts as a stimulus which is conveyed to the brain and transmitted reflexly to the bulb in the floor of the fourth ventricle, the centre for the vaso-motor nerves. Acting upon this centre this impulse is transmitted through the vaso-motor system, producing contraction of the arterioles and consequently increasing the blood pressure. After the abdomen has been opened slight handling of the intestines or stomach causes, in consequence of the stimulus being applied directly to the splanchnic area, a rise in blood pressure. If the stimulus be excessive or often repeated the vaso-motor centre becomes partially or totally exhausted, the peripheral arterioles dilate, and a great lessening in the blood pressure occurs. That a severe traumatism, whether it be peripheral, intraabdominal, intrathoracic, or intracranial, exhausts or paralyzes the vaso-motor system of nerves, is well established by experimental research.

By kymographic and sphygmographic tracings it has been shown in every case of long-continued operation and in cases of severe injury that there is a lessening of the blood pressure. This is due, in operations or injuries without the loss of blood, to the exhaustion of the vaso-motor system and a loss of tone in the heart's muscular contractions. In cases in which there has been hemorrhage it is also due to the diminution of the volume of fluid in the vascular system. It is well to inquire if in shock there is not something more than a weakened heart's action, a lessening of the peripheral resistance by the dilatation of the arterioles, and consequently a lowering in the blood pressure. In every case of severe shock there is a decided lessening or weakening of the mental phenomena. The intellect is inactive, the emotions are suppressed, and volition is at a standstill. There is also a muscular powerlessness. The patient is not only unable to exert his mind, but his muscles have also gone out of action. In severe shock there has been such an injury or stimulus to the nerves as practically to put out of action the mental faculties, the motor and sensory nerves, and the sympathetic system. It seems to me that this condition is

scarcely due in its entirety to the loss of blood pressure, but that the same crushing force which overstimulated the vaso-motor centres and produced their practical paralysis has overstimulated the cortex of the brain, suspending in a large measure the action of the intellect, the force of the will, the play of the emotions, and the function of the motor nerves. It is often stated, following the teaching of Goltz, that patients dying of shock bleed to death in their own veins. This is supposed to occur in the splanchnic areas, but the condition is simply one of vaso-motor paralysis in which the peripheral vessels have lost their tone, and in consequence of which the blood rushes through the arterioles into the capillary lake and venous channels. While this condition perhaps occurs with greater force in the abdominal region than elsewhere, it

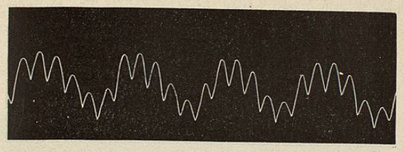

FIG. 4270.

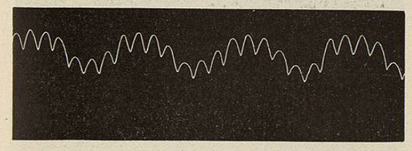

FIG. 4271.

does occur wherever there are arterioles and vaso-motor nerves which may be acted upon by overstimulation.

Prophylaxis.—In the prevention of shock one must place his patient, both physically and mentally, in the best possible condition. Just before the administration of the anæsthetic, gr. $\frac{1}{100}$ of strychine with gr. $\frac{1}{4}$ or gr. $\frac{1}{2}$ of morphine may be given hypodermically with decided advantage, as both assist in supporting the heart's action and in maintaining the blood pressure, while the latter lessens to some degree the amount of anæsthetic required. In the choice of an anæsthetic if there is fear of shock, or if it be already present, ether should be administered, in preference to chloroform, as chloroform lessens very decidedly the blood pressure and favors the production of shock.

Fig. 4270 represents a kymographic tracing from the femoral artery of a dog while under the influence of ether, the dog having undergone a resection of a portion of the intestines and a gastro-enterostomy. The blood pressure had fallen at this time from 14.1 cm. to 13.2 cm. Upon substituting chloroform for ether for three and one-half minutes the pressure fell to 11.8 cm. as represented in Fig. 4271. In another experiment the blood pressure under ether stood at 14 cm. After a change had been made to chloroform it fell in one-fourth of a minute 0.2 cm.; in one minute and a half it had fallen 0.4 cm., and in two minutes 0.5 cm. Upon going back to ether the blood pressure lost was quickly regained. It has been the writer's experience that the use of chloroform will reduce the blood pressure present under ether anæsthesia 0.5, 1, or even 1.5 cm. It would seem reasonable, then, that where shock is present or is to be feared, and consequently where blood pressure is low, chloroform should not be used. The heat of the body should also be as far as possible preserved; consequently the temperature of the room, at the time of the operation, and the covering of the patient are matters of importance. The water used in the immediate preparations for the operation should be of such temperature as to abstract nothing of heat from the patient. Evaporating liquids, such as alcohol, must be used with care, and the towels about the field of operation and the sponges should be dry.

In the prevention of shock during an operation or following an accident it is of the greatest importance to limit the loss of blood to the least possible amount, as the blood pressure depends as much upon the amount of fluid within the vessels as it does upon the contraction of the peripheral arterioles or the action of the heart. The loss of only a small amount of blood will lessen at once the pressure. It is also essential, in order to limit the amount of anæsthetic used and the exposure of the patient, that the operation be done as quickly as is compatible with the performance of good surgical work. Cocainizing the main branches of the peripheral nerves before division has been recommended by Crile and Harvey Cushing for the purpose of blocking these nerves and preventing stimulating impulses being carried to the brain. The few experiments of this character which I have undertaken have seemed to show that the cocainization of a nerve causes about as much stimulation of the vaso-motor centres as would its section. It is a fact which may be easily established that the handling, stretching, manipulating, or cocainization of a sensitive nerve will, in consequence of the irritation, at once raise the blood pressure. The same is also true of the section of such a nerve. Of course, this rise is followed by a subsequent fall. It is only a question as to which is the greater evil. When a patient is under the influence of an anæsthetic, it would seem as though all of his sensitive nerves were in a sense blocked, and that not much more could be accomplished by their cocainization.

Fig. 4273 represents Dudgeon's sphygmograph which the writer has been using before, during, and after operations and before and after the administration of certain drugs which are ordinarily used in the treatment of shock. This instrument, while perhaps open to objections, is nevertheless of great value, when carefully used, in determining the height and character of the wave, which conditions correspond reasonably with blood pressure. During the past few months, for the purpose of more accurately testing the blood pressure and its relationship to shock, I have been experimenting with Ludwig's kymograph, represented in Figs. 4273 and 4274. Twenty-two dogs were used for this purpose,

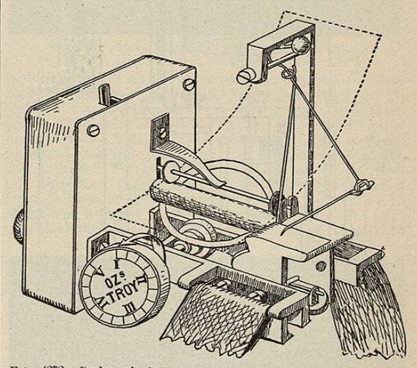

FIG. 4272.—Dudgeon's Sphygmograph. The dotted outline represents the piece of blackened paper on which the sphygmogram is written.

the tube of the manometer being in the majority of cases inserted into the femoral artery, in three in the external iliac, and in a few in the common carotid. The dogs were maintained under full surgical anæsthesia by ether,