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Compliments of the Author.

A NORMAL PULSE IN THE VEINS.

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The phenomenon of a palpable venous pulse in certain cases of obstruction about the heart and lungs, and also in cases of anæmia, has long since been noted and recorded. Walshe and Freiderich assert, while commonly attributing manifest blood movements within the veins to a process of retardation of the blood current in the pulmonary artery, that they have observed pulsation in veins under other circumstances, and even in cases in which the tricuspid valves appeared to be sound and healthy. Similar statements have been affirmed by such well-known authorities as Geigel, Seigel, Senac, and Kreiseg. Whether the clear characters of a normal pulse can be detected and demonstrated remains, however, a question for future investigators to determine.

This interesting inquiry has long excited research, but every attempt hitherto made to discern and render apparent this undemonstrative stream has proved of no avail, and physiologists seemed hopelessly driven to hypotheses to explain its obscure manner and cause.

If the *vis a tergo* derived from the great central organ, whose force is estimated by pounds, propelling a circulation whose velocity can be computed only by seconds, was deemed by any insufficient to propel the blood from the left ventricle quite beyond the ultimate ramifications of the capillary system and back again, *coup sur coup*, the necessity of a theory became apparent by which to explain the mode and manner in which the vital stream was urged along its ceaseless circuit during life.

The velocity of the blood current in veins must be undoubt-

edly greater than that within the circumferential network of the capillaries. A steady and uniform accretion of speed about this stream has been proved by Donders and other observers to be going on *pari passu* with approach to the heart, like Virgil's rumor *acquiret vires in eundo*, since the capacity of the vessels into which so many united forces empty are declining in accommodation with every advance, and above all the important item of friction is being momentarily diminished.

Valentin has found by carefully-conducted experiments upon dogs with a hæmadynamometer that the pressure of the blood backward to the head bore a comparison in the veins of one-eleventh or one-twelfth in force to that in the carotids; a statement subsequently confirmed by the remarkable researches of Niogk upon other arteries and their corresponding veins.

The heart has been naturally regarded by many physiologists as the sole agent in the circulation of the blood, though many have contended that the blood vessels were the principal and the heart but a subordinate power in the maintenance of this current. Even so recent a prelector as Guthrie has expressly declared that "the heart exerts but a trifling degree of influence upon the circulation of the blood."

A few modern physiologists have contended that the capillaries were efficient promoters of this centripetal stream; an opinion, however, very ably disputed by Allen Thompson, who asserted that the power which operated upon the blood in the capillaries was capable only of modifying distribution and not of contributing to its progressive motion.

Todd and his followers believed in the active agency of the large vessels in the conduct of the circulation by some inherent property of rhythmical contraction and dilatation. This latter view was effectively supported by Wharton Jones, and meanwhile Donders promulgated his theory of adequate power about the expiratory movements in the performance of this vital act.

The hypothesis of heart sufficiency to carry on the entire circulation seemed vastly strengthened by the discovery of valves within veins. Such an endowment, it was thought, could be necessary only to prevent refluxion or statical resistance of the onward column of the blood at each returning heart effort.

Sir David Barry's theory which accorded a *vis a fronte* through suction process at the heart appeared refuted in great measure by convincing proofs afforded of a weak anatomical structure of the right auricle.

The illustrious Bell taught that pulsation could not take place in the veins, because the mechanical power of the heart's action, together with contraction of the arteries, seemed wholly insufficient, alternating with each other, to do more than keep up a steady and perpetual stream into the veins, and above all because these vessels were so far removed from the chief motive power by the intervention of the capillary system.

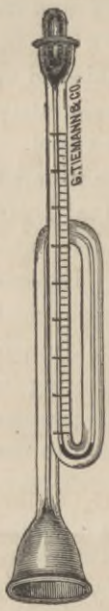
It was with a view to determine this question that Magendie instituted his experiment of isolating a large artery and its proximal vein in the limb of an animal, the latter of which he then opened. He found that when the artery was subjected to pressure, the flow of the blood was interrupted commensurately with the degree of force employed on the trunk of the vessel.

In this connection the reasons should ever be borne in mind which have been assigned as favoring the theory, that heart force is felt throughout the entire circulation, and renders most material aid in returning the blood again to the heart. Experiments have proved that in an animal recently killed mechanical circulation can be kept up for such time as tonic contraction about the vascular system can be delayed. That according to the noted experiments of Hales and Wedemeyer, the passage through vessels of fluid was rendered easy in proportion to the stimulative character of the fluid employed; that in criminals dead for some time, if their bodies be steeped in tepid water and the veins cleansed of all blood by injections of warm water, an artificial pulse can be produced and sustained by a small force of a few pounds maintained at the region of the heart; that when the heart's action is controlled, the flow from a wounded vein is modified, sometimes quite arrested. Finally it is a familiar fact, that in some states of the circulation, particularly in aneurismal varix, the phenomenon of a venous pulse is visible even to the unaided sense.

The rational inference therefore that there existed a normal pulse within the veins, the result of heart energy, has sustained

me through many patient and assiduous efforts to detect and reveal its character and force, however infinitesimal it may prove to be in quantity and quality.

Though absolutely and forever indiscernible, even by means of the most exquisite tactile skill, there yet appears to be an extremely delicate feature about the movements of the blood within veins capable of being brought quite plainly into view by such a manometer only as the hæmarumascope. This original instrument, together with its mode of application, having already been so elaborately described,* the subjoined illustration, on a reduced scale, is here offered to convey an idea of its delicacy and simplicity.



"A series of experiments recently undertaken by me with the ordinary modern appliances, in order to determine, if possible, certain physiological points appertaining to the circulation of the blood, could not fail to impress a desire to have at command some more ready and sensitive instrument by which the various minute and delicate qualities and quantities about this latent current could be detected and analyzed.

Peculiarities had been always supposed to exist in this element of nice grade and character, important to be noticed and estimated, yet destined apparently forever to elude tactual skill and even defy discovery by means of any instrument of precision hitherto devised.

The instrument here prefigured was found after many patient trials to aid in refined investigations. Exquisitely sensitive to any impression, however delicate, received from either artery or vein, it may be intended to explore, matters of vast interest and importance relating to the physiology of the circulation appear revealed by it for leisurely study.

The hæmarumascope consists of a glass tube of fine calibre, free at both extremities, and bent symmetrically upon itself. This configuration has been selected with a view to abridge

* The American Journal of the Medical Sciences, July, 1877.

dimensions, and at the same time to secure, when adjusted, a sufficient column of entrapped air to utilize as a highly sensitive and elastic spring. One extremity is expanded in bell-shape to facilitate accurate coäptation over the trunk of a superficial vessel, to exclude more effectually all external air during process of observation, and to avoid loss of force or volume through impact against upright sides or angles.

Care having been taken to dispense with the interposition of artificial membrane over the vessel, by which the true qualities of a pulse-beat might be vitiated and exaggerated, the instrument here offered I believe to be especially qualified to receive and faithfully impart a full and veracious representation, by means of its contained register, of any pulse characters about to be critically examined.

It has been found important also that the diameter of the tube should bear a certain relative proportion to the diameter at the base, in order to render it highly impressionable to every pulse feature which may transpire beneath, when applied for scientific exploration.

The shaft of the tube will be found carefully graduated into centimetres to facilitate quick estimation of the features to be noted.

In order to prepare the hæmarumascope for an observation, a fraction of a drop of filtered solution of rose aniline in alcohol with some essential spirit must be introduced. The essential spirit is thus employed in combination with a view to its quality to diminish friction within the bore of the tube.

The introduction of this sensitive solution into the calibre of the instrument must be effected with such skill as to insure unbroken solution of continuity in the column of fluid. When so accomplished, the two extremities of the tube being left free, the fluid naturally gravitates to the most depending portion, which is just immediately at the lower bend of the instrument when held in readiness to be applied.

Should the column of fluid, however, at any time become disunited within the shaft of the instrument by accidental admission of air, reconsolidation can be again readily effected by holding the instrument upright and by means of firm and steady

pressure of its larger extremity upon the palmar surface of the hand, force the entire volume of the fluid upward to the smaller extremity. By this simple manœuvre all air bubbles can be expelled, and the return secured of a united column of fluid back to its proper place, ready again for an observation.

When this instrument is made to rest firmly and steadily upon the trunk of a superficial vein of sufficient dimensions, the peculiar movement of the stream of blood beneath the bowl of the instrument sets the sensitive fluid column within the tube into sympathetic motion, clearly demonstrating that the blood within the vein receives the shock and experiences augmentation of contents nearly isochronous with the arterial throb.

The introduction, therefore, of so extremely sensitive a manometer can not fail to extend the field of physiological research, assist in detecting any deviation from a healthy standard in which the circulation is primarily at fault, facilitate distinction between sthenic and asthenic forms of disease, afford early indications for withholding or administering stimulants, aid in the study of the various idiosyncrasies which present so many obscure problems for investigations, and finally lead the way to clearer therapeutical conclusions."

No movement, however trifling and obscure in character, which may transpire beneath the calibre of its shaft can possibly escape detection through this sensitive means. The hæmarumascope will therefore be found competent to exhibit the venous pulse and afford a just idea of its rate, force, volume and irregularity, if any, appertaining to vein tracts and their manner of transmitting blood. By its skillful use correct estimates can be formed of every deviation from an admitted standard, and thus enhance and extend the science of physical diagnosis.

During the acts of inspiration and expiration by a subject pending adjustment of this instrument over a conspicuous vein, the noted experiments upon the circulation of Sir David Barry, of Poiseville, and Volkmann, appear repeated in an original and striking manner.

The doubt not unseldom arises whether certain conditions originated from arterial or venous sources, and when this point

is uncertain, resort may be had to the aid which this little instrument affords.

As with all critical observations upon the circulation of the blood, the venous current should never be examined while the patient is under the influence of sudden emotional shock or cardiac excitement, nor indeed during a state of bodily fatigue from muscular exertion; but when it is desirable to obtain simply a palpable vein pulse, the patient should be fortified with either a stimulant or a solid meal.

The hæmarumascope is therefore again commended, with an assurance that no other manoscope yet invented to render help in the investigation of obscure cases can compare with it in compendiousness, simplicity of construction, sensitiveness, readiness of application, or cheapness of cost.