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A MODIFICATION OF THE SPHYGMOGRAPH, BEING A CHANGE IN THE BASE OF THE INSTRUMENT OF POND.*

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The object of this paper is to introduce to the members of this society for their consideration a modification of the sphygmograph which is in common use in this country—the instrument of Pond—whereby it may be rendered still more practical, and hence more frequently resorted to by the profession. This is neither the time nor place to dwell upon the merits of the various instruments that have been devised, nor to discuss the mechanical and physiological questions which involve a correct appreciation of the action of the sphygmograph. A knowledge on your part of these questions will be taken for granted by the writer. In addition to asking your attention to the advantages of the modified base, a few moments will be taken up with discussing questions appertaining to the practical application of the instrument.

The sphygmograph, it will be admitted, has not become one of the indispensable articles of a physician's armamentarium, as its promoters and admirers had hoped for. This is readily understood, and depends upon many causes. But the chief of these causes is undoubtedly the length of time required to secure a proper tracing. Again, different instruments record varying tracings, and hence there is a lack of uniformity, making comparative study of your own with the work of others almost impossible. The lax rules about regulating pressure have been so confusing that the operator would scarcely be able to select the proper tracing from the many that could be secured by varying degrees of pressure. Had we an instrument by the use of which these obstacles would be reduced to a minimum, undoubtedly sphygmography would grow in favor, and assume

its proper relation in the diagnosis and prognosis of disease. It is confidently believed that the element of time at least will be reduced to the position of a negative opponent, by the proposed change in the instrument, while for accuracy its value will be enhanced.

The sphygmograph of Pond is generally conceded, in this country, to be the most readily applied. Simple in construction and mechanism, tracings can be secured by it more rapidly and with less discomfort to the patient, than with any instrument familiar to the writer. He has used the unmodified instrument several years, but often found bitter disappointment attend its use. The writer suggested to his former student and friend, Dr. H. N. Mateer, now of Wooster, Ohio, to pursue investigations with this instrument, for the purpose of incorporation in a thesis presented for the degree of M. D.* He, too, was often chagrined at meeting defeat in his designs. By careful study and great patience, he devised the changes which are presented to you to-day. To his genius are we indebted for the improvement, and to his generosity the writer is indebted for the pleasure of introducing it to you, for which he makes grateful acknowledgments.

The essential portion of a sphygmograph, in considering its merits, is that which is applied to the vessel, viz.: the base. It should be so made as to closely hug the artery, without exercising such undue pressure as would modify its calibre, in order that the arterial and blood wave should be properly transmitted to the indicator. A study of the anatomical relations of the radial artery, at its most accessible point, will show at once the character of base required. This point is where

* Read before the Medical Society of the State of Pennsylvania at its meeting in Philadelphia, 1884.

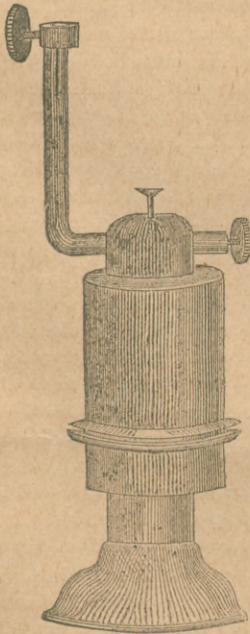
* For this thesis a prize of \$50 was secured by Dr. M. from the University of Pennsylvania.

the artery rests on the bone, between the styloid process of the radius and the radial flexors of the carpus. The distance from the process to the flexor is one-fourth to three-eighths of an inch, in many cases even less. As the artery is on a lower plane than the upper level of these firm structures, it will be seen, and so Dr. Mateer reasoned, that the base or portion to be adjusted to the artery must be three-eighths of an inch, or even less, in width. The base of the Pond instrument is five-eighths inches wide, and it is, therefore, both in theory and in practice impossible to take tracings in very many instances with it.

It is true that in those cases in which the artery is superficial or the tissues are relaxed, admirable tracings can be secured with the old base—true, too, that tracings can be secured from any wrist; but it is held that they are secured with such high pressure that accuracy is sacrificed, or they are not intelligible. The base of the Pond machine was made for general work—to write tracings of the larger vessels, the heart, and aneurisms, etc.—but in so doing, the special work of writing tracings of the radial was sacrificed.

The wood cuts* illustrate the differences in the bases, No. 1 representing the old, No. 2 the new base.

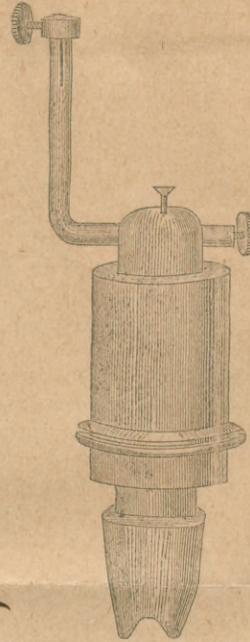
FIG. 1.



*The drawings which illustrate this paper were made by Dr. J. M. Taylor, of this city, to whom the writer is indebted.

A further description is necessary.* It is made of brass-metal, and is firmly attached to the cylin

FIG. 2.

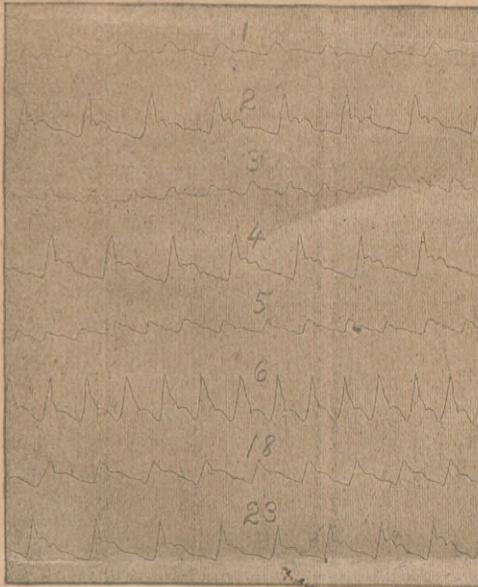


der of the instrument, yet it is readily removed. It is $\frac{3}{8}$ in. long, or $\frac{1}{2}$ in. longer than the old base, and tapers towards the distal end. This end is round, $\frac{3}{8}$ in. in diameter, grooved to the depth of $\frac{1}{8}$ inch. This groove was made by Dr. Mateer, so that it could be more closely applied to the vessel, with the least possible pressure. The advantage of fixation of the vessel by the groove is also gained, so that the tracing is made more regular. The increase in length of the base necessitated a corresponding increase in the length of the central transmitting rod, while the diminution of its size rendered a proportionate lessening of the diameter of the flat disk attached to the distal end of the rod. Instead of the usual rubber cap, a small rubber band (size No. 8 of Faber) is made to stretch across the aperture of the base parallel to the groove. As noted above, the base can be removed at will, and the old base reapplied, for the purpose of taking those tracings for which it is fitted.

It is claimed for the modification, greater ease and rapidity of application of the instrument, and greater uniformity and clearness in the tracings.

*The new base and attachments are made by Gemrig, of Philadelphia.

In order to more fully substantiate these claims the following illustrations of tracings, both by the old and the modified instruments, are presented:



Tracings 1 and 2, 3 and 4, 5 and 6, 18 and 23, were taken from the same individuals respectively. The persons from whom the tracings were secured were all under medical care, with symptoms of deranged circulation, save in the instance of Nos. 18 and 23. In order to correctly appreciate the tracings, one should have a distinct idea of a true tracing. By a true tracing is meant one that graphically represents the action of vessel and contents, whether it (the tracing) be normal or abnormal.

The writer can substantiate the statement of Dr. Mateer, who says a normal tracing, as taken by the Pond instrument, should consist of an upstroke, departing 10° to 15° from a perpendicular, an acute apex, and a descent at an angle of about 45° ; the descent is marked by two secondary waves of almost equal size, and the general trend of the descent is a slightly curved line, with its convexity downwards. Comparing the tracing so delineated (No. 23) with tracings by a Marey sphygmograph, one sees as much contrast as in a comparison between the "old and new base" tracings. This difference is worthy of explanation just here, in order to facilitate comparative study of tracings taken in similar forms of disease. The two forms of sphygmograph above

mentioned represented two classes of instruments, and their work may therefore be compared. The lever, which is moved by the pulse, is restrained by a spring, and follows closely the movements of the vessel in the "Marey." The intervening rubber membrane follows the subsiding vessel in the "Pond," leaving the recording needle free to the influence of inertia. On account of this inertia, a greater height is given to the tracing, and the secondary waves are more distinctly brought out. As shown by Mateer, this same inertia causes the acute apex in the "Pond" tracing, the obtuse in the "Marey." Any one comparing tracings of these instruments, will see the uniformity of tracing and the distinctness of outline of the former as compared with those of the latter. It is, indeed, rather marvellous to be able to read correctly the ill-defined and irregular tracing of the Marey machine.

In conclusion, it seems not unbecoming to speak of the methods of ready use of the sphygmograph, and first regarding the wrist rest. Office work often will not permit one to delay long in arranging position, etc., and the writer has found that as good tracings can be secured without resort to this delay, and especially the discomfort of the patient, without the special rest as with it. As to pressure, its importance seems to be exaggerated. With Mateer, the writer studied it carefully, and we found the following formula a safe guide, one much more arbitrary than is generally given. Always apply that amount of pressure which yields the greatest amplitude to the tracing. The gauge adjusted to Pond's instrument is absurd, for it measures the pressure of the entire instrument *on the wrist*, enormous often with the old base. Then the gauge should be adjusted to the central part, which is raised by the artery. Even then its utility is doubtful. Graduated pressure is used to secure the same amplitude to a tracing—say one-half inch. The difference in pressure necessary to accomplish this in a hard and soft pulse would be equaled or surpassed by the varying resistance of the tissues surrounding the vessel.

The rate of speed of the slide is of practical moment. It should be such that the length of the tracing, horizontally, will be equal to its height, thus permitting the fullest development of all its elements. A tracing taken with the proper care, indicated by this instrument, is very legible and easy of interpretation.

A word may be said as to the value of sphygmography. As clinical studies are not within the province of this paper, they will not be detailed;

Tracing

the conclusions which can be drawn from considerable experience will not be out of place, however. Briefly, they are to the effect that in the diagnosis and especially the prognosis of various diseases, it is of extreme value. Especially is this true in the settlement of mooted questions connected with high tension, and the high tension diathesis, and with heart disease in its various forms, particularly in the estimation of cardiac power. In the prognosis of fevers, the sphygmograph is also of value. But withal, this only can be said that its value is great to the individual operator alone. In securing tracings, which can only be done properly after long practice, the personal equation is a most important factor. One can learn his power and know of what value his own control of the instrument is to the result of a

proper ~~treatment~~, which he can utilize in his judgment of the meaning of it. To another this is unknown, hence they can not interpret tracings taken by others. Therefore, the writer believes that to the operator who forms judgments of a case, its power is invaluable and increases with his experience; while, save in the conclusions, the general profession can profit but little.

In conclusion, the writer ventures to express the conviction that the modification of Dr. Mateer will be of inestimable service in popularizing this valuable instrument. He feels that the judgment of the profession will be that the claims which have been presented for it are not too extravagant, and that sphygmography is materially promoted by the addition.

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