*Observations with the Sphygmograph on Asylum Patients.**

By T. Duncan Greenlees, M.B.Edin., Assistant Medical Officer, The Counties Asylum, Carlisle.

It has been said by some astute critic that "insanity has no pathology," but it would be a nearer approach to scientific truth if he had said that, with our present imperfect means of investigation, there are many cases of insanity in which no pathological changes can be discovered as the cause of the mental phenomena. The microscope, for example, has as yet failed to differentiate the delicate alterations in the protoplasm of the cerebral cells which result in an outburst of maniacal excitement; nevertheless, the ophthalmoscope shows changes in the vascular supply of the brain in many such cases, and, with the aid of the sphygmograph, light has been thrown on many hitherto obscure conditions of the circulation.

In making the following investigations I used Dudgeon's sphygmograph, owing to the ease with which it can be adjusted to the artery of even an extremely excited or restless patient, and, from an extensive experience of its use, I have no reason to doubt the accuracy of the results obtained, the larger and more cumbrous instruments being quite unsuited for such cases. As the tracing in the same individual varies according to the pressure gauge used, I have noted in every case that amount of pressure which is necessary to produce the most characteristic tracing; and, as the condition of the circulation is affected by many extraneous influences, I have endeavoured, by taking several tracings from the same patient at different times and under different circumstances, to obtain as near an approach to the characteristic tracing of the case as possible. By excluding, unless where specially mentioned, cases in which cardiac or other physical diseases exist, I have eliminated many sources of fallacy which might otherwise have interfered with the scientific accuracy of my results.

In a systematic examination of the pulse of the insane, it is necessary that insanity be recognized as a protean condition consisting of several clinical diseases, each, it may be, presenting different pathological lesions. Following this plan, I have taken sphygmographic tracings from patients exhibiting in a marked degree the clinical features of each disease.

1. *Mania.*—In this disease, especially when we consider the

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more acute forms, the face is usually flushed, the pulse quick, and, according to Griesinger,* full, but at the same time small, and the heart-sounds are generally indistinct. Several observers state that the pulse-tracing in mania bears a strong resemblance to that found in fever or acute disease. In *acute mania* the line of ascent is nearly always perpendicular, the apex sharp, and the descent line short, and presenting a fairly prominent dicrotic wave; but I have not succeeded in obtaining the dicrotism so common in, and so characteristic of, acute febrile conditions of the system. The characters of the pulse of a case of acute mania are shown in Fig. 1, which was obtained from a young girl on admission, who, for eight days previously, had been labouring under what is somewhat vaguely termed "uterine or ovarian insanity," but in whom no active physical disease existed on examination; she was acutely excited, noisy, sleepless, and incoherent. The pulse was full and bounding, but could be easily compressed. In another female with the symptoms of acute mania, the result of alcoholic excesses, the line of ascent was slanted, and dicrotism not even so well marked as in Fig. 1; indeed, the tracing presented characters similar to those described by Wolff as the *pulsus tardus*, said to belong only to incurable cases of insanity; the prognosis in this patient was unfavourable, but as she was shortly afterwards transferred to another asylum her subsequent history has been lost. Patients who are acutely excited, and have grandiose delusions, but in whom none of the physical symptoms of paresis exist, I have grouped under this class of acute mania, and Fig. 2 illustrates the character of the pulse in many such cases; the arterial tension is low, and dicrotism is not so marked as in other cases. In the cases of acute mania examined, it would seem that in the majority the cardiac systole is sudden and sharp, and the *vis a tergo* feeble; the sudden ventricular contraction produces a high ascent line, and as the systemic arteries are rapidly emptied, the summit of the tracing forms an acute angle, and the descent line is short, and occasionally interrupted by a dicrotic wave.

The sphygmogram is by no means characteristic in *chronic mania*. When there is a constant condition of more or less congestion of the nerve centres, producing altered psychical phenomena, it is not unreasonable to suppose that in time the circulation accommodates itself, hence the tracing presents little or no deviation from the normal; the high upstroke of acute cases disappears, and although the summit is, as a rule,

* "Handbook of Insanity," p. 288.

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formed by an acute angle, the line of descent is more prolonged than in acute mania, and is interrupted by several secondary wavelets.

2. *Melancholia.*—The circulation is torpid and the heart's action feeble in many cases of melancholia, and in some livid and swollen extremities frequently occur, while in others a marked tendency to chilblains exists. The pulse, unless in acutely melancholic patients, where it is more rapid than normal, is slow and easily compressed, and the sphygmographic tracing in the larger number indicates a weak and feeble cardiac systole, and an imperfect filling of the vessels. The upstroke is short and slanting, and the descent line prolonged considerably, the secondary wavelets being either indistinct and unrecognizable or not marked at all. Fig. 4 is a characteristic tracing from a case of acute melancholia. The patient was a female, who, after her first confinement, became extremely dull, and refused her food. The pressure used to produce the tracing was only 1oz.; a greater pressure destroying the pulse altogether. As she improved in her mental and physical condition, the cardiac systole became stronger, and the pulse fuller and more sustained, and the tracing indicated a slight amount of arterial tension.

In those cases of melancholia associated with stupor or hebetude to a marked degree, the bodily health being good, I found in the pulse tracing arterial tension common; in some the apex is prolonged to form a "plateau." In one case (see Fig. 6) this indication of arterial tenseness disappeared entirely after a stimulant or full meal.

Certain cases of melancholia exist in which there is some derangement of the liver, associated with a sallow or even jaundiced condition of the skin; the pulse is weak and easily compressed; the tracing of such a case is depicted in Fig. 7; the line of ascent is low—as compared with a normal tracing; the apex forms a sharp angle, and arterial tension is not prominent.

Chronic cases of melancholia, or those in whom the physical health is good and the circulation active, have, as a rule, a full and sustained pulse; arterial tension existing in many such cases, but never to so marked a degree as in some other forms of insanity.

3. *Epileptic Insanity.*—Whatever may be the ultimate cause of an epileptic fit, there can be no doubt that the circulation within the cranial cavity is altered in some way.

Dr. Gowers* states that ophthalmoscopic examination of the

* "Ophthalmic Medicine," p. 173.

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fundus of a patient while in a fit reveals a turgid condition of the veins of the retina, and, according to other observers, the retinal arteries are contracted.* In patients who have succumbed to a series of fits, the cerebral membranes are generally found congested, and the cortex presents a deep pink colour. Microscopically, many of the cerebral vessels are distended with hæmacytes, and occasionally even rupture of the smaller arteries takes place. The pulse-rate in epilepsy is slightly quicker than normal, and its character may be briefly defined as wanting in tone. According to Dr. Thompson,† the pulse-tracing of an epileptic indicates a lax condition of the arterial walls. The ascent-line is seldom high or vertical, the percussion-wave is generally rounded, and the line of descent either prolonged with secondary wavelets imperfectly marked, or else short and presenting a dicrotic wave, which sometimes reaches the height of the primary wave. This description, however, applies more particularly to the tracings of those patients in whom the disease has been of long duration, and the mental characteristics are those of dementia, or to those who, at the time the tracing is obtained, are passing through a rapid succession of fits—the "status epilepticus." Such a condition is illustrated by Fig. 10, a tracing taken from a male patient while in a state of coma after taking a large number of fits. Tracings obtained from patients while in the unconscious stage of an isolated fit present characters similar to Fig. 10.

The pulse-tracing of an epileptic at other times varies according to his mental and physical condition, but, as a rule, it presents characters indicative of feeble cardiac systole and a lax condition of the arterial walls. There were several cases which presented tracings referable to increased arterial tension, but this condition existed only when the general health was particularly good, and the number of fits were few and of slight severity. Fig. 9 indicates a certain amount of tension, which, however, disappears entirely while the patient from whom the tracing was obtained is taking fits. The preceding tracing is a good example of a jerky and almost monocrotous pulse, similar to that usually found in acute pulmonary disease; it was obtained from a male epileptic, who was also the subject of syphilitic disease, while he was in a condition of restlessness and acute melancholia, and a few days before several paralytic

* Eulenburg and Guttman maintain that epilepsy in many cases owes its origin partly to a direct and partly to a reflex irritation of the vaso-motor nerves—the "angio-neurotic" theory.

† "West Riding Asylum Reports," Vol. II.

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seizures rendered him quite bedridden. His temperature was above normal, but there was no evidence of either thoracic or abdominal disease of an acute nature.

4. *General Paralysis.*—It is to this disease that psychologists have more particularly directed their attention, partly because it possesses a pathology of its own, and partly on account of its extreme fatality. Some years ago calabar bean was strongly advocated as a specific in the treatment of general paralysis of the insane. Recognizing the disease to originate in increased tension of the arterioles of the central nervous system, the drug was administered with the view of combating this condition, but although it has an obvious influence on the pulse-tracing, I am not aware of a single authenticated case of general paralysis being cured by this treatment, and the drug has now fallen into disuse in most asylums.*

The pulse may or may not be more rapid than normal in general paralysis according to various circumstances—temporary or permanent—which influence the condition of the circulation; but it is characterized by tenseness and hardness very similar to the pulse of chronic renal disease. This high arterial tension is most marked in the second stage of the disease, and generally disappears towards the termination of the case.

Thompson refers the tracing in general paralysis "to arterial contractions, the result of certain pathological conditions," and Spitzka† states that "the pulse in the early stages reveals very high tension in the active forms of the disease. In a large number of patients it is normal, and in the depressive forms unusually low tension in several cases."

Tracings have been taken from patients exhibiting the symptoms of general paralysis at different stages of the disease, and as the characters of the pulse varied at each stage, I have classified them accordingly.

In the *first stage* of general paralysis the upstroke is usually somewhat slanted, the primary wave does not form an acute angle, the descent line is of fair length, the fall is gradual, and

* In the "British Medical Journal," 1874, p. 522, Dr. J. Crichton Browne records the treatment of two cases of general paralysis by the continuous administration of calabar bean. The first case was discharged "recovered" in less than a year; the second, a female, after three years' treatment. I am unable to say whether these were real recoveries or only remissions, as the ultimate history of the patients is not given. Several other supposed recoveries have been published, but in none is a complete life history recorded, and they may have been only remissions in the course of the disease.

† "Insanity," 1883, p. 212.

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it presents a number of wavelets varying from 4 to 8; the dicrotic wave is not recognizable, and the aortic notch is either imperfect or it does not exist. Fig. 11 represents the tracing of a male paralytic, recently admitted, exhibiting the psychical phenomena of the first stage of general paralysis; his pulse-tracing is fairly typical, and the undulations on the descent-line are similar to those figured by Dr. Bevan Lewis,* and said to be characteristic of multiple sclerosis.

In the *second stage,* and towards its termination—immediately before the paralysis becomes so advanced that locomotion is impossible and the patient takes to his bed—the pulse becomes remarkably altered. The ascent line is now more perpendicular, but seldom of any great height, as often occurs in hypertrophy of the left ventricle; the wave of percussion, instead of being rounded, is prolonged horizontally, forming in many cases the "plateau" of Voisin. In some rare cases the tidal wave ascends higher than the primary wave; the aortic notch is generally well marked, the dicrotic wave obliterated, and the descent line short. With a few exceptions, it is this plateau-like summit to the tracing that is characteristic of the pulse at this stage, and it indicates a high tension of the pulse, sustaining the lever of the instrument for some time before the emptying of the vessel permits of its fall.

The difference between the pulse in chronic Bright's disease and the second stage of general paralysis is that in the former disease the systole of a hypertrophied left ventricle produces a high and perpendicular percussion line, while in general paralysis the *vis a tergo* is more feeble; in both diseases there is interference with the circulation through the systemic vessels, and this is no doubt the explanation of the tension so common at this stage.

In the pulse-tracings of the second stage of general paralysis, appended to this paper, high arterial tension exists in all with one exception (Fig. 14), which was obtained from a male paralytic dement; no active thoracic disease was present, but his feet and hands were livid and swollen from a torpid state of the circulation, and it is evident that the tracing is that of a jerky pulse of lowered tension, dicrotism being marked. The tracing depicted in Fig. 15 was taken from a male patient in whom paralysis was more advanced than in the other cases, and high tension is even more pronounced than in the other tracings, the apex forming a horizontal line.

I have been fortunate in securing sphygmograms from three

* "Journal of Mental Science," April, 1881.

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male patients exhibiting the physical and mental symptoms of the *third* or *last stage* of general paralysis. The first had been bedridden for several months, and was beginning to bedsore; he was very restless, and it was only after many unsuccessful attempts that I obtained a correct tracing; the line of ascent was high and slanting, the percussion-apex sharply pointed, and the descent-line short and almost uninterrupted by wavelets, indicating a forcible cardiac systole, but a lax condition of the arteries producing lowered tension. The second case was that of a patient who died from exhaustion after a large number of epileptiform fits; the tracing was taken while he was unconscious, and bore a remarkable resemblance to tracings obtained from epileptics immediately after taking a fit or while in the "epileptic state." The third patient only recently had become bedridden, but at the time the tracing (Fig. 16) was obtained he was rapidly getting more feeble and paralysed; lowered tension, but with a fairly strong cardiac systole, are the chief characters to be noted in this pulse.

In the *female*, general paralysis has a much more prolonged course, and the symptoms are rarely so intense as they are in the male sex. I have taken tracings from six patients at different stages of the disease, and although they might not have been expected to correspond with the preceding descriptions, a low percussion-wave and a prolonged "plateau" summit existed in four cases. Fig. 13 was obtained from a female patient who, on admission, presented all the characteristic symptoms of general paralysis, but at the time of the tracing, about one year subsequently, she seemed quite well mentally, and, with the exception of slight nervous twitchings about the mouth while speaking, no physical symptoms existed. As there is no evidence of renal or cardiac disease, and as the arterial tension persists, it is to be feared that this amelioration in the symptoms will only be temporary.

5. *Dementia.*—In all cases of insanity where the intellectual processes are impaired, there exists a torpid condition of the circulation, accompanied by a feeble and easily compressed pulse, probably due to inhibition of nerve-impulses along the vaso-motor system of nerves. Twenty cases of dementia were examined, and in only two was there a perfectly healthy state of the circulation; in many the pulse was so feeble that it was with much difficulty that a tracing could be obtained at all. In the majority of the cases the line of ascent was slanted and very short; the apex pointed, and the descent-line prolonged, and, in a few tracings, presenting several small undulations.

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In two cases some arterial tension was observed: the first was a female patient (Fig. 18), who about twelve years previously had had an attack of rheumatic fever, which apparently resulted in some valvular mischief; the other case was that of a stout woman with evidences of cardiac hypertrophy.

In several cases of *Senile Dementia* of both sexes examined the upstroke was slanted and not high, the apex was rounded or prolonged somewhat, and the descent-line interrupted by several small notches; these characters indicate a feeble condition of the heart and tense arterial walls, the result either of muscular hypertrophy or of atheromatous deposit along the course of the vessels.

6. *Imbecility.*—Persons with congenital mental defect exhibit a diminished activity of the vital functions. The heart's action is slow and laboured, the circulation sluggish, and the extremities frequently cold and bluish. The pulse is slower than normal, small but tense, and in a large number of cases examined I found arterial tension to exist, not to so marked a degree as in the second stage of general paralysis, but sufficiently constant —quite irrespective of the age of the patient—to justify the conclusion that increased arterial tension is the rule in cases of mental defect.

It is interesting to note that in cases of insanity where we have reason to believe there is an arrest in the development, or an atrophied condition of the cerebral hemispheres, a certain degree of arterial tension is almost invariably present. In this asylum during the past six years, 317 autopsies were made: of these, 15 were cases of congenital defect (including epileptic imbeciles), and the average weight of the encephalon in these cases was 42·2 oz. In general paralysis—although a case occasionally occurs of excessive size and weight of the brain—the brain is no doubt as a rule atrophied, for the average weight in 55 cases was 45·54 oz. (males 48·34 oz., and females 42·75 oz.). According to the latest authorities, the average weight of a healthy brain is 46·75 oz.; Meynert* exceeds this, giving from 1321 to 1375 grms. as the average. I would suggest that a possible explanation of the high arterial tension existing in cases of cerebral atrophy or congenital deficiency is to be found in a similarity of the morbid anatomy of the above conditions and that of cirrhosis of the kidneys. There is a certain amount of destruction of tissue in both cases, replaced in the one by serous fluid or the products of inflammation, and in the other by fibroid changes; in both conditions pres-

* "Psychiatry," by T. Meynert. Translation by Dr. Sachs, 1885, p. 255.

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sure is exercised on the arteries within the part affected; this obstructs the systemic circulation, and to overcome the obstacle, hypertrophy of the arterial tunics, and hence increased arterial tension, results.

In several cases of *Circular insanity* ("folie circulaire") pulse-tracings were obtained in the different stages; in the dull and depressed stage there was shortening of the ascent-line, the apex was more or less rounded, and the line of descent was prolonged and wavy, indicating a short and feeble ventricular systole and slight arterial tension. In the excited stage the percussion-impulse was high and perpendicular, and the descent-line short and interrupted by prominent tidal and dicrotic waves, arterial tension being lowered, and the characters of the tracing in many respects similar to that usually present in cases of acute mania.

Two cases of *Syphilitic insanity* were examined, and in them the pulse-tracings bore a remarkable resemblance to that usually found in the second stage of general paralysis. The ascent-line was of medium height, nearly perpendicular, the summit was prolonged as almost a horizontal line, the descent was short, and the dicrotic wave imperfect. Whether, in many cases, it is possible to differentiate between progressive paralysis of the insane and advanced syphilitic disease, as it affects the cerebro-spinal system, is doubtful; both diseases have their focus of energy in the cerebral vessels at a certain period of their course, and in both there is a certain amount of wasting of the cerebral substance. It may be these facts explain the resemblance existing in the sphygmographic tracings of both diseases.*

The sphygmograms of two cases of *Paralytic insanity* were very similar, although one pulse-tracing was obtained from a male paralytic aged 65, and the other from a female aged 42 (see Fig. 21). In both the ascent-line was high, and high arterial tension was prominent, indicating the forcible systole of a hypertrophied ventricle with a certain amount of thickening of the coats of the arteries.

From the preceding remarks I proceed to draw the following conclusions:—

(1). In the various forms of insanity, the influence of the nervous system upon the heart and circulation is such that *in nearly every case the sphygmographic character of the pulse is altered in some way from the normal.*

* In an interesting paper ("American Journal of Insanity," July, 1886), Dr. H. M. Hurd discusses the relationship existing between syphilis and general aralysis.

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(2). In acute mania, and in other forms of insanity associated with mental excitement, the nerve-centres are congested, but the walls of the arteries being in a lax condition, there is lowered arterial tension, and the pulse in the tracing is dicrotic. As the case becomes chronic the pulse more or less resumes its usual characters.

(3). Mental depression, if recent and acute, produces a feeble cardiac systole and an imperfect filling of the arteries; if, however, the depression is long continued, or if it is accompanied by mental hebetude or stupor, the systole becomes stronger, and the tracing indicates slight arterial tension.

(4). The arteries of epileptics are lax, and low arterial tension is the rule. During the "status epilepticus," and during the unconscious stage of an epileptic fit, the ordinary characters of the pulse-tracing are lost, and it becomes monocrotic or dicrotic, and the pulse becomes "soft, frequent, small, and running," similar to that found in coma or collapse from any acute disease.

(5). In general paralysis, the pulse varies according to the stage of the disease:—(*a*) in the first stage the systole is strong, but sudden, the tension of the arteries is low, and the descent-line is marked with numerous (4 to 8) undulations, probably the result of muscular tremors; (*b*) in the second stage the percussion-impulse is moderately strong, and the apex presents either a rounded summit or else it is prolonged, indicating marked arterial tension; (*c*) in the last stage the ventricular systole is feeble, and the pulse-tracing resembles somewhat that found in the first stage.

(6). The pulse-tracing of dementia indicates a feeble cardiac action, and a torpid circulation from imperfect distension of the vessels, probably due to the slow evolution of nerve impulses along the vaso-motor system.

(7). Cases of congenital mental defect where it is inferred there is an arrest in the development of the encephalon, as well as cases where it is evident a certain amount of wasting or atrophy of the brain-tissue exists, have tense arteries, and, as a rule, a strong cardiac systole, a condition in many respects similar to that found in fibroid degeneration of the kidneys, and in advanced aortic obstructive disease.*

* It follows also, although perhaps needless to formulate, that the opinion of those who have maintained the scientific importance of pulse-tracings in mental disorders is more than justified.

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OBSERVATIONS WITH THE SPHYGMOGRAPH ON ASYLUM PATIENTS.



FIG 1.—Mary A., æt. 22. Acute Mania: pulse 100; pressure used 90 grms.



FIG 2.—William M., æt. 30. Acute Mania (G.P.?): pulse 94; pressure used 60 grms.



FIG. 3.—William B., æt. 32. Chronic Mania: pulse 96; pressure used 90 grms.



FIG. 4.—Jane D., æt. 30. Melancholia: pulse 90; pressure used 30 grms.



FIG. 5.—Eliza H., æt. 40. Melancholia (acute): pulse 80; pressure used 90 grms.



FIG. 6.—Eliza B., æt. 42. Melancholia (G.P.?): pulse 90; pressure used 120 grms.

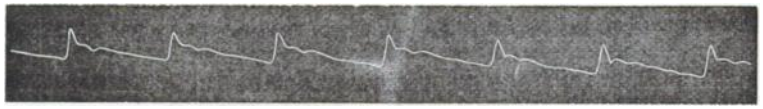


FIG. 7.—William B., æt. 40. Melancholia: pulse 84; pressure used 90 grms.

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FIG. 8.—Arthur McA., æt. 39. Epileptic Mania: pulse 100; pressure used 30 grms.



FIG. 9.—Jessie B., æt. 27. Epileptic Mania: pulse 86; pressure used 80 grms.

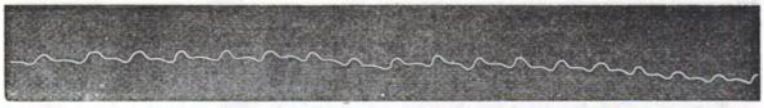


FIG. 10.—Isaac S., æt. 29. Dying from a series of Epileptic Fits: pulse 130; pressure used 30 grms.



FIG. 11.—John K., æt. 36. General Paralysis (1st stage): pulse 80; pressure used 80 grms.



FIG. 12.—Thomas B., æt. 42. General Paralysis (2nd stage): pulse 74; pressure used 120 grms.



FIG. 13.—Dinah G., æt. 40. General Paralysis (2nd stage): pulse 74; pressure used 120 grms.



FIG. 14.—William W., æt. 30. General Paralysis towards termination of 2nd stage: pulse 90; pressure used 80 grms.

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FIG. 15.—William R., æt. 55. General Paralysis (2nd stage): pulse 86; pressure used 60 grms.



FIG. 16.—William G., æt. 38. General Paralysis (last stage): pulse 90; pressure used 40 grms.



FIG. 17.– Job B., æt. 46. Dementia: pulse 86; pressure used 60 grms.

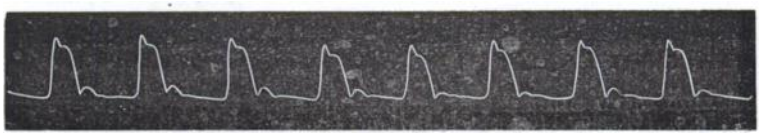


FIG. 18.—Catherine M., æt. 59. Dementia; has had rheumatism: pulse 80; pressure used 60 grms.

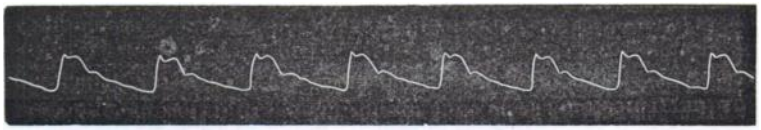


FIG. 19.—Isabella P., æt. 54. Congenital Imbecility: pulse 74; pressure used 60 grms.



FIG. 20.—Mary W., æt. 50. Congenital Imbecility: pulse 80; pressure used 80 grms.



FIG. 21.—Tamar W., æt. 42. Paralytic Insanity: pulse 84; pressure used 60 grms.

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