Emilius Rowley Nicholson

ON THE PULSE

1853
The Pulse.

Considering the limited time and opportunities enjoyed, for the actual investigation of physiological science, by one who is engaged in acquiring a knowledge of general principles which are soon to be brought to bear upon the realities of practice, I have ventured to mark out for myself a course of study relating to ascertained facts and generally received theories, rather than attempt researches concerning latent obscure phenomena, albeit the reward of academical distinction awaits the fortunate experimenter.

My great object being, assuredly, to fit myself for the practice of medicine, it appears to me that I shall best attain that end, by directing my attention to some subject intimacy connected with practical medicine. In accordance with this conviction I have selected the Physiological art for the subject of this dissertation. Originality having been abandoned, the
sources of error are diminished, and consequently I feel less diffidence regarding the merits of a mere collation of the observations and propositions of others, than if I had made an attempt to shed additional light on this important subject, by my investigations of my own.

Having premised these few remarks, I submit the following pages to the keen consideration of the Medical Faculty.

It is my intention to divide this essay into two parts, viz.,
1st Historical,
2nd Physiological and Pathological.

History. From the most remote antiquity, physicians have been accustomed to judge of the relative states of health and of disease by the pulsations of the arteries, so named from the supposition that they contained air, or mere tubes, whose use was mainly for the purpose of conveying this fluid, (air and vapor); and they were furthermore confirmed in this delusion, by observing that
after death, these results were found empty. The first notice we have of the pulse is in the writings of Hippocrates; however he does not appear to have attached very much importance to it, seeing that he deduced no practical inference therefrom, with the exception of ascribing him in forming his prognosis, he seems in fact to have quite overlooked it as an means of diagnosis.

Hence whilst it is generally admitted was the first physician who truly appreciated the importance of the pulse, but it would appear that being a favourite subject, he had introduced too many nice distinctions, which, although supported by Galen, were nevertheless condemned by Pliny and Claudius, which latter, is the most author worthy of mention, not only on account of his elegance as a classic, but also for his acuteness of observation, and soundness as a practitioner, which when we review the absence of facilities at that period, and find how near his observations coincide with more modern views, seems truly
wonderful. This author in speaking of
the pulse in fever, remarks "For we depend so
much on actual action, and on most jarring
effects of diagnosis it is; because these (pulsations)
are often more frequent or more rapid, according
to the age, sex, and nature of constitutions,
and generally when a person is in good
health, if the stomach be weak, or sometimes
under incipient fever, the pulsations are
diminished in number and volume; so
that he may appear weak, who is sufficient
by able to sustain a severe paroxysm."—
Then he tells us that "the pulse may be
affected by external circumstances, by the heat
of the sun, by the bath, by exercise; and also
that it may be accelerated by emotions of
the mind such as fear or anger;" now we
are not prepared as modern practitioners to
go all the way with him, for although
the pulse may be affected by, and liable
to alteration from these extraneous circum-
stances, we can nevertheless, derive most
valuable aid in detecting functional and
organic disturbance by its means.
It is probably owing to the exertions of Galen that the pulse has been rendered an object of so much attention as a means of Prognosis and Diagnosis, and even down to the present day is regarded as a precious symptom. He has paid particular regard to the pulse, and treated of it in no less than six different works, in which he investigates in a most elaborated manner everything concerning the use of it, its causes, varieties, &c. These works are well worth perusal, but his ingenuity and imagination have led him to invest the subject with so many subtle distinctions respecting its varieties, all of which being now generally exploded as frivolous and impracticable, renders anything beyond a very slight notice superfluous.

With respect to the cause of the Pulse, Galen attributes it to a specific faculty inherent in the heart and, which he names pulsatile, by which their alternate dilatation and contraction is produced. In his time the use of the Pulse was sup.
posed to be to maintain the heat of the body, and to remove the exces of excretements matter from the blood: By considering the condition of the vital powers, in relation to these supposed procures, he laid the foundation for the differences in the pulse which he endeavours to establish. These differences he first arranges under the two heads of simple and compound, which he again subdivides into numerous varieties, depending partly upon the supposed quantity of motion in the parts, the nature of this motion, the length of time which it occupies, the space which intervenes between the pulsations, the force of the vital action, and the particular disposition of the artery. Proceeding upon these principles he forms all the supposed combinations of these different circumstances, and from them he deduces a great number of varieties to which he gives distinct appellations. After the death of Galen, there was but little, if any, advance made in the science
of medicine or physiology, that is worth no-
tice till the sixteenth century. —
Referring to Greek authors for information
on the subject, we find that the physicians
of that country were in the habit of ex-
amining the state of the pulse by apply-
ing the back of the hand to that part of
the thorax where the pulsation of the
heart is most discernible.

The Chinese Physicians it is well known
have long had the credit of attending
very particularly to the pulse; they even
pretend to derive a much more minute and
accurate knowledge of the state of the sick
than European practitioners lay any claim
to, believing indeed in the power of being
able by this sign alone, to detect the nature
and nature of a disease, and also of deter-
mining in which of the cavities, and on
what side of the body it is situated. —
The method they adopt in judging of the
pulse is this; — the patient is directed
to be laid in bed with his arm resting
on a small cushion. — The Physician must
be seated, and both parties are enjoined to remain silent, calm, and collected. The fingers are next applied in due succession on after another, in order to judge of the comparability of the artery. The Chinese do not infer solely from the rapidity of the pulsations, but compare the number of pulsations of the artery with the intervals of the respiration of the patient. The number of pulsations of a man in moderate or good health, they consider in relation to the time of a natural inspiration and expiration. Four beats of the pulse during this period they conclude indicates perfect health, the ratio which we in the day understand to be normal. If it exceed five pulsations, they consider it as too rapid, if under that number, as too slow respecting health.

It may not be considered an "error loci" just to glance at the state of medical science as it was a few years since in Turkey, and the best account of it is given in a work published by Dr. Oppenheim, from which it would seem that medicine in
all its branches and in all its foundations is at a very low ebb, so low that it is difficult to comprehend how it can happen that a people in constant communication with polished nations, could remain so lamentably destitute of medical and scientific knowledge. This singular fact may perhaps be attributed to the influence which Islamism as the common faith exerts in opposition to the introduction of a more rational system, for it is known that the religion does not permit women to be unveiled in presence of the opposite sex, and this restriction extends even to the medical man, who is only allowed to see the hand, and feel the pulse of the fair patient, the rest of the body being strictly covered.

From the author above mentioned it would appear that animal justification of the propert kind, is the governing motive of the whole male population, which assertion is demonstrated by the fact, that the most prized, if not the principal part of the miserable duties of the practitioner, is to
minister by fancied restoratives and corroborants, to the pallid, appetites and jaded powers of an exhausted or superannuated sensuality.

It is somewhat singular that, although the pulse is regarded by the Turks as capable of indicating everything necessary in diagnosis and practice, they are ignorant of the circulation of the blood, but an surprise will diminish when we find that their doctors are chiefly impirics, who hawk their medicines about, and when summoned by a passing patient, ask no questions, but feeling the pulse with an "I know your disease," administer on the spot a pill or powder, receive their fee, and recommence their cry of "good physic." A striking mark of the general ignorance of the people concerning medicine, and of the ignorance and baseness of its ordinary professors, is furnished by the extraordinary value attached to the pulse as a means of diagnosis and prognosis. Dr. Oppenheim remarks that, "Nothing can give the doctor so
higher place in the estimation of his patient, than his observing from the state of the pulse alone, the whole of his judgment, respecting the state of the malady. By its means he must not only know the complaint, but also whether, and how the patient has slept; if he has taken anything, and what this may be; the nature of the evacuations. Every question the patient has to answer is on inquiries to him, and with every query, the estimation in which the physician was previously held, obviously diminishes.

At the very first visit, the physician is expected to indicate merely by feeling the pulse, the precise time at which death will ensue, or when a favourable crisis is to be expected to relieve the patient from all his sufferings. Nor is this opinion regarding the all importance of the pulse confined to the lower ranks, but is prevalent among Turks of the highest order. This leads the cunning Greek practitioners to ascertain from the servants, in an indirect manner, the state of the patient, whose confidence is thus gained, and
whose credulity is so much abused as to
make him believe that the practitioner
can, by feeling his pulse, see into the
almost receptacle of his body.”

The mathematical set of Physicians sprung
up about the commencement of the seven-
teenth Century; but their opinions being
founded upon a fallacious basis, do not on
require commenting on; but the termination
of the seventeenth century gave rise to Bellini,
who was Professor of Medicine in Pisa, and the
author of a treatise on the pulse, “De Vrini et Pulsiis,”
in which he notices a vast variety— as
the formicans, the vermicular, the tremulis,
the serratus, the caprizans, “caprizans autem
dicitur eo quod dicunt capra saltantes primi
solum urget,”— the dirotris, the myurus,
or mouse-tailed pulse, with a great many
more, both undefinable and unintelligible,
but notwithstanding all the pains he
has taken to be minute, he has never re-
marked the number of beats in a minute.
It remained however for the brilliant dis-
covey of Harvey to cause Physicians genrally
to recognize the importance of the pulse, which desirable object was joined, as soon as medical men began to understand the mode in which the circulation was carried on—Harvey's discovery moreover, gave a great stimulus to investigations respecting the nature and cause of the pulse. The first improvement which was effected for ascertaining with accuracy the state of the pulse, is due to Sir John Floyer, who in the year 1707, was the first to apply a portable instrument to the purpose, beginning with the very primitive aid of a minute flap, and subsequently introducing the "Physicians Pulse Watch"; this was the excito to something better, and it is only during the present age, that the general introduction of such instruments among professional men has taken place. Of the varieties of the pulse, as regards the sensation it affords to the hand, he makes considerable use, and enumerates very many sources of such inequalities in its beats; as different diseases of the heart and lungs,
affections of the spleen, stomach and other abdominal viscera. This enumeration of these inequalities, is taken from Bellini, and the chief of them I have before quoted.

The most useful distinction, however, Sir John Floyer tells us, "is the difference we observe in the numbers of the pulse in a minute; seventy-five being the most usual pulse."

He divides the constitution into hot and cold, and considers all pulses above seventy-five, as belonging to hot constitutions, "because the body is over heated, and the blood and spirits too much rarified"; and all below, or the deficient pulses, as belonging to cold constitution and cold diseases. He also describes these pulses as deficient in magnitude, force, &c. — This division of Sir J. Floyer, into hot and cold diseases, with the exposition of the accompanying pulses, present an interesting example of the great tendency there is in the infancy of science, to build up a system upon too small a collection of facts. That a rapid and forcible pulse, is generally observed in diseases in which there
is a hot skin, and a high degree of fever; it is very true, yet it is equally so, that the frequency of the pulse, is not always in proportion to the heat of the body, nor is a slow pulse always weak and feble, indeed as regards the last, the contrary is often the fact, a pulse of only thirty-two beats per minute, being often very powerful. —

Sir J. Floyer supposed forty to be the number at which "in syncope the pulse ceased, with allsense and motion." — In his chapter on the causes of the alteration of the pulse by the temperaments, he has adopted the Hippocratic division, into Sanguineous, Choleric, or Phlegmatic, and melancholic. —

In the year 1731, a singular work written by Solano, entitled "Lapis Lydicus Apollinis" made its appearance, in which he directs, his attention particularly to the rebounding on pulse, describing several others, which he terms minutity; and instituting many fanciful distinctions. — He is reported to have arrived on a very great degree of tactile acuteness. —

Fourteen years subsequently, Nibbhill published
his "New and Extraordinary Observations concerning the Predictions of crises by the Pulse", which was just a prosecution of Solano's inquiries, with the good intent of rendering his observations more intelligible. It would appear that in France the system of Solano was more favourably and generally received, than in this country, since Borden and Forquet were rivals even of Solano in the minutiae of their distinctions, and the accuracy of their peculiar differences.

Although we may feel convinced, that the discipless of Galen and the followers of Solano, have invested the subject with too great a degree of minutiae; on the other hand I think we shall not be quite justified in falling with that most able of Physicians Dr. Abercromie in conjunction with Dr. Falconer, into the opposite extreme, viz: of reducing all the cognizable variations of the pulse into two, e.g. quick and slow. For in the first place the uncertainty of the healthy standard in individuals, which induced Dr. Falconer to take the trouble of calculating a long series of tables of comparative rates...
in different persons, necessarily renders the ce-

larity of the pulse a point of considerable or

uncertainty; not to mention the numerous o

sources of variety in this respect, from age,

strength, time of day, &c., which will be treated

of in their proper place; and in the second

place every attentive practitioner, with a very

moderate tact, will be able to distinguish

several other varieties, which occasionally di-

rect his decision as to the mode of practice

which he intends to pursue.

The distinctions for instance, of strong and weak,

large and small, equal and unequal, regular and

irregular, and intermittent, are surely very impo-

tible in many cases of disease, and not un-

frequently serve to modify both the diagnosis

and prognosis, as well as the direction of re-

medies.

As the history is not the most important part

connected with this subject, I now propose

to enter into the consideration of the second

division, as being one of more practical interest.
I. Its Mechanism. — In considering the physiology of the pulse, we are naturally led to enquire into the cause of this phenomenon, and we find this, since the discovery of Harvey, attributed to the heart's action in the first place; in prosecuting the enquiry, however, it may be expedient, and will certainly be interesting, to glance at the different physiological views taken by different observers down to the present period.

Haller, although one of the earliest observers on the subject, appears to have arrived at greater accuracy in this field than most of his successors; he plainly ascribes the pulse to the alternate dilatation and contraction of the artery, from the impulse of the wave of blood, corresponding with the systole and diastole of the left ventricle of the heart. — This physiologist says: "that the arteries are in a living person, always full of blood; since the jet or stream that starts from an artery, is not interrupted by alternate stops, while the heart rests or relaxes itself, but flows on in a continued thread." — Add to this,
"That the microscope shows the arteries, in a living animal, to be always full of blood, both in their systole and diastole; nor can the circular fibres so far contract themselves, as entirely to evacuate these tubes. — Since therefore a new wave or column of blood is sent into the arteries, already full, although it be but a small proportion to the whole mass contained in the arterial system throughout the body, hardly ever exceeding two ounces; yet, by its immediate contact with the precedent one, which moves slower as it goes farther from the heart, it consequently drives the same forwards, lengths the artery, and makes it assume a cylindrical form, augments its diameter, forces the membranes closer to one another, urges the convex parts of the arterial flexures, and causes their spiral waves to be more perpendicular, as injections demonstrate to us. — This dilatation of the artery, whereby its length or capacity is changed from a line to a greater circle, is called the Pulse."

From this it would appear that Haller was nearly as well acquainted with the cause of the Pulse as
ourselves. — Bichat, considered the pulse as chiefly owing to a kind of locomotion in the whole artery, wherein it springs against the finger during the systole of the left ventricle of the heart. — The locomotion alluded to by Bichat, may be represented by moving up and down in the direction of its length, a piece of flexible cane, its size and diameter, during this movement being in no respect changed. — Speaking of the existing obscurity in the subject, he says, "we cannot but acknowledge, that the locomotion of the arterial system, contributes greatly to the production of this phenomenon." At the moment when the mass of blood is driven by the contraction of the left ventricle of the heart toward the extremities, by a general movement (mouvement de totalité), so to speak, it tends inevitably to raise or elevate the arteries, especially on when they are tortuous. — This act of elevation necessarily causes an act of locomotion, which latter produces the beating of the artery. — "As to the dilatation," he observes, "it is almost no-thing in the ordinary state." He then con-
cludes thus: "the dilatation and the contraction of the arteries being almost nothing in the ordinary state, it appears that the official cause of the pulse is to be found in the locomotive motion of the arteries (as Weitbrech has well observed), which is generally instantaneous throughout the whole arterial system, and not consecutive as Haller considered it to be."

Dumas, in advancing his solution of the problem, observes that, "the general property of the arterial vessels, that of being alternately contracted and dilated, constitutes what Physicians call the pulse. It is impossible to doubt this activity of the arteries in the alternate contractions and dilatations which they produce; if one reflects on the object and end of this double movement. For when they are about to receive the blood, they arrange themselves for the reception of this fluid, by the movement which dilates and opens them, they then remove the blood by that movement which contracts and closes them. Hence they act before the blood enters into their cavities, by an action of their own, and
"they are dilated, not because the blood...enter their, as Galen opined, but rather the...blood penetrates them, because they are dilated."

Dumas concurs with Galen in the idea that the dilatation and contraction of arteries are inherent in themselves, and independent of the mechanical impulse of the heart, but differs from him in dispensing with the aid of a myth, such as the presence of Galen has been proven to be, and also in asserting that the arteries are dilated because the blood penetrates into them, while the latter maintain that the blood penetrates into them, because they are dilated. —

Richerand Portal, with the greater number of preceding physiologists, attribute the pulse to an increase of diameter in the artery, from ventricular impulse of blood from behind. — The former physiologist observed, "Inasmuch as the arteries are always full during life, and as the blood flows in them with so much the less rapidity, as they are more distant from the heart, it follows that...

the portions of this fluid which the contractions of the left ventricle project into the aorta, meeting the
"Antecedent columns of blood, communicates to them the impulse which it has received; but, retarded in its direct progress, by the resistance which they make, it acts against the walls of the vessels, and causes them to deviate from their axes. — This lateral action by which the arteries are dilated, depends then on the fact of their cavities being always filled by a fluid which resists that which the heart propels. — This dilatation, more considerable in the large arteries, than in those of less calibre, is manifested by a beating known under the name of the pulse."

Sammering ascribes the pulsation of arteries to various causes. — He believes that the pulse is produced by "a longitudinal motion, in connection with the dilatation and locomotion of the arteries." But his opinion appears to be little conformable with truth; because in the first place he supposes that the artery can effect these movements, which is not possible, since nature never multiplies agents unnecessarily, and in the second, because the longitudinal motion is opposed to dilation, each opposing the other.

Iacopi, formerly Professor of Anatomy and Physiology.
in the University of Pavia, thus explains the mechanism of the pulse. — "The blood" says he, "which runs uninterruptedly through the arteries, becomes more rapid under the consecutive compression of the heart; the arterial reflexes; this sanguineous wave, upon which the heart has an immediate action, driven by the force of that organ into the aorta, proceeds with a strong impetus to dash itself against the wave which has preceded it, and which being thus broken, cannot but likewise upon the one before it, and thus successively, the sanguineous wave which is found in the aorta, resists that which is on its way thither, whilst the latter encounters resistance from the anterior one, and thus because the velocity of the blood decreases considerably as it reaches from the heart, being therefore, compressed both before and behind, it cannot but compress and dilate the arteries, which compression and dilatation taking place, as it were, instantaneously, and with a smart blow, the beating becomes imperceptible, and is properly that which we call the "Pulse" — Op. cit. Tom i p. 288. —

Dr. Parry in his observations on the pulse, appears
to have subscribed to the error of considering the arterial tubes as merely inanimate transmitters of the vital fluid, he observes that, "in the large arteries there is no sensible dilatation or contraction, therefore the pulse cannot depend on this alteration. The chief cause is a strong and predominate increase of distension, from the systole of the left ventricle, given by the blood as it projects through any portion of an artery forcibly contracted within its natural dimensions." In this assertion he assumes that an artery has the power of contracting forcibly, but in his general theory denies that it possesses any capability of expansion. From a careful investigation into the opinions of different authors, there appears to be more besides those already quoted, whose observations throw more light on this subject, therefore I propose giving a short outline of the ideas held in the present day, and then view some of the different modifying circumstances.

Before entering on the present theory of the formation of the pulse, it may perhaps be deemed necessary that the action of the arteries
in modifying the force with which the column of blood is sent from the heart, should be taken into consideration. It is only since the introduction of the microscope, that we have become aware of the existence of five distinct coats in the construction of arteries, viz. 

An external or fibro-cellular coat; 

An elastic coat as Huxley called it, consisting of yellow elastic tissue; 

A muscular coat, which is greatly developed in the small arteries, and scarcely perceptible in the larger vessels; 

An internal coat, consisting of a fine, colourless, transparent membrane, elastic, and easily broken down; and an 

Epithelial lining of the tesselated variety. 

Of these five layers, only two require any close attention, viz. the Elastic, and the Muscular, as it is through the medium of these, that the circulation is chiefly influenced. 

By means of the elastic coat, the arteries are guarded against the abrupt pressure to which they are necessarily subjected by the contraction of the left ventricle of the heart; their elasticity
enabled them to expand under the distending impulse of the blood, thus becoming at the same time more tense and resisting to the shock, which but for this provision might produce a rupture of the vessels.

In conjunction with this mechanical property of elasticity, arteries are endowed with a vital power of contractility, by which means they are enabled to narrow their calibre; this property has been observed to reside in the muscular coat, which, however, does not (as some have surmised) produce rhythmic contractions like the heart, but is prolonged in its action, and has the effect of contracting the area of the tube, resisting by this means the force of the distending blood. This tenacity of the vessels, combined with the action of the elastic tissue, seems to regulate the width of the artery to the quantity of blood passing through it.

The before mentioned vital contractility of arteries may be clearly exemplified, by drawing the point of a needle two or three times across one of the larger arteries in the web of a frog's foot; by means of a microscope the vessel will be...
observed to contract, and the stream of blood seen to become smaller and smaller, till it may be made to disappear totally.

Brunt proved from many experiments the elastic and tonic power of the arteries, and the observations he made on a placenta and umbilical cord shewed, that the contractility of the muscular coat, continued in force for two days, when it was ultimately overcome by the elastic coat, which opened the vessels to their natural diameter. — Meiss' Ed. and E.H. Weber have also shown satisfactorily, the muscular contractility of the arterial coats, by means of Electro-magnetism applied to the mesenteric arteries of frogs; a vessel whose diameter did not exceed 5 to 7 of a Paris line, in five or ten seconds became one third less in diameter under the stimulus, and the area of its section about one half. — By continuing the stimulus, the tube decreased so much in size, that only one row of capillaries could pass through at a time, and eventually the tube was completely occluded.

At present we only are aware of three modes
in which the arteries act on the circulation which are,

1. The conveyance and distribution of blood to the several parts of the body;

2. The equalization of the current, and the conversion of the pulsatile, jetting movement, given to the blood by the ventricles, into an uniform flow;

3. The regulation of the supply of this fluid to each part.

Mr. Hume explains this triple action of the arteries most concisely; he says "there are three states in which an artery is found, viz."

1. The natural jenuous state;

2. The stretched; and,

3. The contracted state, which may or not be jenuous.

"The natural jenuous state," is that to which the elastic power naturally brings a vessel, which has been stretched beyond, or contracted within, the extent which it held in a state of rest.

The stretched, is that state produced by the impulse of the blood, in consequence of the
contraction of the heart, from which it is again brought back to the natural state, by the elastic power, perhaps assisted by the muscular.

"The contracted state," arises from the action of the muscular power, and is again restored to the natural state by the elastic.

The theory of the propagation of the pulse advanced by C. F. Weber is, "that the impulse given to the blood by the heart, dilates first nearly those arteries nearest the heart, which by their elasticity again contract, thus causing successive contractions of the whole arterial system." But Mr. Colt objects to this explanation on the ground that the pulse is perceived in every part of the arterial system, before the occurrence of the second sound of the heart, i.e., before the closure of the aortic valves; he then proposes to obviate this difficulty by a theory, which appears to be little if any thing more than a repetition of Haller's. Mr. Colt supposes "that the blood which is injected onwards by the left ventricle does not so impart its impulse to what the arteries
already contain, as to dilate the whole arterial
system at once; but, that as it enters the
arteries, it displaces and propels, what they
before contained, and flows on with what
may be termed a head wave, like that which
is formed when a rapid stream of water
overtakes another moving more slowly—
The slower stream offers resistance to the more
rapid one, till their velocities are equalized;
and because of such resistance, some of the
force of the more rapid stream of blood, is
diverted laterally, and with the rising of the
wave the arteries nearest the heart, are dilated
and elongated. — The wave at the head of
the more rapid stream of blood runs on,
propelled and maintained in its velocity, by
the continuous contraction of the ventricle; thus
it dilates in succession every portion of the
arterial system, and produces the pulse in
all.

II. Age and Sex. — In considering the influ-
ence which time of life exerts on the pulse, it
will be necessary to commence at earliest infancy,
and in order to be as accurate as possible, I
Subject some tables compiled by several celebrated authors on the subject. The pulse of the infant at birth, and for some time afterwards, is very variable, which renders it impossible that we should trust to it as a criterion of the state of health.

Mr. Daget found the average pulse of thirty-six infants at birth, one half of each sex, to be as follows: Maximum, 165. Minimum, 106. Medium, 135.

The following were the results observed by Mr. Billard: in forty-one infants from 1 to 10 days old, the pulse varied from 80 to 180; in 16 of these, it was less than 80, and in 12 between 110 and 130. In 36 children from 1 to 2 months, it varied from 60 to 150; in 14 of these, it was from 80 to 85, and in 7, from 125 to 130. In 20 children from 2 to 3 months old; in 14, it was more than 90, and in 4, from 70 to 80.

Dr. Knox is of opinion that the pulse of infants is so variable, that we are not justified in saying that there is any average. According to Mons. Troussonnet, "in infants from 15 days to 6 months old, the pulse
"beats when they are awake, 100 per minute, 
and during sleep 121 times.—

In infants from 6 to 31 months old, the 
numbers are 138 during waking, and 112 
during repose." These facts I think war 
rant us in concluding that practically, 
it is difficult, on account of the consider 
able interval which separates the maxima 
and minima in the normal state, to judge 
of the febrile state of an infant, seen for 
the first time, merely by the frequency of 
the pulse, unless its frequency be very much 
exaggerated. — If, indeed, the normal state 
be well known, then an increase in the 
number of its beats, becomes a valuable sign. 
And if in a sleeping infant, the pulse 
is 140, or in one that is awake and not 
aperated, 150 or 155, a state of fever may 
generally be suspected. —

On the whole however, with the child at 
the breast, as with the adult, the frequency 
of the pulse has lip value as a solitary 
symptom, then when combined with other 
functional disturbances, among which, change
in the temperature of the surface, may
be allowed to hold a prominent position.
The following table presents the maximum,
minimum, and mean frequency of the
in healthy males and females at the
several ages specified; as well as the
range of the pulse, that is to say,
the difference between the lowest and
highest number, according to Dr. Guy.

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<tr>
<th>Age</th>
<th>Maximum</th>
<th>Minimum</th>
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<td>1 Week</td>
<td>160</td>
<td>104</td>
<td>128</td>
<td>56</td>
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<td>2 to 7 Years</td>
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<td>8 to 14</td>
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<tr>
<td>50 - 56</td>
<td>92</td>
<td>46</td>
<td>67</td>
<td>46</td>
</tr>
<tr>
<td>57 - 63</td>
<td>84</td>
<td>56</td>
<td>68</td>
<td>30</td>
</tr>
<tr>
<td>64 - 70</td>
<td>96</td>
<td>54</td>
<td>70</td>
<td>42</td>
</tr>
<tr>
<td>71 - 77</td>
<td>94</td>
<td>54</td>
<td>67</td>
<td>40</td>
</tr>
<tr>
<td>78 - 84</td>
<td>97</td>
<td>50</td>
<td>71</td>
<td>47</td>
</tr>
</tbody>
</table>
From this table it appears that the maximum and the mean frequencies, present a progressive decrease during the first seven periods, or up to 36 years, and the minima during the first five periods, or up to 22 years. The table next appended shows the frequency of the female pulse, at the several ages.

<table>
<thead>
<tr>
<th>Age</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Week</td>
<td>160</td>
<td>104</td>
<td>128</td>
<td>56</td>
</tr>
<tr>
<td>2-7 Years</td>
<td>120</td>
<td>70</td>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>8-14 &quot;</td>
<td>120</td>
<td>70</td>
<td>94</td>
<td>50</td>
</tr>
<tr>
<td>15-21 &quot;</td>
<td>144</td>
<td>56</td>
<td>82</td>
<td>68</td>
</tr>
<tr>
<td>22-28 &quot;</td>
<td>114</td>
<td>54</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>29-35 &quot;</td>
<td>94</td>
<td>62</td>
<td>70</td>
<td>32</td>
</tr>
<tr>
<td>36-42 &quot;</td>
<td>100</td>
<td>56</td>
<td>70</td>
<td>44</td>
</tr>
<tr>
<td>43-49 &quot;</td>
<td>106</td>
<td>64</td>
<td>77</td>
<td>42</td>
</tr>
<tr>
<td>50-56 &quot;</td>
<td>96</td>
<td>64</td>
<td>76</td>
<td>32</td>
</tr>
<tr>
<td>57-63 &quot;</td>
<td>100</td>
<td>60</td>
<td>77</td>
<td>48</td>
</tr>
<tr>
<td>64-70</td>
<td>100</td>
<td>52</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>71-77</td>
<td>104</td>
<td>54</td>
<td>81</td>
<td>50</td>
</tr>
<tr>
<td>78-84</td>
<td>105</td>
<td>64</td>
<td>82</td>
<td>41</td>
</tr>
</tbody>
</table>

This table shows us that though the variations are as great as in the case of the
male pulse, the minor frequencies present a regular decrease up to 56 years, and a progressive increase from that period up to 84 years of age. If we regard the occasional irregularities in the decrease or increase of the pulse at the several periods, as the necessary consequence of a limited number of observations, the general result of the above facts may be stated in the following terms: — the pulse falls rapidly during the first seven years of life, then rapidly still, from 21 to 35; from 35 to 56, it remains nearly stationary, and from 56 to 84, again increases by a few beats. If we compare the male with the female pulse it appears that, 1st. The female pulse differs little from the male pulse during the first seven years of life, but after seven years of age, the mean pulse of the female exceeds that of the male by from 6 to 14 beats, the average excess being 9 beats, or about one eighth of the mean frequency in the male. 2nd. The minimum frequency of the female,
at more than one period of life, falls below that of the male; but its maximum frequency is, at all periods, above that of the male. — 3½. The range of the pulse is in both sexes considerable; in the male it extends from 20 to 56; in the female from 32 to 60 beats per minute. — The average range in the male is 43, in the female 40. —

Maquainie has also given a scale showing the difference in frequency of the pulse in the infant and old age; the velocity gradually diminishing with increasing years; but it so closely coincides with those above given, that it will be superfluous to insert it.

In females the pulse usually ranges from 70 to 75 or 85, and is moreover much more excitable than in males, and particularly under the influence of mental emotions, especially in early years; a similar excitability may also often be observed in males about the age of puberty, or soon after, owing perhaps to the mind at this period being more active, and alive to the influence of exciting and depressant passions.
In girls, after the first two months, the pulse is a little more frequent than in boys, by from ten to fifteen more beats in a minute. The most common range in females in good health is from 72 to 80, but the pulse is usually more frequent and developed during pregnancy, this is attributable probably to the fact, that the general condition of a pregnant woman is febrile, the quantity of the circulating fluid is said to be augmented, and its quality believed to be altered by an increase of fibris, if the buffy coat presented by blood drawn under such circumstances, bear any evidence of an increment of the fibris.

With regard to the pulse in senescence, medical men are undecided, some maintaining that it is diminished in velocity, and others advocating a contrary opinion. Man at an advanced age, becomes the subject of very great corporeal degeneration, joined with manifest impairment of vital energy, becoming in fact as Dr. Gregory well delineates him, "rigidus, siccus, pallidus, macer."
Since then, we find in this stage of existence, such prostration of the vital powers, it seems natural that it should be Jupitered of a characteristic pulse; accordingly it has been described as "slow, rare, and hard.". As in old age there is little capability of active exertion, there also must be less need for so large a supply of blood as in adult life; consequently, this fluid being diminished in quantity does not stimulate the heart and arteries, to such vigorous contractions, by means of which feebleness in the circulation, we have produced the slow pulse. The hard pulses of senescence, may perhaps with propriety be admitted to be owing to certain changes having taken place in the organization of the individual. It has been well ascertained, that the thickness and density of the arterial coats increase with age, sometimes becoming lined with a calcareous deposit; thus being deprived of their flexibility and softness. Many of the smaller arteries in aged persons, have been found entirely oblitera-

|
on ligamentous bands; from these cases, it would appear that nature requires a diminution of blood, as a kind of compensation for the smallness in quantity of the blood, and the weakened cardiac action. To these causes, and to the gradual decay of the general strength, I think we may attribute the fact of the pulse seldom exceeding seventy beats in a minute.

In decrepitude or extreme bodily decay, we find frequently the heart itself acquiring the same morbid condition as the arteries, becoming in fact indurated, thence rendering the pulse so "rare, hard, and slow," as not to exceed in many cases sixty-five beats per minute, or according to Frugoni "in bocu decrepito, aliquando at quinquaginta et intra decrescit."

Flyer has given a list of thirteen old persons, in whom the pulse was "76 in a minute," from which he argues that the pulse is not at all diminished in velocity by age. Dr. Falconer is disposed to believe, though not very confident in his opinion, that, "the pulse in a healthy person, becomes gradually slower..."
"from about forty-five years of age, to about sixty, after which period it again begins to grow quicker, and to become as several other circumstances in the system do also, more resembling that of children." But to this he adds "there are doubtless many exceptions." Physiologists generally, have considered it as an established fact, that the frequency of the heart's action diminishes in advanced age; and no one since Flourens time called the accuracy of this view into question, until Mr. Leuæt and Motier in 1832, whilst engaged at the Hospital of Salpêtrière, Paris, in observations relative to the pulse of the insane, were surprised to find, that the pulse of 94 sane women in good health, whose medium age was 71 years, presented the average of 79 beats per minute. The result of some further observations which this fact induced them to make, as to the relative frequency of the pulse in the young adult, and in the aged, proved, that the medium pulse of 110 young men, average age 31 years, was 65 per minute; of 27 aged men, average age 71 years, was 73 per minute,
at a temperature of 32° Far. —

Dr. Boumann and Deschambles of Paris, considering these as too limited a number of cases to draw correct conclusions from, investigated the subject for themselves, in connection with the respiration of the aged, and afterwards advanced what they considered confirmatory evidence of the truth of Leriche & Patrie’s experiments.

Knowing as we do, that the pulse is influenced by so many modifying causes, both inherent in the body and extraneous, it appears to me impossible to draw any definite or infallible conclusions on this interesting subject, without entering into a series of very lengthened observations, and at the same time having much more than ordinary facilities afforded for its investigation.

III. Temperament. — The same causes which produce a quicker pulse in women than in men, probably operate in different temperaments; for those persons who bear marks of a nervous, irritable, or sanguine habit, (which approximates to the female constitution), namely those who have a fair and florid complexion, light-
coloured and soft hair, blue eyes &c., coupled
with considerable sensibility of mind and
disposition. Persons, in a slight degree of
greater pulse, than persons with dark hair,
and eyes, have a hollow complexion, muscular
tonicsity, and in the mental qualifications,
resolution and equanimity.

Habit of body, also affects the pulse more or
less, but much depends upon the actual
state of the vascular system; for in the
case of Pithora, we may have the velocity
of the pulse ranging below the normal rate,
especially in a state of repose, but evidencing
by its character that the heart is affected
in its action; while on the other hand, if
there be a deficiency of the vital fluid,
as occurs in particular states of the system,
chlorosis for example, we may find the
pulse much accelerated and very irritable.
It has also been observed that, individuals
possessing an obese habit of body, have
an asthenic state, on a natural slowness
of all their functions; the circulation being
languid, and the pulse slow and small.
This state of the pulse may possibly be accounted for physically, by the thickness of the adipose tissue which intervenes between the finger of the observer, and the artery, so that it cannot sensibly manifest its pulsations. Opposed to this is the natural pulse of persons endowed with a spare habit; in these it is quick, energetic and tolerably full and developed, individuals of this class, being more sensible to the action of stimuli; by reason of their possessing more energy, more blood, and a more highly developed physical organization.

Stature. — Dr. Bryan Robinson, who possessed a very mathematical turn of mind, has given a table of pulses according to stature, taking six feet as the standard, at which height he found the pulse to be fifty-five, and computing upon this rule, which he says was founded upon a great number of observations, maintained, that the mean pulses of well proportioned bodies were to one another inversely, as the biquadrate roots of the cubes of the lengths of the bodies.
Smeac held a similar opinion, but his conjecture was somewhat different; he states the following proportion, viz.:

- At two feet — Pulse 90
- At four feet — Pulse 80
- At five feet — Pulse 70
- At six feet — Pulse 60;

the last number of which he says was deduced from the observation of a hundred men of the Royal guards, who were selected for that purpose, on account of the tallness of their stature.

Valler appears to have paid but little regard to this opinion, and instances in opposition to it, the Swif people, who are in general tall of stature, and their pulses more numerous. He himself was six feet high, and he says his own pulse beat 70 in a minute.

At the present day however, Smeac's would be decidedly too low an average.

It may be questioned whether difference of stature occasions so marked an alteration in the velocity of the pulse as the older physicians maintained, though, reasoning from analogy
it probably possesses some modifying influence. Observation proves to us that the energy of the vital powers is in an inverse ratio to the bulk of the bodies of animals; for, whilst the pulse of the elephant performs but very few beats in the course of a minute, that of the horse performs proportionately, in the same time, from 32 to 34; that of the ox, from 36 to 38; that of the sheep, nearly 64; that of the dog, almost 78; and that of pigeons, more than 100 — The truth of this seems more evident by comparing the pulse of an infant which beats 140 times, in the short space of a minute, during the first moments of its life, with that of an individual perfectly developed, which performs only 75 beats in the same time, as is the case with the pulse of an adult. — The reason why, in short persons, the pulse is stronger, fuller, and quicker, than in tall ones, remains to be elucidated, it may probably be, that the heart of the former is larger, relatively to the bulk of the body, than that of the latter, consequently the contractions of its ventricles are proportionately
more energetic; add to this, that the arterial
trunk is of lip extent. —

Idiosyncrasy. — Respecting this peculiarity,
there are but few conclusive facts known.
The lowest healthy pulse given by Flyger, was 55
in the minute; but lower frequencies have
certainly been met with in healthy persons.
Heberden records 42, and 30, and even 26 beats,
in a man of 80. — Findlay mentions the case of
an old man who fell under his notice, in
whom the pulse did not beat faster than
36 beats in the minute.

Pulses beating as low as 15 or even 14 beats in a
minute, are on record, but it admits of no
serious doubt whether the persons in whom
they occurred were healthy. — Falconer has
observed cases of very low frequency in women,
one beating only thirty-six, and another 24;
and Dr. Graves mentions the case of a "lady aged
fifty, of strong constitution, in whom since
her childhood, the pulse has never exceeded
38 in a minute;" the most singular feature
of the case being "that it is the same in all
positions, and its frequency is not altered by
"the ascession of febrile or inflammatory disorders, no disease of the heart either can be detected." — The Emperor Napoleon appears to have been the subject of a peculiar idio
dency in this respect; it is reported of
him, that even when enjoying the best of
health, his pulse never exceeded in frequency
45 beats in a minute.

From the little that is known however on this
kind, it becomes necessary that the young
practitioners should be aware of the fact
that healthy persons, however closely resem-
bling one another in age, temperament, and
constitution, frequently present marked dif-
fences in the state of the pulse; and the
knowledge of this will frequently be the means
of preventing rash conclusions being arrived
at. In an investigation of this kind, not
only the above modifying circumstances should
be recollected, but also others of a less in-
fluence, such as, position of the body, and
the state of sleeping and walking —

Posture. The credit of the most accurate obser-
vations in this point, appears to be due to Dr. Young
he remarks "that the pulse in the exact position " in healthy persons, is more frequent than in " the horizontal, by from six to fifteen beats in a " minute. If the pulse is but 60, the difference " is generally not more than six or eight, and "this difference increases with the frequency of " the pulse at the time of the experiment;
"Thus, if it has been raised to go or 100, by " moderate exercise, it is not unusual to find " the difference twenty or thirty."

Inversion of the body, the above author found to " have the effect of rendering the pulse some- " what irregular, and weaker than when in " the horizontal position, but did not find that " it further retarded it.

Dr. Guy however differs from him on this latter " and addresses in support of his own notion, a " table of the mean frequency of the adult male " pulse in the different postures; which is as " follows:

**Standing 79.** — **Sitting 70.** — **Lying, 67; including all " exceptions to the rule.**

**Standing 81.** — **Sitting, 71.** — **Lying 66; excluding all " exceptions to the rule.**
In the adult female of the same mean age, the numbers are,
Standing 95 - Sitting 83 - Lying 80; including all exceptions to the rule,
Standing 91 - Sitting 84 - Lying 80; excluding all exceptions to the rule.
The extremes however are very remote from these mean numbers. Numerous exceptions also exist to the rule that the pulse is more frequent in the sitting than in the lying posture, and the standing than the sitting.
The effect of change of posture on the same frequency of the pulse, is nearly twice as great in the male as in the female, and nearly three times as great in adults, as in early youth.
Seeing then that in the horizontal posture, the pulse attains simultaneously, the greatest strength and least frequency, Dr. Graves thought that by this means the relief afforded, by placing patients in the horizontal posture to avoid syncope, could be more satisfactorily accounted for, than had been hitherto done. That there is much lip, muscular
exercise required in the sitting than in the standing posture, and in the lying than the sitting, goes a great way to explain the fact of the differential pulse. Gravitation according to Dr. Perry, exerts a very considerate influence on the pulse; thus for instance he says, "if the arm be raised into a vertical position, the beat of the artery becomes much feeble." Dr. Robison also seems to have been fully aware of this fact.

The pulse may be arrested voluntarily; not by any effort of will on the heart itself, but by throwing the body into such a position, that compression will be exerted on the large arteries. Müller states that by taking a prolonged inspiration, we can for a short time arrest the radial pulse; but Dr. Robison observes, that, "whatever effort we may make, this does not always result, and the pulse can only be arrested at any time in this way for a few beats at a time." We can arrest it however in a far less painful manner, in one or both arms for as long as we like. To this end we have only to throw the shoulder,
facially backwards and downwards; by this position, the cellular-fibrous expansion of the cervical fascia, and the aponeurosis of the subclavian muscle, which stretches over the subclavian artery, is rendered tense, and presses upon the artery, thus diminishing its calibre. Dr. Blog turns this to advantage, for the purpose of arresting hemorrhage in wounds of the upper extremities. By this means also, we can facilitate the operation for tying the subclavian, for by putting the shoulders of the patient in this position, the depth of the cavity in which the artery lies may be diminished.

**Period of the Day.** Respecting the influence which time of day exerts on the pulse, we have several very accurate observers holding diametrically opposite views—Sir John Floyer remarked that his own pulse in the morning fasting, beat 76 times in a minute; at little before dinner 77, and immediately after dinner, 95.

Pouca in his Traité du Cœur, has left some observations on the same subject, and according to him the pulse which beat 62 in the morning,
rose to 86 after dinner. — Haller, found that the pulse which beat 75 in the morning, in the evening towards the time of rest beat 93. Dr. Bryan Robinson from whom we have a number of valuable experiments, and whose facts are drawn up with great care, states decidedly "that the pulse is slower in the morning, than at any other time of the day; that it grows somewhat quicker before breakfast, and a little more so after it; that it grows slower again before dinner, and quicker again directly after dinner, and that the velocity it acquires by this meal continues for about three or four hours, and then abates a little, and continues in that state without any considerable change, in persons who eat and drink little at night, till they go to rest" — advocating the other view we have Drs. Knox, Guy, and Shattock. Dr. Knox maintains that its greatest frequency is most marked in the earlier parts of the day, reaching its maximum about noon, and its minimum towards midnight. The most lucid observations are those made
made by Dr. Stalnor on his own person, aged 25, in the sitting posture, and worked into a series of tables which I propose to append.

Table 1. In thirty-four daily observations, from 18th of Nov. 2nd to 24th Dec. 1841, on twenty-nine days, the morning pulse was higher than the evening, and on five days it was lower.

<table>
<thead>
<tr>
<th>Time</th>
<th>Beats</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>81</td>
<td>91</td>
</tr>
<tr>
<td>Evening</td>
<td>87</td>
<td>4</td>
</tr>
<tr>
<td>Lowest</td>
<td>62</td>
<td>5</td>
</tr>
<tr>
<td>Average</td>
<td>63</td>
<td>9</td>
</tr>
</tbody>
</table>

The highest morning pulse was 91, the lowest 62, and the average 63.

According to this series, the morning pulse is higher than the evening, except once in nearly every 7 days, (6 1/2 days more correctly).

Table 2. In seven daily observations (25th-31st Dec.), the morning pulse was higher on six days, and lower on one day:

<table>
<thead>
<tr>
<th>Time</th>
<th>Morning</th>
<th>Evening</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>92</td>
<td>84</td>
<td>6</td>
</tr>
<tr>
<td>Lowest</td>
<td>76</td>
<td>64</td>
<td>12</td>
</tr>
<tr>
<td>Mean</td>
<td>83</td>
<td>73</td>
<td>10</td>
</tr>
</tbody>
</table>
Pulse was quicker on five days, slower on one, and the remaining day they were equal.

**Table 4.** For seven days (19th-25th), the morning pulse was higher on all the days.

**Table 5.** On twenty-three days (23rd Feb.-16th March), the highest pulses were, 19, morning; 3, evening; 1, equal.

**Table 6.** To take the average of all the series:

<table>
<thead>
<tr>
<th>Table</th>
<th>Morning</th>
<th>Evening</th>
<th>Equal</th>
<th>%2 of daily observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39</td>
<td>5</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>3</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>10</td>
<td>2</td>
<td>70</td>
</tr>
</tbody>
</table>

After deducting the two equal days from 70, we have in 76 days, the morning pulse quicker than the evening on 66, and slower on 10 days; the evening pulse being quicker once in 7 2/3 days.

The different views that have been taken of this subject, may be briefly stated as follows:
1. That the pulse is slower in the morning than in the evening.

2. That it is of the same frequency morning and evening.

3. That it is slower in the evening than in the morning.

4. That in 3/5 of cases, it is slower in the evening, and in 2/5 it is quicker.

The first opinion is the oldest, and was adopted by Heil (in 1718), by Robinson (in 1732), and Falconer (1796).

The second opinion seems to agree with some incidental observations of Dr. Port in 1814.

The third was first advanced by Dr. Knox, in which he was quite opposed to the views held by his predecessors.

The fourth opinion is supported by the experiments of Drs. Guy and Statton, which latter adds a

Fifth, viz. that out of seven days, the pulse is quicker in the morning on six, and slower on one day.

Table 7 shows the mean of the experiments made by Drs. Knox, Guy, and Statton.
Morning Pulse.

<table>
<thead>
<tr>
<th>Name</th>
<th>No. of Observ.</th>
<th>Higher</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Knox (say)</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Dr. Guy</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Dr. Straton</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

According to this, the morning pulse is higher than the evening, except once in eight and a half, or twice in 17 days.

It is probable that the great discrepancies of opinion which existed between authors who have devoted themselves to the elucidation of this subject, may have arisen from the earlier ones not having taken into consideration the effect of ingesta, different positions, mental emotion, etc., besides that of differently constituted individuals as regards physical energy and development.

Sleep. — The pulse is varied by the state of the system with respect to rest or activity. Observations have been sufficiently numerous to prove, that during sleep the pulse is usually slower than when a person is awake, as indeed might be anticipated from the
Consideration that various causes of excitement, both mental and corporeal, cease to operate during that condition. Duntz found that there was a difference during sleep of the beats in an adult female, the same difference in a girl from three to four years old, and in a boy from four to five years, a difference of sixteen beats. Boerhaave seems to have noticed this fact for he says "Pulsus dormientium manifeste tardior, secum lentior est, lentior item respiratio," and Albert Haller says nearly the same thing in these terms "Nam vigilatibus hominibus visus, et musculorum motus, et animi studium aut adspectus pulsu sunt, qua ommia ad dormiente homine absunt." It must be understood however, that the pulse varies both in waking and sleeping, in proportion to the improper duration of both; for sleep unnecessarily prolonged beyond the time required for recruiting the strength, renders the pulse weaker and slower; owing to the respiration being more languid, and this again favouring the collection of effete
matter in the blood, which matter exerting a delirious influence on the sensibilities, produces prostration of the vital powers. It is a well-established axiom that the inordinate prolongation of the period of repose, as is the case in some indolent persons, will induce a predisposition to apoplexy.

On the other hand, long continued wakefulness will excite the nervous system unduly, and consequently react upon the circulatory; as soon however as the system is restored to its former tone by sleep, the pulse re-acquires the ordinary strength, energy, and quickness, which it loses in the course of vigilance prolonged beyond the limits assigned by nature. But the pulse of an individual who enjoys a regular and tranquil sleep, is as different from that of him whose rest is disturbed, as a state of health is from that of disease. The pernicious practice of taking large suppers, crowned with Sunday "magent cup" of some stimulating fluid, a little time before going to bed, germinally carries its own punishment by inducing circulatory, or dreams of an unpleasant
Character, during which a disturbed state of the circulation is engendered.

Motion, Exercise, and Mental agitation.

Motion and exertion of every kind, is found to have the effect of accelerating the pulse; even the little effort that is made to preserve the body in an erect position, is sufficient to produce a very perceptible increase of the pulse above what it was in the sitting or recumbent posture. Moderate exercise exerts the most beneficial influence upon the circulation, rendering the pulse during the time it is used, fuller and quicker, and imparting to the muscular system the tone and vigor which it may have lost from the debilitating influence of long repose. On the contrary, if the bounds of moderate exercise be exceeded, the pulse becomes labile in its beats; the heart in persons who rise regularly, very violent exertion is generally found hypertrophical, by which condition, the pulse is rendered, strong, irregular, and frequent. In persons who are accustomed to much exertion, the pulse will be found to undergo a collapse on the cessation of the excitement, falling to
much below the natural standard. Dr. Robinson has given a proportion of relative increase upon change of position and motion, as follows: Lying down, Pulse 64. Sitting, Pulse 69. Standing, 70. Walking at the rate of two miles an hour, 73. At the rate of four miles an hour, 107; running raised it to 140-150 or more.

Speaking in persons in ill health, is a kind of exercise which has a considerable effect on the pulse, acting not so much by the muscular effort required, as by the mental agitation it involves. Every physician has observed the pulse quickened during his examination of it several beats in a minute, on a question being asked the patient at that time, more especially if there be a febrile state of the system existing. The depressing passions also, as fear, grief, anxiety, tend to render it weak, whilst, the stimulating passions, such as joy, and anger, render it fuller and stronger. — Floyd mentions a case in which
the pulse was raised to 104 in a minute; from an excessive fit of anger, he also states that the circulation did not recover its tranquillity for 3 or 4 days. — Authentic cases are on record, where either the atheistic or athesitic passions having invaded a man suddenly, with great impetuosity, have even extinguished life immediatly. — Among other cases exemplifying the influence of terror, the following is related by Ludovico Visi; "A Jew, in Frenze, put in the dark without harm, across a dangerous place which lay over a brook; the next day on viewing the perils situation in which he had been placed, he fell down dead." Many instances of the fatal effects of joy, are also recorded: the fate of Sophocles, who died on being crowned, for composing a successful tragedy in his old age, is an early though opposite example; also that of Chilon of Lacoonon, who whilst embracing his son, when disclaiming Victor in Olympic games, died in his arms.
Precautions to be observed in examining the pulse.

Before we could derive any correct information from the pulse relative to disease, it was necessary to be acquainted with the foregoing facts which have been ascertained concerning its common standard, and the common causes of its variation. Against the above-mentioned ordinary causes of the fluctuation of the pulse, the practitioner must be always upon his guard even in disease; and although the advice of Claren may be old, it is not in that account of disconsideration, as long as the pulse continues an object of medical attention. After enumerating many causes of its variation, he mentions apprehension, anxiety, and other mental emotions. "Therefore" says he, "when the physician first enters the room, if he be a skilful man, he will not immediately apply his fingers to the patient's wrist, but he will first sit down with a cheerful countenance, and make some general enquiries; and if he perceive any alteration in the patient, will relieve him by encouraging remarks, and will then proceed to examine the pulse. Now if the
"sight of the physician be sufficient to quicken the pulse, how easily may a thousand other circumstances disturb it?" It appears to me that no better counsel than the above can be given, and his preservation with regard to the cheerful countenance is in my humble opinion of the utmost importance in imparting to a patient confidence and hope; having, myself witnessed the beneficial effects produced in a patient, who was obliged to endure the infliction of a daily visit from a medical man who was unfortunately for his patients, endowed with an extremely unprepossessing and morose visage, combined with uncultivated manners.

In examining the pulse, the two principal qualities to be ascertained are, the quickness and strength of the pulsations. — The former of course is easily determined by a stop-watch, but the latter requires some amount of tact and experience, for, as above stated, the degree of strength in the pulse is very different in individuals of different age, sex, temperament and rigor, in health.

In order to arrive at the force of arterial pulsation—
tion, the vessel should first be grasped firmly, by at least three of the fingers placed horizontally, and if any doubt arise, it should be then strongly compressed, till no pulsation can be felt, and then the fingers should be gradually relaxed, until the comparative force with which the pulsation returns may be estimated; the degree of compriinitivity of the pulse, or the facility with which the pulsation may be entirely stopped, affording a tolerably good comparative notion of its strength. The degree of obesity of a patient, should also always be attended to, in estimating the strength of the pulse; for very fat persons profess naturally a feeble state of the circulation, and moreover, the pulsation of the artery is less distinctly felt through a layer of adipose tissue. A strong, firm pulse, is consistent with good health, for the heart contracts with vigor when filled with healthy blood; but the strongest pulse, though scarcely com-pressible under the finger, has some degree of softness, if healthy.
Varieties of the Pulse in different Diseases.

In diseases of the Encephalon.

In active congestion of the brain, the pulse is weak, suppressed, or sluggish, often slower than natural, and occasionally unequal. The arteries are in an unfilled state, or which account, the pulse becomes jerking in its character, or in other words, it is the anemic pulse.

In Influenza of the Dura Mater.

In the 3 stages of acute meningitis.

The first stage is characterized by the pulse being frequent, usually full and hard, unless the subject be weakly or anemic, when it is sharp.

Is the second stage, or that of dyspnoea, the pulse in consequence of central confusion, or obstructed circulation, not only becomes weak and soft, but...
In SLOWLY, we heard the pule, quick, quick, quick, and sometimes quieter, quieter, becoming slower, slower, slower, until it was the pule. Meanwhile, the noise of the traffic, the sound of the wheels, the hum of the street, the shouts of the people, all faded away completely. The pule became more and more distinct, until it was the only sound we heard.

The pule was a human, rhythmic, repetitive sound, a reminder of the beat of life, the pulse of existence. The pule was a symbol of survival, of continuing to live, to breathe, to exist.

As we listened to the pule, we began to understand the importance of this sound, the pule, in our lives. It was a reminder of the fragility of life, the delicate balance between life and death. The pule was a symbol of hope, of the possibility of survival, of the power of the human spirit.

We listened to the pule, and we listened to the world around us, to the sounds of the city, the sounds of life. We listened, and we learned, and we understood the importance of the pule, the significance of this human, rhythmic, repetitive sound.
Acute partial arteritis.

The pulse seldom rises above 70 or 80, and sometimes remains at or falls below its natural standard.

It differs in the three stages.

In the 1st stage, it is at the first little elevated, but occasionally irregular both in force and frequency, but if the symptoms be still marked it is accelerated and excitable.

In the 2nd stage, it becomes irregular, and of unequal force, decreasing in frequency till it falls to the natural standard, or below it, accelerated by the slightest exertion.

In the 3rd stage, it becomes more frequent, often rapid, thready, and weak, and has been known to rise as high as 210 in a minute.

In transient apoplexy, the pulse is strong, not frequent, sometimes bounding.

In sudden or primary apoplexy, the pulse is usually full, not frequent, or below the natural standard, but occasionally
small and weak.

In insidious apoplexy, although the patient quickly recovers consciousness, the pulse becomes gradually weak and frequent, again acquiring strength a short time before coma supervenes.

The character of the pulse in apoplexy is very variable. It may be strong without frequency; a soft, or it may be firm and irregular. At the commencement of an attack it may be slow and full, and at the termination, it may be weak, rapid, and irregular. The character of this disease is of great importance, and are also valuable diagnostic signs.

In the 1st stage, it is slow, soft, and easily compressible, often full and irregular.

In the 2nd stage, small, and soft, ranging between 100 and 120 beats per minute.

In the 3rd stage, the pulse rises in frequency, becoming so rapid as scarcely to be numbered, and often thread, and hardly perceptible.
Epilepsy

The pulse at first small, becomes frequent, hard, irregular, and sometimes imperceptible; after the attack, it becomes full, soft, and angular. A weak, small, and accelerated pulse, is one of the presacriatory symptoms. The character of the pulse in tetanus varies according to the stage of the disease; in the early part there is no remarkable acceleration, but during the spasms, it is somewhat quickened, and towards the termination of the disease it becomes weak and frequent, also thready. — Dr. Parry held the opinion that "the patient was safe, if the pulse did not exceed 110 beats in the fourth or fifth day." In reality, however, can be placed on this statement, many cases having died when it was lower, while others have recovered when it was more frequent.
The Pulse in Thoracic Diseases.

In Thoric Bronchitis, the pulse is quick and frequent, and in asthenic Bronchitis, it is quick, weak, and often irregular and unequal.

The pulse is generally quick and hard, but we may find it small and weak, if the effusion is great as considerably to interfere with the function of the lungs.

In this disease the pulse is usually quick, and in most instances shocky, sometimes, but not commonly it is hard, but it generally loses this characteristic as the disease advances, becoming feeble.

In Heart diseases.

The pulse is very variable; in some forms often but little affected, whilst in more aggravated cases it is feeble, irregular, or intermittent in some, quick and strong in others, its arrangement being frequently accompanied by a marked tendency to syncope.
It is very variable also, in some rare cases being unaffected at first, or according to Dr. Williams "slower than natural"; more ordinarily the pulsations at the wrist, towards the commencement especially, are frequent, full, strong and regular; in they may be hard and jerking, along with violent impulse of the heart; or again small and lively and quite at variance with the strong action going on in the cardiac region — at an advanced stage of the disease the pulse is small and weak, uneven and irregular — Dr. Jones is of opinion that the intermittent pulse is amongst the earliest signs of approaching periocarditis, caused by a "regular cardiac action".

In this disease if the circulation through the heart be free, the pulse is not remarkably accelerated, ranging between 80 and 120; Dr. Taylor states that it "less in frequency at the onset of the complaint". In those cases when the
Circulation is obstructed, the pulse is small, weak, irregular in force and rhythm, and rises to 130, 140, 150, or even higher.

As a consequence of mitral regurgitation, the pulse becomes irregular, unequal, and weak, but when complicated with dilatation by hypertrophy of the left ventricle, we may have it regular in force and rhythm, small, with occasional sharpness, rather frequent and comparatively, unless there is much hypertrophy; — or irregular in force and rhythm, small, feeble, with occasional sharpness, and tenuously under excitement of the heart.

The character of this is the same as in mitral regurgitation; if, however, these coexist, we may have the palpable pulse, and distinctly visible aortic pulsation.

The pulse in cases of moderate constriction, is not materially affected; if the constriction be great, the pulse though regular in force and rhythm,
Antic

Rejuvenation.

Hypertrophy.

is small, hard, rigid, and contracted. In this condition of the valve, the pulse is abrupt, short, jerking; a sudden fall back instantly following the rise of the nipple. Commonly regular in rhythm, sometimes notably lagging behind the second sound of the heart, occasionally deceleration, and each pulsation is in rare instances attended with a thrill.

In simple hypertrophy of the left ventricle, and also in that with thickening predominating over dilatation, if no valvular disease be present, the pulse is strong, full, regular and tense, prolonged under the finger, in consequence of the intracardiac systole of the ventricle. In concentric hypertrophy also, the pulse is tense and thickening, but in consequence of the small wave of blood emitted at each systole, it is smaller than in the preceding instances.

In dilatation, the pulse is large, soft, un-
Dilatation

In

Atrophy.

In

Softening

Fatty

Degeneration.

In

Aneurism

of the

Aorta.

slow of reaching the distant arteries, but
not necessarily irregular or unsteady, when
complicated with softening of the heart, or
vascular disease; in the latter stages however,
it becomes irregular and small, on account
of the concomitant atrophy and dyspnea.
In this disease the pulse is weak,
small, and thread-like.
The pulse irregular in force, may be
excessively so in rhythm; being feeble,
fluctuating and small; in some instances
it has been observed unnaturally slow.

Pulse irregular in force and rhythm
either constantly or from time to time,
under excitement; on such occasions
it may become extremely frequent.
The radial, carotid, and subclavian
pulses, are occasionally rendered unequal in force and frequency: the pulse
on the side affected also, beats a little
later than on the sound one; the pulse
has also a sharp and jerking charac-
ter, and is sometimes acentous.
The Pulse in Abdominal diseases.

At the commencement the pulse is frequent, rapid, and concentrated, but as the disease advances, it acquires the pathognomonic character of abdominal affections, becoming very frequent, ranging from 120 to 130 in a minute; it is also very small, as if not only the heart, but also the aorta, at the wrist, had contracted upon itself; yet if it be accurately examined it will be found smaller than natural, feeling like a small whisper and a half string vibrating under the finger.

In inflammation affecting the serous membrane of the bowels, the pulse prognostics a different character, being in general, soft, insensible, but rapid and as frequent as 120 in a minute.

In the peritonitis, when the peritonenum becomes involved, we have again the peritoneal pulse.

In Diarrhea the pulse is sometimes said to be intermittent, as always by some old writers.
In this as in other abdominal diseases, the pulse is small and weak, but in fatal cases it becomes very rapid, and small.

In Acute Gastritis.
The pulse is frequent and small, for a short time persistent, but soon becoming weak and thready.

The pulse has nothing characteristic; in some persons it is steady, slow, in others frequent and irritable; in one patient intermittent, in another irregular.

The pulse is not much accelerated, but is full and hard in its character.

Scarcely audible.

The pulse in these diseases is merely a modification of the general inflammatory pulse.

The Pulse in Fevers.

In Syphillis or inflammatory fever, the pulse continued at first is soft and fluctuating, afterwards becoming hard, sometimes full a
In Continued Fever.

Bounding, often small, high and incurvivisible, generally very rapid, mounting even to 140, 150, or 160.

In typhus, or nervous fever before the accession of true typhus, the pulse is full and more curvivisible, still jarring, but falling somewhat in frequency.

In typhus, the pulse becomes frequent, ranging between 90 and 100, seldom higher, except in the young or in irritable habits; occasionally natural, or even under the healthy standard; generally however it is small, jarring, and always easily curvivisible.

In the cold stage, the pulse is small, contracted and firm, generally quick but sometimes slow and intermittent; the rigors however present its being accurately noticed.

In the hot stage, it becomes full, strong, and frequent.

In the feverish stage, it continues full, but loses its hardness and frequency.

The pulse preceding the attack is less frequent than in health; on
the accession of the fever however, it becomes frequent, sometimes small and irregular, at other times full and forcible, but rarely hard or tense; during the remission there still remains much quickness and irritability.

In Infantile Remittent Fever.

During the exacerbation the pulse is very rapid, varying from 120 to 160.

The pulse is generally frequent, varying between 90 and 120, usually small, jarring but compresible; always irritable, and accelerated by the slightest excitement; generally quicker in the evening.

In Scarletina Simplici, the pulse is only accelerated in an ordinary disease.

In Scarletina Anginosa, when the delirium is great, the pulse is more frequent and of unequal strength.

In Scarletina Maligna, it is small, full, and often irregular.

Emilius Rowley Nicholson. 1853.