THE INTERNAL AND EXTERNAL TEMPERATURE OF THE HUMAN BODY AS MODIFIED BY MUSCLE-KNEADING: WITH SPHYGMOGRAPHIC AND SPHYGMOMANOMETRIC RECORDS.

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THE observations on the internal and external temperature of the human body which I have ventured to offer for the consideration of this Section are based upon a series of experiments extending over a period of nearly eighteen months, but the examples selected for their illustration are derived for the most part from the records obtained during the past five months, before and after subjecting healthy individuals to the process of kneading the muscles of the trunk and limbs on the one hand and the abdomen with its contents on the other. The results afforded by these examples are identical with those which were noted in the earlier experiments, differing from them only in their elaboration by the addition of sphygmographic and sphygmomanometric readings taken under the same circumstances as the thermometric records.

In order to avoid as far as possible any sources of error in the investigations referred to, the individuals dealt with were carefully examined as to the state of their organs, secretions, habits, and mode of life; and any conditions which might tend to modify the uniformity of the circumstances under which the observations were made have been noted. Briefly, the subjects were all healthy persons who had not taken food for four hours prior to the hour appointed for experiments, which were carried out in a room whose temperature, as registered by an ordinary thermometer placed at the head of the couch, was maintained at 65° F. The subjects were divested of their clothing and placed in the recumbent position on a couch or bench, and covered with a Turkey towel sheet and a warm rug. The thermometers were then applied in the situations indicated—an ordinary magnified index clinical thermometer for the axilla, three Immisch's for the surface, and a strong clinical thermometer of the ordinary pattern for the rectum (this last being encased in metal to avoid any untoward accident). As soon as the thermometers had been adjusted, sphygmographic tracings and sphygmomanometric readings were taken of the radial artery on the right side, the pulse being also taken by the finger. In every case Richardson's modification of Dudgeon's pocket sphygmograph was employed, the clockwork being wound up before each application, and the length of the band necessary to enclose the wrist and retain the instrument firmly in position having been ascertained, a distinguishing mark was made on the ends of the band exactly where the clamp was first secured, so that it might be adjusted accurately in the same position on each subsequent occasion of its use for the same individual. The same pressure was always used for all the tracings taken from the artery of a given individual throughout the experiments to which he was subjected, but varying pressures were employed in different individuals. In regard to the manometric records, they were taken with von Basch's pocket sphygmomanometer, care being taken to avoid any error through slow leakage by refilling the tube whenever the drum (or "pelotte") appeared to contain any air; and in each case the compression of the artery was repeated, the reading recorded by the pointer being taken at the moment of perceptible disappearance and again of first perceptible reappearance of pulsation.

The conditions of temperature and circulation having been thus noted, kneading of the lower extremities, trunk (excluding the abdomen), and upper extremities, in the order here set down, was employed for a period varying from half to three-quarters of an hour, according to the time required in order to thoroughly carry out the manipulations, necessarily varying with the muscular development of the individual; but in each case the character and extent of the kneading were rendered as uniform as possible.

At the conclusion of muscle-kneading the instruments were reapplied, and the readings having been taken, abdominal massage was then employed, the stomach and liver being first dealt with, then the small intestines, and finally the colon and sigmoid flexure, the course of the large intestine being carefully followed, its gaseous or solid contents being propelled as far as possible

towards the commencement of the sigmoid flexure. Abdominal kneading, as a rule, occupied from fifteen to twenty minutes, but occasionally, as in the case of Example II, the process was prolonged.

The records were again taken, and the experiment thus concluded, save in the cases of certain individuals who submitted themselves to further thermometric investigation with a view to show the length of time during which the effect of the manipulations appeared to be maintained.

The first example to which I desire to draw your attention may be taken as typical of a series in which the effects on the circulation described by me in a paper on the physiological effects of massage, read before the Royal Medical and Chirurgical Society of London in January, 1887, are produced, and further investigated and confirmed by the sphygmographic and sphygmomanometric records. So, also, with the thermometry, previous observations have received confirmation, but an additional inquiry into the internal temperature as indicated by rectal thermometry has been included in the experiments made, with the unvarying result shown in the tables of temperature, that as the axillary and surface temperatures rise under the influence of muscle-kneading the rectal temperature falls, while exactly the opposite effect is produced by kneading the abdomen. The subject of this experiment was a healthy male, aged 25, whose height was 5 feet 8 inches and weight 10 stone 12 pounds, with good muscular development, free from organic disease of any kind, and leading an active life.

Table of External and Internal Temperatures in Example II.

Before Muscle-Kneading.	After Muscle-Kneading.	After Abdominal Kneading.	Situation.
98.0° F.	99.4°	98.0°	Thermometer.
98.0°	97.0°	93.0°	15 mins. 20 mins. 30 mins.
91.0°	95.0°	93.0°	98.0° 97.4°
87.0°	90.0°	87.0°	94.0° 84.0°
100.4°	99.6°	99.8°	100.6° 101.8°
			100.6° 101.8°

It will be noticed in this example that the initial axillary temperature is only 98° F., somewhat lower than that which is indicated on the scale of clinical thermometers as representing the average normal; but I attribute this to the unclothing of the patient, rather than to any inaccuracy in the record, as the thermometers for each reading were kept *in situ* for ten minutes, so as to avoid any error arising out of hurry in taking the note. The surface temperatures having in each case been taken by means of an Immisch thermometer, fractions of a degree are not noted. The effects of muscle-kneading are well seen in this example in regard to the internal and external temperatures; for whereas there is a difference of 2.4° F. between the axillary and rectal temperature, as much as 13.4° F. between the temperature of the foot-sole and the rectum, 9° and 10° respectively between the calf and palmar temperature and that of the rectum, and a corresponding difference between the axillary and surface temperature, it is found, on reference to the next column, that the axillary temperature has been raised 1.4° F., the surface records more nearly approach the axillary degree, while the rectal temperature shows a declination of 0.8° or 1°.

After abdominal kneading only, practised on the same occasion as soon as the temperature and pulse records had been made after muscle-kneading, one finds a gradual decrease in the axillary and superficial temperature, with a steady rise of rectal temperature, until at the close of half an hour's abdominal manipulation (excluding the necessary intervals for the observations recorded at the close of fifteen and twenty minutes), the axillary temperature stands at 97.4° F., a decrease of 2° F. below the post muscle-kneading record, with a much more marked reduction of surface temperature, and a gain in the rectum of 2.2° F. above the degree noted before abdominal kneading, and of 1.2° F. above that which was registered by the rectal thermometer before the muscle-kneading had been carried out. It will, I think, be interesting to compare with these alternations of temperature the condition of the circulation so far as observations on the radial pulse will allow.

First, in regard to the pulse rate, it was found to vary as follows:

Before Muscle-Kneading.	After Muscle-Kneading.	After Abdominal Kneading.
75	70	72 65 64

The sphygmomanometric readings were:

Before Muscle-Kneading.	After Muscle-Kneading.	After Abdominal Kneading.
139 mm. Hg.	170	140 120 120

The sphygmographic tracings were taken under a pressure of

¹ Read in the Section of Anatomy and Physiology at the Annual Meeting of the British Medical Association held in Glasgow, August, 1888.

three ounces, the precautions previously referred to having been taken to ensure accuracy.

Sphygmographic Tracings in Example H. Pressure 3 ounces.

Before.

After.

After temperature records before abdominal kneading.

After abdominal kneading, fifteen minutes.

After abdominal kneading, twenty minutes.

After abdominal kneading, half an hour.

I will not here attempt to analyse the characters of these readings, except in reference to those which appear to be common to all the experiments, for it will be found that, although one sometimes notes a diminution in the pulse rate after general kneading, excluding the abdomen, occasionally, especially if the kneading is not prolonged, the pulse rate is rather accelerated than diminished, and this (which has occurred more frequently in my practice since the conclusion of the experiments, of which my previous paper on the physiological effects of massage was the record, than before) I attribute to a modification of the reflex action following stimulation of the cutaneous and muscle sensory nerves, which I believe depends not only on the vigour or intensity of the stimulus applied,

but also in a great measure on the varying irritability of the general nervous system to which the irritability of the cutaneous sensory nerves is a valuable index. But in regard to the modifying influence of abdominal kneading on the pulse rate, it will always be found, so far as my experience hitherto goes to show, that this is in the direction of retardation, even in cases of what, for want of a more clearly recognised condition, are termed abdominal neuroses, in which the pulse rate is already diminished.

It will be seen on reference to the temperature records, tracings, and manometric readings, which I have brought with me to-day for your inspection in addition to the examples quoted in this paper, that the records just referred to are by no means the most remarkable, as some of the others afford better examples of the pulse-rate variations; but I have selected this experiment rather with a view to demonstrate the effect of abdominal kneading as compared with muscle-kneading on the temperature topography than on the pulse.

Now allow me to refer to an example in which, while the majority of effects produced by the different manipulations are similar to those occurring in Example H, it will be seen that here muscle-kneading was followed by acceleration of the pulse rate, other effects undergoing no apparent variation from those noted with a diminished pulse rate.

Table of External and Internal Temperatures in Example B.

Before	After	After	Situation of
Muscle-Kneading.	Muscle-Kneading.	Abdominal Kneading.	Thermometer.
98.4° F.	99.8°	98.6°	Axilla
94.0	97.0	96.0	Palm
95.0	97.0	94.0	Calf
93.0	95.0	92.0	Sole
99.0	99.0	100.4	Rectum

The maintenance of the rectal temperature after muscle-kneading alone constitutes the only deviation from the usual condition, and does not occur in the other cases wherein the effects have been noted in dealing with healthy persons under ordinary conditions of activity; but it is not so infrequent in cases of persons whose surface temperature appears to be improved by a course of massage pursued during a period in which the patient is kept at rest in bed.

In this case the pulse rate varied as follows:

Before	After	After
Muscle-Kneading.	Muscle-Kneading.	Abdominal Kneading.
84	102	60

The sphygmo-manometric readings were:

Before	After	After
Muscle-Kneading.	Muscle-Kneading.	Abdominal Kneading.
140 mm. Hg.	160	140

Sphygmographic Tracings in Example B. Pressure 2½ ounces.

Before.

After.

After abdominal kneading.

Under a pressure of two ounces and a half the sphygmographic tracings show an increase of amplitude of the ascending limb with a more rapid fall after muscle-kneading, the amplitude of the trace, even after abdominal kneading, being in excess of the first tracing taken before any manipulations had been practised, while the retardation of the pulse after the abdominal kneading amounts to 42 beats per minute. The subject was a man, aged 40, of somewhat spare habit of body, who appeared to be free from disease; but he was a little inclined to be afraid of the instruments on this occasion, the first of several experiments to which he subsequently submitted without alarm.

It appears, therefore, that the effect produced on the rate of the circulation by muscle-kneading varies from not a very marked reduction of rapidity in the majority of cases to an increase in celerity sometimes amounting to twenty beats or more in a comparatively few cases; but clinical experience teaches that the effect on rate alone is not a reliable guide as to whether or not treatment by mechano-therapy is likely to prove valuable; the effects on temperature, however, are very significant, and have been found useful by me in helping to decide as to what dosage of the various manipulations should be employed in different cases. Moreover, it is found that under a course of muscle-kneading extending from three weeks to two months, the temperature topography, which in feeble persons, and notably in dyspeptics and persons suffering from malassimilation, assumes much greater disproportions as between axillary, surface, and rectal temperatures than in health, will be modified very considerably, internal and external temperatures being more nearly approximated and less easily influenced than before the treatment, which of course consists also in careful dieting and rest.

If I have transgressed in referring to these clinical matters before this Section, I have done so because the question may arise in regard to these observations, *Cui bono?* To those who do not regard this method of treating disease by mechanical rather than pharmaceutical means as a fad unworthy of serious investigation, it may possibly impart an interest to these observations on healthy persons undertaken in order to test certain phenomena previously noticed at the bedside, and I would venture to hope that these records, imperfect though they be, may induce some who are inclined to deny the efficacy of mechano-therapy to see whether the failures they have met with are not rather due to its unskilful application by persons who, if they knew how to perform the ordinary manipulations, are not to be entrusted with the administration of the remedy save under the most rigid supervision of one who is conversant with the subject.

It will be seen from the temperature records before you that the immediate effects of muscle-kneading are to raise the external temperature, and at the same time to approximate the external and internal temperatures, the rectum apparently losing heat while the surface of the body gains it, and in some instances the axillary temperature has been found to be higher by a fraction of a degree after muscle-kneading than the rectal temperature; this may be an error in the thermometry, but as it has occurred with different thermometers and on various occasions, I have thought that possibly it may be accounted for by an actual loss of heat in the abdominal organs owing to the abstraction of blood from them towards the periphery, where not only are the vessels dilated and the blood current increased in volume, but, as I think we may infer, greater activity of interchange between the blood and the tissues has been brought about by the mechanical stimulation of the local nerves. The increased blood-pressure following muscle-kneading is followed by a marked fall on the substitution of abdominal kneading; it would therefore appear that, as abdominal kneading causes a diminution in the volume of the radial pulse, previously enhanced by muscle-kneading, we should not be guilty of unfair theorising if we believe that the loss of rectal heat is due to a diminution in the calibre and contents of the abdominal vessels with a synchronous cooling of the internal temperature, and this is the obvious conclusion to be arrived at if, on the other hand, the rise in rectal temperature is to be attributed to the altered conditions of abdominal circulation, which it is probable exist in a modified degree, as Goltz proved them to occur in his tapping experiment on the frog. Certainly the characters of the peripheral circulation, as shown by the sphygmomanometer and the sphygmograph, are somewhat akin to those which have been noted when, as it is said, "the animal was as it were bled into its own belly."

The gain in surface-temperature following the muscle-kneading will be lost by radiation if the subject is not kept well covered

both during and after manipulation; and it may not be uninteresting to note here that where these precautions are omitted the whole body temperature will be reduced if the surface, with its greatly-dilated vessels, is not protected from the effects of exposure. I have known the axillary temperature, after having been raised to 99.8° F., fall to barely 97° F., and the rectal temperature to below 98° F., the thermometers having both been shaken down to 95° F. before being placed in position. Now this loss of heat does not follow either the one form of kneading or the other if the surface of the body is kept covered. The immediate effects of the process do not maintain their intensity for a longer period than an hour, so far as my observations serve; but for three hours after a noticeable effect exists, in that the temperature will remain more nearly equalised, and the amplitude of the pulse-tracing remains increased above the record taken prior to the muscle-kneading for over two hours after the conclusion of the experiment.

The effect of manipulating the muscles on the circulation, as shown by the sphygmograph, is invariably that the amplitude of the ascending portion of the trace is increased, and with this it is also rendered more vertical; dicrotism as a rule appears to be less marked, and sometimes a systolic plateau is developed to a greater extent than it was prior to the kneading; but with the exception of the increase in amplitude and verticality, there is no constant feature common to all the tracings taken. This greater amplitude and verticality of the systolic wave must, I suppose, denote a more sudden and forcible contraction of the ventricle, though, as some of the traces show, this does not always imply a short, sharp systole, for in certain of the subjects the contraction appeared to be prolonged, a long vertical upstroke being followed by an almost horizontal short line terminating in a more or less well-defined notch.

Burdon Sanderson has attributed the sharp expansion of the artery to reflex influences on the heart, and has described what he calls "the shock sound" heard at the impulse preceding or inaugurating the first sound of the heart: this sharp sound I have only been able to recognise in the cases where the pulse rate was reduced after muscle-kneading in patients suffering from chronic Bright's disease or gouty symptoms with arcus senilis and other signs of arterial degeneration, and in one case after a month's kneading the sound appeared to be less easily distinguishable. The greater verticality and amplitude of the wave in the tracings appears to be associated with an increased quantity of blood sent through the vessel, which is obviously dilated; it may be that on the conclusion of the kneading the vessels of the limbs are almost over full, and thus give rise to the sudden and more forcible contraction of the heart, in order to send the blood through the distended vessels; the manometric records point to a greater fullness of the vessel, and this also is usually apparent to the finger. The conclusions I have ventured to arrive at from the results obtained by these experiments and clinical observations are that after general kneading, excluding the abdomen, the amount of blood sent out by each systole is increased, the quantity of blood sent to the right side of the heart being increased by the centripetal squeezing of the veins, the circulation through these vessels being by this process aided and accelerated, thus providing a greater volume of blood for distribution by the pulmonary system, and so supplying a larger quantity of blood to the left side of the heart, the increased pressure so produced within the ventricle stimulating it to more forcible contractions. The force of the cardiac systole, I believe, is increased, whether the pulse rate is accelerated or retarded by muscle-kneading, the influence on rhythm being of a reflex character, depending on the degree of stimulation of the sensory nerves, the slighter stimuli afforded by moderate kneading² affecting the accelerator centre, which we are told that "it is more than probable exists in the medulla oblongata,"³ while the stronger stimulation of vigorous kneading affects the vagus centre.

My reason for believing that the increase in pressure recorded by the manometer after muscle-kneading depends on the action of the heart equally in the cases of accelerated and retarded pulse rate, rather than on the condition of the peripheral vessels, are based on the fact that the manometric pressure was estimated at the moment when the pulse ceased to be felt by the testing finger on the distal side of the drum or "pelotte." I am aware that, unless the greatest care is taken to avoid too long compression of the vessel, an erroneous reading will result, as one will obtain a

² Effleurage or friction of the skin accelerates pulse rate, *Practitioner*, June, 1887.

³ Landois *Physiology*, p. 887.

record of the centripetal *plus* the centrifugal wave, if practice has not rendered the tactile sense more keen than it is at first when commencing to employ von Basch's little instrument; and, unless I had been warned against this source of error, and had been careful to obviate mistakes arising out of it, I should not have ventured to draw your attention to this phenomenon of apparent independence between pulse rate and pressure, or rather, as I would prefer to state it, with great diffidence, as the result of these observations, the apparent independence of the force of the ventricular contractions on their number.

Marey has shown that the effect of muscular action, as tested by his experiment on the horse, in which he applied his compensating manometer to the carotid before and after making the animal canter for ten minutes, is to increase the frequency of the pulse and to decrease arterial tension, exactly opposite conditions arising after the animal had been allowed to rest; from which he argues that the first effect of muscular exercise is to accelerate the course of the blood in the vessels of the limbs, the acceleration of the heart's rhythm being a secondary effect, and depending on the decrease of arterial tension which follows on the dilatation of the peripheral vessels. Within the limits of this paper it is not possible to detail further the deductions drawn by so great an authority on this subject, but he sums up his views thus:—

"So, then, one of two conditions exists: either the force of the heart is first increased, and under some exciting influence the beats of the heart are accelerated; or the first effect is a more easy flow of blood through the small vessels, from which arises lowering of arterial tension and secondary acceleration of the heart. One way of settling the question is to gauge the arterial tension by means of a manometer. In fact, in the first case, if it is an excess of impulsion which constitutes the initial phenomenon, there ought to follow an elevation of arterial tension. In the second case, the tension will be diminished. The enormous increase of energy in the heart's beat under these circumstances would tend to make us believe that the heart really expended greater force after violent muscular exercise. It is not so. The fall of arterial tension increases the force of the pulsations of the heart and arteries."

It was a source of great perplexity to me when I found, both under the circumstances of increased and decreased rapidity of pulse after muscular kneading, that, with what one believes to be a condition of dilated vessels as shown by the greater warmth and redness of the surface, and the visibly greater fullness of superficial vessels, one also obtained from von Basch's sphygmomanometer a rise of pressure; and if careful search for a source of error and constant repetition had not confirmed the result of the earlier experiments, I should have felt still greater hesitation than that which I feel to-day in drawing your attention to this unexpected and unlooked for condition, which is apparently the result of kneading the muscles of the limbs and trunk.

I much regret that I have not been able to institute control experiments with a schema which doubtless would have helped to clear up this difficulty; but, failing this, the fact remains that, unless some fatal inaccuracy has crept into the observations made, the sphygmomanometric pressure is increased independently of the increase or decrease in the number of the heart's beats, and in spite of the dilatation of the vessels; so that, in default of a better explanation of this phenomenon, one ventures to suggest that the effects of muscle-kneading, as shown by thermometric, sphygmographic, and manometric readings, is to increase the force of the heart's action, the quantity of blood passing through the external organs (muscles and skin), and the interchange between these tissues and the nutritive fluids, whose passage through them is thus facilitated.

On the other hand, judging from the results obtained by similar tests in their application to the effects produced by abdominal kneading, one believes that by this process the rhythm of the heart is influenced uniformly in the direction of retardation, the vessels of the external tissues, probably also of the brain,² are contracted and unloaded, the circulation through these parts, as also their warmth, being diminished; while, judging from the increase of rectal temperature arising during and after the process, it is probable that the abdominal organs undergo a modification of their circulatory conditions similar to that shown to exist in the skeletal tissues after muscle-kneading.

SECTION OF ANATOMY.

WEDNESDAY, THURSDAY, FRIDAY, AUGUST 8TH, 9TH, AND 10TH.

Development of the Heart.—Mr. LOCKWOOD showed a series of histological specimens to illustrate the early development of the pericardium, diaphragm, great veins, and organs of respiration. The series began with sections showing that the mammalian heart was developed in splanchnopleure and in two separate parts, situated on either side of the situation of the future pharynx. The gradual approximation of the halves of the heart was illustrated, until at last it became a single median organ attached to the ventral wall of the pharynx by the mesocardium posterius. From its commencement the splanchnic heart protruded into the foremost part of the cardio-pleuro-peritoneal sac. Numerous specimens were shown to illustrate this point, and to demonstrate that the cardiac division of the coelom was demarked from the pleuro-peritoneal by the passage of the vitelline veins across its ventral boundary. The fixation of these vessels by the mesocardium laterale, and the conversion of their cardiac ends into the sinus reuniens was also shown. A series of specimens to trace the order of the appearance of the somatic veins showed that the umbilical veins developed first, and made their way through the mesocardium laterale into the sinus reuniens; later, the anterior cardinals originated and opened into the umbilical, and themselves received the posterior cardinals, when they had formed. The portion of the anterior cardinal vein which carried the combined blood of the anterior and posterior cardinals was the Cuvierian duct, which was shown to run through the body wall, past the side of the passage leading from the cardiac into the pleuro-peritoneal part of the coelom (iter venosum); and specimens were shown to prove that that passage was occluded by the gradual approximation of the Cuvierian ducts to the sides of the pharynx. The development of the ventral and dorsal diaphragms and of the lungs and pulmonary veins was also illustrated, and also the early stages of the portal system.—Dr. PATERSON (Manchester) called attention to Mr. Lockwood's statement that the ventral part of the diaphragm was of earlier formation than the dorsal part; and stated that they should be considered as parts of one and the same fold; and instanced Cadiat's and Uskow's researches on the development of the diaphragm to prove this.—Mr. LOCKWOOD, in reply, agreed that the splanchnopleure might be said to take a share in the dorsal diaphragm, and adhered to his assertion that the crescentic downgrowth of mesoblast which completed the dorsal diaphragm originated later than, and separate from, the ventral part.

Cranimetry and Cephalometry.—Professor BENEDIKT explained and demonstrated his methods of craniometry and cephalometry. One of these was executed only with the compass; but, as all median measurements were taken from two points (the basion and the radix nasi), and all measurements of lateral points from three points (the basion, the radix nasi, and the spina nasalis), the diagram of each skull could be at any time reconstructed, and in such a diagram many other measurements could be deduced from those already determined. A variety of this trigonometrical method could be employed for the measurement of the skull and of the living head. With this object, instead of taking the measurements from the basion, they should be taken from two terminal points of an auricular diameter; the median point of this diameter represented the basion. In relation to this method, we could also apply the system of projection with the help of a good cranio-fixator and of beam-compasses. But, in order to make precise measurements in every variety of skull, to determine the actual curves, and to deduce therefrom the laws of construction, it was necessary to use an exact cathetometrical apparatus and a delicate instrument for the mechanical reproduction of the curves. Professor Benedikt demonstrated some of the mechanical reproductions made by means of his instrument; also the method of analysing the geometrical composition of these curves, and the general laws deducible from his methods.

The Construction of the Cardiac Ventricles in the Mammal's Heart.—Dr. J. MACDONALD BROWN read a paper, in which he said that in the development of the ventricles, the formation of the septum took place in such a manner that, by subsequent growth, the right cavity became practically an accessory ventricle. It might be regarded as consisting of a single crescentic wall adherent to the left ventricle, and along its line of attachment to the latter there was a marked increase of connective tissue in the myocardium. The probable functions of the trabeculae carneae and the precise condition of the papillary muscles in the ventricle

² Marey, *La Circulation du Sang*, p. 343.

³ Vide *The Treatment of Sleeplessness, Practitioner*, March, 1888.

and their characters were discussed. The moderator band was said to be a constant quantity in the human heart; its position and nature in man, and in the hearts of various mammals, were described. The probable reasons why the existence of this band in the human heart was generally overlooked were indicated. The double function of the anterior papillary muscle and the functions of the moderator band were discussed. In conclusion, the author dealt with physiological and pathological over-distension of the right ventricle.—Professor STRUTHERS complimented Dr. Brown on having called attention to what was too commonly overlooked. He suggested that some other name should be found for the structure, as the name "moderator" was teleological and misleading. It did not follow that it had any function at all. The relief of the right ventricle when distended was accomplished by regurgitation, as long ago shown by the late Dr. King, of Guy's Hospital, in a most able research, which he published under the title of the "Safety-Valve Action" in the Heart.

*Morphology of the Epitrochleo-anconeus or Anconeus Sextus (Gruber).—*Dr. H. ST. JOHN BROOKS read a paper in which he expressed the belief that he had been able to throw a new light on the morphology of the muscle by the examination of amphibians and reptiles, and by comparing the muscles of these animals with the corresponding muscles in mammals. It had been generally assumed that the epitrochleo-anconeus was a portion of the triceps; this was implied by the name. The following "anconeus" had been enumerated: anconeus longus, or scapular head of triceps; anconeus externus v. brevis, or outer head of triceps; anconeus internus v. profundus, or inner head of triceps; anconeus quartus; anconeus quintus, or dorsi-epitrochlearis and epitrochleo-anconeus. Gruber, however, stated that he named the muscle "epitrochleo-anconeus" on account of its position, origin, and insertion.¹ Moreover, he said (p. 35) that the muscle in man was sometimes independent, sometimes a part of the triceps, but that in the mammalia it was always independent. Gruber had also conclusively shown that the epitrochleo-anconeus was always supplied by the ulnar nerve. The innervation by the ulnar nerve and the usually independent condition of the muscle in the mammalia would appear to indicate that the epitrochleo-anconeus was not a part of the triceps. An examination of the amphibians and reptiles, the results of which Dr. Brooks described in detail, confirmed this view, and also showed that the epitrochleo-anconeus was not primarily an independent muscle, but that it was a portion of the flexor carpi ulnaris.—Mr. Lockwood said much stress was usually laid upon nerve-supply as a guide to homologies of muscles; but, in view of the fact that nerve-supply sometimes varied, he wished to know what importance Dr. Brooks attached to the nerve which the epitrochleo-anconeus received from the ulnar nerve.

Pelvic Epiphyses in Mammals.—Dr. RICHARD J. ANDERSON read a paper on this subject. He said that it was well known that in many animals the ossa innominata became united by bone. Albrecht, in a paper written five years ago, spoke of an ossification in the pelvic girdle as a true pelvic sternum, and gave some examples. Three years later Dr. Anderson sent a short note on the subject to the Zoological Society, and gave some examples. He had now collected some statistics, which showed (1) that the pubes near the inferior margin became capped by a distinct piece of bone in some animals; (2) that the symphysis was ossified in many forms by distinct centres. There might be one principal posterior centre, which in some cases resembled in position the triangular ligament in man; or two principal centres, one in front and one behind, with a middle piece developed separately or in connection with one of the other centres. The post-pelvic bone was very considerable in some forms, as in the kangaroo.

Mechanism of the Heart and Pulse.—Dr. MAYO COLLIER read this paper, in which he first drew attention to the fact that extensive and sudden movements of the valves of the heart were quite out of the question. The valves were in absolutely closed spaces, having blood or the solid walls of the heart on either side, and, consequently, the flapping action described in the textbooks was manifestly impossible. The first act of the ventricle was to close the tricuspid and mitral valves; subsequently to lift the semilunar valve, to distend the first part of the aorta, and increase the general tension, so expediting the outflow, but not dilating the whole arterial system simultaneously. It was shown that during the systole of the ventricle, at two periods the pressure on both sides of the semilunar valves was equal at the commencement and end of the injection. The second sound of the

heart was due to the sudden difference in pressure on the two surfaces of the semilunar valves at the commencement of diastole of the ventricle. The mechanism of the pulse was next dealt with, and the conclusions drawn from arterial schemata were ridiculed as totally irrelevant, the experimenter being unable to imitate the gradually increasing force of the ventricle, and the gradually decreasing thickness and power of resistance of the arteries. The pulse was defined as a wave of dilatation and recoil, passing from the heart onwards till lost in the smaller arteries. The wave was normally single, but under circumstances of diminished tension, from whatever cause, two or more waves or pulses could be felt and recorded by the sphygmograph. These secondary pulses were due to the fact that on recoil of the artery, after the primary distension, the whole recoil was not expended in dilating a more distant section of the artery as normally occurred, but a redistension would occur of the part last dilated, or the penultimate section. This penultimate section would again recoil, and distend the ultimate—that is, the one under consideration—and so on as often as the diminished tension and the diastole of the ventricle would permit.

Arrested Twin-development.—In this paper Dr. J. MACDONALD BROWN described (1) the methods of origin of twin monsters; (2) the "thoracopagus" class; (3) parasitism and its causation. His remarks were illustrated by a demonstration of the Hindoo boy "Lalloo," whose case was fully described and illustrated in the JOURNAL of February 25th, 1888, p. 436. The dangers of his condition and the question of operation were discussed.

CLINICAL MEMORANDA.

HEART-SOUNDS WHEN THE BREATH IS HELD.

Will you allow me to caution practitioners against what I believe to be a not uncommon source of error in connection with certain conventional modes of examining the heart?

The patient is told to "stop breathing." This he does with a more or less forcibly inflated lung, the result being that the contact and impulse elements of the heart-sounds—and we too often forget how large these elements really are—become exaggerated. In addition to this, the lung being not infrequently distended by a very deep inspiration, taken hurriedly at the moment when the patient is told to "stop breathing," the mechanical obstacle offered to a free passage of blood through the vessels of the lung is especially great.

What the listener hears when the patient's breath is held will not be the cardiac sounds, simply unmasked by the suspension of the pulmonary sounds, but the former exaggerated and distorted by the accidental physical conditions of the lungs and the heart, and their surroundings in the thorax; which conditions are abnormal, for a state of forced, or even fixed, inspiration is not normal, and it modifies as well as intensifies the heart-sounds sensibly, as any close observer may detect.

The very frequent appearance in the consulting room of cases of supposed heart disease, in which, when examined under ordinary conditions, nothing can be discovered to support the hypothesis of disease, may perhaps be to some extent accounted for by the method of examining to which I have ventured to object.

Another point of moment is the position of the patient. I do not think any physician is justified in affirming the existence of a morbid state until, or unless, he can satisfy himself that the known effects of change of position on the several performances of the cardiac mechanism are produced. It is a matter of very great concern that the number of persons living lives of misery because they have been told that "there is something wrong with the heart" is of late largely increased and increasing; while no inconsiderable proportion of such persons have, in fact, nothing whatever the matter with their hearts beyond, perhaps, some sympathetic disturbance. I am not now thinking of the scare produced by "anæmic" sounds, which, by the way, are too often misconstrued even by expert and experienced examiners, but of hypothetical "valvular disease" in hearts which are in no way organically affected, or even the subjects of exceptional muscular debility.

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¹ Mém. de l'Acad. Imp. des Sciences de St. Pétersbourg, 7 Ser., Tom. x, No. 5, p. 1.