lithium, traces. Total solids, 15,997.64 grains. In Anderson's work on the mineral springs of California the above analysis is stated in parts per thousand. Its correctness cannot be vouched for. This acid sulphate water does not seem to have come into much use as yet. Well diluted and properly administered, it ought to be valuable in many conditions requiring tonic and astringent remedies. It will be observed that the water closely resembles that of the Matchless Mineral Wells of Butler County, Alabama, being, however, according to the above analysis, much stronger. *James K. Crook.*

THERMIN, tetra-hydro-beta-naphthylamine hydrochloride, $C_{10}H_{11}.NH_2HCl$, is a crystalline body recommended by Filehne as a powerful mydriatic. *W. A. Bastedo.*

THERMODIN, acetyl-para-ethoxy-phenyl-urethane, $C_6H_4.OC_2H_5.N.CH_3CO.COOC_2H_5$; is an almost odorless and tasteless, insoluble, white powder with mild antipyretic and antineuralgic properties. Dose 0.3–1 gm. (gr. v.–xv.). *W. A. Bastedo.*

THERMOMETERS, CLINICAL (θέρμη, heat; μέτρον, a measure).

DEFINITION.—Instruments for determining the temperature of the body in disease.

HISTORY.—The ancients had no better means of estimating the temperature of bodies than that of observing the sensation of heat or of cold which they imparted to the hand. Hippocrates applied this method to the clinical investigation of diseases, and was fully sensible of the value of the information thus obtained.

The first successful attempt to represent differences of temperature to the more accurate sense of sight has been attributed both to Drebbel, of Holland, and to Sanctorius, of Italy, living in the early part of the seventeenth century. The first instruments for this purpose, called weather glasses, depended upon the expansion of air, and were both rude and inaccurate. Atmospheric thermometers of a much better pattern were afterward devised by Boyle and the academicians of Florence. The liquid was colored spirits of wine. After the spirits had been boiled to expel the air, the tube was hermetically sealed. A system of markings, or a scale, had next to be devised. The fixed points at first selected were the cold of snow or ice, and the greatest warmth known at Florence. A great deal of discussion arose, however, throughout Europe in regard to the most suitable fixed points upon which to base the scale, as well as upon the most suitable substance for use in the instrument. Newton discovered that snow and ice melt at invariably the same temperature, and that the heat of boiling water is almost as constant. These points were then selected, and are still maintained, except that the temperature of the vapor arising from boiling water is taken as being more constant than that of the water itself. Deluc and Römer demonstrated the even expansibility of mercury under the influence of heat, and adopted it in the construction of their thermometers; but to Fahrenheit is generally given the credit of having brought the mercurial thermometer into favor.

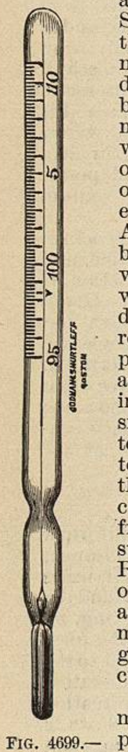

FIG. 4699.—Self-registering Clinical Thermometer.

Sanctorius is said to have adapted the thermometer to the investigation of human temperature, but fully a century elapsed before any systematic use of the instrument for that purpose was recorded. Boerhaave, Van Swieten, and De Haen are the three names which appear most prominently in the literature of thermometry in the eighteenth century. But it required another hundred years to bring thermometry into favorable clinical use.

DESCRIPTION.—The mercurial thermometer has been almost exclusively used for clinical purposes. It consists of an exhausted capillary glass tube, one end of which is expanded into a globular or cylindrical bulb containing mercury (Fig. 4699). Its action depends upon the great difference in the extent to which glass and mercury expand when exposed to the same degree of heat.

The scale of the thermometer is generally engraved on the stem and illuminated by a white or black stripe incorporated in the glass behind the mercurial column. A range of 10° C. (18° or 20° F.) is quite sufficient for the scale of a clinical thermometer. This should embrace from 35° to 45° C. (95° to 113° F.), limits which include the range of probable physiological and pathological temperatures. The thermometer must be long enough to bear a legible scale (not less than three inches); for the sake of portability, however, it should not exceed five inches. The bulb or reservoir should be formed of as thin glass as is compatible with strength. Thermometers having rather long but narrow reservoirs (*e.g.*, the "minute thermometer," Fig. 4700) register more promptly than those whose bulbs are short and thick.

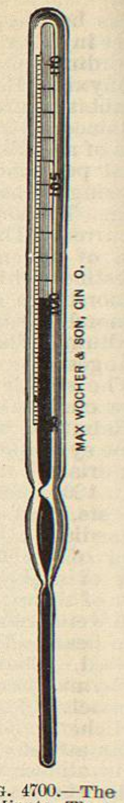

FIG. 4700.—The Minute Thermometer. The column of mercury appears magnified by means of the so-called lens front.

Thermometers having a double, "twin," bulb, or a branched, "crescent" bulb are also meeting with favor, although their superiority to the simpler patterns is questionable.

Thermometers are now made self-registering. This was first attained in the instruments used by Currie, in the early part of the nineteenth century, by means of a small piece of iron resting upon the surface of the mercury. The register now used is known as the "indestructible" index, secured by a constriction of the tube near the bulb so narrow as to prevent the passage of an unbroken column of mercury through it. The expansion of the fluid causes it to pass the constriction in little "jumps" which render the reading slightly inaccurate, but not to the extent of one-tenth of a degree in a properly constructed instrument. The index must be "shaken down." This is best accomplished by grasping the upper end of the instrument between the thumb and fingers and giving it a short, sharp swing from the wrist or elbow.

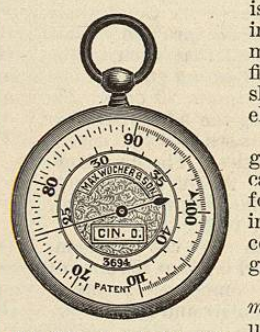

FIG. 4701.—Immisch's Avitreous Thermometer. (Exact size.)

The reading of the register is greatly facilitated by the so-called "lens-front," a conical form given to the face of the instrument, through which the column of mercury appears greatly magnified.

The avitreous (*Immisch's*) *thermometer* (Fig. 4701) depends upon the same principle as the mercurial, but its construction is different. In appearance it resembles a miniature watch. Its mechanism consists of a small metallic tube bent into a circular form, having one end fixed to a support, the other free to move, but connected by a fine spring to a shaft which carries a needle or dial indicator. The tube is filled with a highly expansive fluid. In consequence of its expansion the tube uncoils, producing a corresponding vibration of the indicator. Upon cooling the tube curls and the indicator returns to its point of repose. The dial over which the indicator moves is graduated according to both the centigrade and the Fahrenheit scales. A device for "registering" the temperatures has been added, in the form of a stop-catch passing through the stem. In action this thermometer is slower than the mercurial. It is now used chiefly as a surface thermometer.

The surface thermometer is designed chiefly for determining differences in temperature of the surface of various regions. The reservoir is usually given a flattened extremity (Fig. 4702), or is made into a coil, the object in either case being to expose as great an amount of the expansive medium as possible to the temperature of the surface to be investigated. In using the instrument the bulb must be carefully covered, in order that the result may not be altered by the temperature of the atmosphere.

The differential or metastatic thermometer was devised by Walferdin for the purpose of determining with great accuracy the fluctuations of temperature within certain narrow limits. It consists of a capillary tube of very small calibre, at either extremity of which is a small reservoir. At the junction of the upper of these reservoirs with the tube there is a slight constriction. The quantity of mercury contained in the reservoir and tube must bear such relation to the capacity of both that an elevation of temperature amounting to three or four degrees Celsius (from five to seven degrees Fahrenheit), will cause the entire lumen of the tube and reservoirs to be filled. In order to prepare the instrument for use, it must be warmed to about the highest temperature that is anticipated in the investigation to be made. The column of mercury is then broken at the point of constriction by a quick tap. The mercury in the tube rapidly falls, but is not followed by that in the upper reservoir. The lower bulb is now inserted into one of the thermometric cavities, and permitted to remain, while the fluctuations of temperature are carefully observed and recorded. The only advantage possessed by the instrument is its great delicacy, depending upon the wide space allotted to each degree. Walferdin was able with it to detect variations of temperature amounting to but one two-hundredth of a degree Celsius.

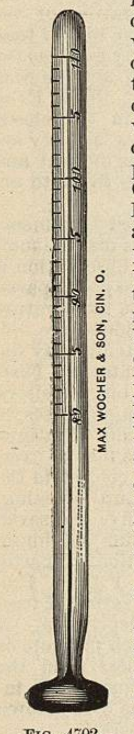

FIG. 4702.—The Surface Thermometer of Seguin.

The thermo-electric apparatus has been used in clinical investigations. It was introduced into physiological experimentation by Becquerel, especially for determining the differences of temperature which exist in different regions of the body. The apparatus was perfected by Dutrochet. Its action depends upon the physical law that when, in any metallic circuit composed of two or more different metals, the points of contact are exposed to a temperature different from that of the other parts of the circuit, an electric current is produced which is readily recognized by the magnetic needle, and may be measured by a galvanometer. The thermo-electric pile constructed in conformity to this principle has been applied to the measurement of temperatures in physiological experiments on animals by Gavarret, Heidenhain, and others, and to the determination of human temperature by Lombard and Hankel. Its action is both delicate and prompt. It can be applied to the investigation of internal temperatures by means of a properly constructed needle, composed of two or more elements brought into contact at its point. The instrument is not suitable to general clinical use, on account of its size.

The Thermograph.—Instruments have been devised by Marcy and W. D. Bowkett for the purpose of automatically registering changes of temperature, by which continuous observations can be made over a considerable period of time. To these the name thermograph has been applied. They have not, however, been much used for other than experimental purposes.

GRADUATION OF THERMOMETERS.—Thermometers are graduated according to the scales of Celsius, Fahrenheit, and Réaumur. The Celsius, or centigrade, scale is used exclusively on the continent of Europe; the Fahrenheit, almost as exclusively in the United States and Great Britain; whereas that of Réaumur, at one time preferred in France and in some parts of Germany, is now retained only in Russia and Sweden. The relative position of fixed points in these scales is shown in the following table from Wunderlich:

Celsius	..	0	25	50	100
Fahrenheit	0	32	77	122	212
Réaumur	..	0	20	40	80

The subdivision of the scale between the fixed points is arbitrary; hence we find that Celsius divided it into 100 parts, or degrees, Réaumur into 80, and Fahrenheit into 212. The zero, centigrade, corresponds to the thirty-second degree of Fahrenheit; 100° C.=212° F., and 1° C.=1.8° F., or $\frac{9}{5}$° F. If, therefore, it is required to convert a given temperature expressed in terms of the C. scale (*e.g.*, 40° C.), the number is first multiplied by 1.8. The product in the example is 72. To this 32 is added, in order that the degrees may be counted from the same fixed point. This gives us 104. Therefore, 104° F.= 40° C.

If, therefore, C represent a given temperature expressed in the centigrade scale, the unknown equivalent of which in the Fahrenheit scale is F, the formula for finding the latter term is:

$$C \times 1.8 + 32 = F; \text{ or, } \frac{9}{5} C + 32 = F.$$

Conversely, a temperature expressed in the scale of Fahrenheit may be converted into that of Celsius by means of the formula:

$$\frac{F - 32}{1.8} = C; \text{ or, } \frac{5}{9}(F - 32) = C.$$

In the same manner the terms of the Réaumur scale may be converted into those of Fahrenheit by the formula:

$$R \times 2.25 + 32 = F; \text{ or, } \frac{9}{4} R + 32 = F.$$

Consequently, to convert Fahrenheit into Réaumur:

$$\frac{F - 32}{2.25} = R; \text{ or, } \frac{4}{9}(F - 32) = R.$$

To convert degrees of the Réaumur scale into their equivalent in the centigrade scale, it is only necessary to multiply them by 1.25.

The following table gives the thermometric equivalents within the range of physiological and pathological temperatures:

Cent.		Fahr.	Cent.		Fahr.
35	=	95	40	=	104
35.55	=	96	40.5	=	104.9
36	=	96.8	40.55	=	105
36.11	=	97	41	=	105.8
36.66	=	98	41.11	=	106
37	=	98.6	41.66	=	107
37.22	=	99	42	=	107.6
37.77	=	100	42.22	=	108
38	=	100.4	42.77	=	109
38.33	=	101	43	=	109.4
38.61	=	101.5	43.33	=	110
38.88	=	102	43.88	=	111
39	=	102.2	44	=	111.2
39.44	=	103	44.5	=	112.1
39.5	=	103.1	45	=	113

The centigrade scale, based upon the decimal system of numeration, is now almost universally used in scientific observations, and its adoption by the medical profession is recommended on the highest authority. The Fahrenheit scale, based as it is upon an error, has nothing to recommend it but usage.

More important to the clinician than the kind of scale which is adopted is the use of a thermometer of known accuracy. It is not essential that the thermometer shall be precisely correct in its readings throughout the entire scale so long as the exact amount of error and its location are known, for the correction may then be made in reading the register. To insure this, a certificate may be obtained through the manufacturer, guaranteeing the accuracy of the instrument, or stating to what extent it is inaccurate.

Unfortunately, mercurial thermometers do not retain their accuracy. Owing to the liability of glass to undergo molecular contraction, the bulb not infrequently becomes reduced in size and thus causes the instrument to register erroneously high temperatures. This is generally avoided by thoroughly "seasoning" the tubes before engraving the scale.

Application of the Thermometer.—The object to be attained in the use of the clinical thermometer is usually to determine as nearly as possible the temperature of the interior of the body, the blood heat. Several localities are available for this purpose, on account of the nearly constant character of their temperature, but the axilla, the mouth, and the rectum are most employed. At times the conditions of disease render necessary the selection of other localities, as the groin, the urethra (female), the vagina, or the closed hand, and it has been proposed to take the temperature of freshly voided urine. The mouth is the most easily accessible. The bulb should be placed under the tongue, and the lips closed on the stem. The mouth must remain closed during the observation. If oral respiration has been carried on previous to the introduction of the instrument, a minute or more should be allowed for the rise of the mercury beyond the time that would otherwise be required.

In many cases the axilla will best answer the purposes of thermometric investigation. The arm-pit must be thoroughly dried, if moist, before the introduction of the thermometer. The instrument should then be inserted into the middle of the axilla in such a manner as to insure contact with the skin only. The cavity is then closed by pressing the arm firmly against the chest, the forearm being drawn slightly forward. It is advisable, when practicable, to use the thermometer in the axilla of the side upon which the patient has been lying. From three to five minutes are usually required for a correct register of the axillary temperature.

Taking the temperature in the rectum yields the most trustworthy results, particularly in children. The use of the urethra or vagina is resorted to only in such conditions as Asiatic cholera, when the temperature of the axilla has been found as much as 7° C. (12.6° F.) below that of the vagina; and the temperatures of the mouth and rectum are also unreliable. Whatever locality is selected in an individual case, the same should be used for all subsequent observations.

Thermometric observations should be made at stated intervals, the frequency of which must depend upon the character of the case and the object of the examination. In the commencement of a febrile disease it is often necessary, in order to arrive at a correct diagnosis, to take the temperature at frequent intervals, every half hour, every hour, or every two hours; but regular morning and evening observations are, as a rule, sufficient for the requirements of treatment. These are best taken between 7 and 9 A.M., and between 5 and 7 P.M. If, however, the points of maximum and minimum temperature are found not to occur in these intervals, the times must be made to conform to the peculiarities of the case.

In addition to the periodical observations, the thermometer should be used upon the occurrence of any phenomenal event during the progress of the disease, as after a rigor, a sweat, or psychical disturbances.

The systematic observation of temperature changes is essential to the intelligent treatment of almost every febrile disease. The attendant should be provided with a reliable self-registering thermometer, with instruction how and when to use it in the absence of the physician.

It is not enough that the temperature be regularly measured; it must be regularly recorded on a chart prepared for that purpose. Every chart should bear the name of the patient, the diagnosis of his disease, the region in which the temperature is taken, the date and time of day. Its value is enhanced if it have recorded upon it the rate of the pulse and respiration at each thermometric observation, the occurrence of critical evacuations, the alvine dejections and urine, the explanation of any anomaly of temperature or other feature of the disease.

The Temperature in Health.—In speaking of the body temperature, whether physiological or pathological, reference is usually had to the temperature of but a single thermometric region, which region, accuracy of statement requires, should always be indicated in clinical reports.

The temperature of the axilla in health averages about 36.89 C. (98.4° F.), as stated by Liebermeister, or 37° C. (98.6° F.), according to Wunderlich. It varies, however, between 36.40° C. and 37.77° C. (97.5° and 100° F.). Landois states, as the average of five hundred observations, 36.49° C. (97.68° F.). The temperature of the mouth is from a fifth of a degree to a degree higher than that of the axilla. The last-named authority gives as the average 37.19° C. (98.94° F.). The rectal and vaginal temperatures vary from 37° C. to 38° C. (98.6° F. to 100.4° F.). Thermometric observations in the closed hand are too variable for clinical purposes, as they are liable to be altered by external conditions of heat and cold. Römer places the variation which is liable to occur in this region at 6° C. (10.8° F.).

The factors which are generally recognized as influencing the results of thermometric observations may be summarized thus: 1. The region in which the observation is made; the closed cavities are warmer than exposed parts, the trunk is warmer than the limbs. 2. The temperature is higher in the extremes of life than in middle age. 3. The taking of a full meal causes a slight temporary depression of the temperature; digestion elevates it. Fasting lowers it. Alcohol produces a prompt but transitory depression, after which the temperature again rises to about the normal. 4. Physical exercise short of fatigue causes a slight rise of temperature, whereas mental exertion is said to depress it. 5. The body is coolest in the morning, gradually becoming warmer until evening, reaching the maximum, as a rule, between five and seven o'clock. A gradual decline to the morning minimum occurs during the night. This daily fluctuation ordinarily amounts to a little more than 0.5° C. (1° F.). 6. Prolonged exposure to heat causes a slight elevation of temperature, exposure to cold a slight depression. A marked effect is produced by agencies which promote or retard the radiation and convection of heat from the body. 7. The nervous system exerts a considerable influence over the bodily temperature, as has been shown by the experiments of H. C. Wood and others.

The Temperature in Disease.—A large proportion of diseases are accompanied by an elevation of temperature. In a comparatively few, there is at some period a decline below the normal. In order to denote a morbid process, in the absence of other positive signs of disease, the temperature must remain for several hours outside the bounds of health. The temperature in febrile affections undergoes a fluctuation from morning to evening and from day to day, which is typical of the underlying morbid process. By the use of the thermometer we are able to recognize this fluctuation and estimate from it the severity of the disease, and any variation which may occur in the course of the affection as a result of complications, accidents, or treatment.

The thermometer is therefore a valuable aid in diagnosis, in prognosis, and in treatment.

In Diagnosis.—The early diagnosis of infectious diseases is of the utmost importance. By the use of the thermometer we are often able, more than by any other means, to corroborate our suspicions of their existence, or, on the other hand, to disprove the evidence of fictitious symptoms. Complications arising in the course of a fever and relapses from convalescence are usually indi-

cated by a more or less pronounced alteration of the temperature range, or by a return of high temperature.

Thermometry is no less valuable in the diagnosis of certain chronic affections, but more particularly for determining their activity or latency at the time of the observation. This is particularly true of tuberculosis. The thermometer has led to the discovery of this affection in individuals who had exhibited no subjective manifestations of the disease.

An inequality of temperature between corresponding surfaces of the body, in the absence of local inflammation, often points to the existence of paralysis of the cooler part, or of other nervous disorder, a fact which is especially of value in the presence of coma.

A diagnosis cannot be based upon a single thermometric observation. A series of observations must be made before we can learn enough of the temperature range to render a differential diagnosis possible. The absence of abnormal temperature conveys more positive information than does its presence.

Notwithstanding the value of thermometry, its results are not infallible. A sudden rise of the temperature may be due to a specific infection, but it may arise solely from an acute attack of indigestion. The taking of food, exercise, and excitement are liable to elevate the temperature in disease, as does also the retention of urine or of fæces. Due caution is always to be exercised in estimating the diagnostic as well as the prognostic importance of an elevated temperature in women, when accompanied by hysterical manifestations, when the pyrexia often appears to be due solely to the peculiar condition of the nervous system. Children are subject to sudden elevations of temperature as a consequence of the most trivial disorders, such as a simple angina or a disturbance of digestion.

In Prognosis.—The thermometer is an aid to prognosis in the extent to which it enables us to detect an approach of the temperature to the danger line. But the points at which the temperature crosses the lines of danger are not fixed points, and depend in most instances upon a combination of circumstances peculiar to the individual case. A few more or less positive rules may, however, be stated.

When the temperature reaches a height of 40° C. (104° F.), it is considered a factor of considerable gravity in prognosis. When 40.5° C. (105° F.) is passed the febrile state is termed "hyperpyrexia," and the gravity of the prognosis rapidly increases until 42.5° C. (108.5° F.) is reached, when death is usually imminent. A few cases of recovery from a temperature of 43.3° C. (110° F.) have occurred. In a few instances recovery has been reported after hyperpyrexia ranging from 44.5° C. to 50° C. (112° to 122° F.). Anomalies of such rarity, even if real, have little or no scientific value.

It is not when considered by itself that the temperature is of most value in prognosis, but when taken in connection with the other features of the disease in which it occurs; for in some diseases hyperpyrexia is frequent, whereas in others it is exceptional. A temperature which in one malady would be looked upon as of the gravest import, would in another be considered of less significance. Acute articular rheumatism, scarlatina, relapsing fever, and tetanus, for example, are often attended with hyperpyrexia, 41° to 42° C. (105.8° to 107.6° F.), which is not necessarily serious. Yet persistently high temperature is an evil omen in these diseases. A high evening temperature is less to be feared if the morning remission be considerable than if it be slight. An evening hyperpyrexia followed by an equal or still higher morning temperature is very apt to foreshadow death by a short interval, the temperature, as a rule, continuing to ascend until the fatal issue. It follows, as a corollary to this, that a high morning temperature is more to be feared than a high evening elevation.

A sudden pronounced rise of temperature after it has, in the ordinary course of the disease, declined to near the normal, is generally of evil import, because it often denotes the development of a complication, except in such diseases as malaria, smallpox, and relapsing fever.

A persistence of pyrexia, even of low degree, after the other symptoms have subsided, very often indicates a delayed convalescence, generally from the presence of a complicating affection, as when a catarrhal pneumonia or tuberculosis follows measles or smallpox; or when sepsis follows typhoid fever.

Many febrile diseases undergo a more or less rapid defervescence, involving a fall of temperature to or below normal; but under other circumstances a sudden marked decline is often as much to be feared as a sudden rise, particularly if the fall be accompanied by acute prostration. The designation "collapse temperature" has been applied to a fall below 35.5° C. (96° F.); falling below 34° C. (about 93° F.), it has been called algid collapse. A rapid fall of temperature may augur evil to the patient, without, however, reaching a subnormal degree.

In some conditions the temperature falls from the norm without previous elevation, as in certain forms of insanity, in emphysema, asthma, cardiac lesions, and in the coma of alcohol and narcotic poisons. In these the prognosis is not always so grave as the temperature would, under other circumstances, indicate. Several well-authenticated recoveries have occurred after a temperature as low as 37.7° C. (90° F.), the result of alcoholism.

In Treatment.—Here a thorough knowledge of symptomatology, including the usual temperature range of the affection in which the observation is made, is imperative. It is generally recognized that a high temperature demands prompt recourse to the application of cold or other remedies to reduce it. *Per contra*, a subnormal temperature calls for the application of heat and the use of such measures as promote heat production or retard its radiation. The cause of the pyrexia must in all cases be taken into account. *James M. French.*

THIGH, THE.—The term thigh is used to mean the part comprised between the hip and the knee. In this sense it is limited above by the line of the groin (Poupart's ligament) in front, and the gluteo-femoral crease behind. The patella and knee-joint mark its boundaries below.* In its restricted sense, as the regio femoralis of regional anatomy, the thigh has more artificial, but more definite, boundaries. It is limited above and posteriorly by the gluteo-femoral crease and anteriorly by a line drawn 12 to 15 cm. under Poupart's ligament (Lig. inguinale) and below by a line drawn around the limb from 3 to 8 cm. above the superior boundary of the patella.†

In this restricted sense the inguinal region (regio subinguinalis) lies between its superior boundary and Poupart's ligament. However, the separation into two regions at this point is entirely artificial.

Various bony prominences aid us in determining the relations of the structures of the thigh. The most important are the anterior superior spine of the ilium, the crest of the pubis, the tuber ischium, and the great trochanter above. Below, the patella, the internal and external condylar processes serve as guides. The most important muscular landmark of the thigh is formed by the sartorius. This is best seen when the limb is raised, and it helps to form the boundaries of Scarpa's triangle, Hunter's canal, and the popliteal space.

The general shape of the thigh is that of a truncated cone with its base above. Its contour varies with the amount of muscular development, the condition of contraction of these muscles, and the thickness of the subcutaneous fascia. Its median surface is marked by a furrow running from the inguinal fossa (fossa subinguinalis) to the inner side of the knee. This groove marks the boundary between the adductor muscles and the vastus internus muscle (M. vastus medialis). The sartorius lies

* The term thigh is defined in this manner in the Century Dictionary and is used in this sense by Cunningham, Quain, Morris, etc.

† Joessel: "Lehrbuch der topographischen Anatomie;" article on the *Thigh* by Huntington, in the first edition of this work; etc.