tetanus. In other (severe) cases again, spasms of the ocular muscles, of the œsophagus, of the larynx (spasmus glottidis), and of the muscular apparatus of the bladder (desire to urinate, but micturition impossible) have been observed.

During the attack patients complain of severe pain in the affected muscles; there is, furthermore, marked diminution of tactile sensibility in the extremities, the patients not being able to distinguish the character of objects placed upon the skin, and having the feeling, when standing on the bare floor, as though they were walking on velvet.

In a few cases a rise of temperature to 104° F. has been observed; Weiss observed a rise in only one case out of twelve.

Headache, vertigo, tinnitus aurium, and excessive perspiration are other symptoms which are occasionally observed during an attack of tetany. The attacks may last only a few minutes, but may at times last for hours and even days. Severe attacks of tetany may bear a striking resemblance to genuine tetanus; but it may be noted that there is no initial spasm of the masseters in tetany, and that in this form the spasms spread from the periphery centripetally, and not centrifugally as is the case in tetanus; and, furthermore, it is evident that the reflex excitability is not nearly so great in tetany as in tetanus. There is also this further distinguishing characteristic, that in cases of tetany the patient may be entirely free from attacks for hours, days, weeks, and even months.

A. Westphal (*Berl. klin. Wochenschrift*, 1901, p. 849) has called attention to the occasional association of epilepsy with tetany, and believes that toxic products are important etiological factors in both diseases.

Symptoms of the Latent Period.—In the intervals between the attacks the patient may be entirely well; but some exhibit even at this time weakness, with rigidity of the affected muscles. The calf muscles are particularly apt to be the seat of slight tonic contractions. Weiss observed in one case, during the latent period of the disease, tonic rigidity of the calf muscles, and fibrillary as well as fascicular contractions in the quadriceps cruris and vastus externus; in another case Chvostek observed slight contractions of the orbicularis palpebrarum.

The intervals between the attacks of tetany may vary in duration from several hours to a few days, and even a few months. Of course, we can speak of a latent interval in the course of the disease only in case the disease can be proven still to exist. This can be done by proving the presence of Trousseau's symptom, and of increased electrical and mechanical excitability.

Trousseau's Symptom.—This symptom refers to the fact discovered by Trousseau, that in persons afflicted with tetany a characteristic attack can be elicited by pressure upon the large nerve trunks and arteries of the extremities usually affected during an attack. The attacks cease as soon as the pressure is removed. Kussmaul and Quincke maintain that in some cases pressure on arteries only is necessary, while in other cases the slightest pressure on a nerve trunk is sufficient to produce contractions of all the muscles supplied by this nerve. *Trousseau's symptom is present in no other convulsive disease.*

Increased electrical excitability is another symptom observed during the *latent* period. Erb, Chvostek, and Weiss showed that the motor nerves of the extremities and of the trunk, in cases of tetany, exhibited an increased response to both the faradic and the galvanic currents. They could not only obtain the cathodal closure contraction (CCC) with very small currents, but were able, with moderate currents, to obtain CCT and even an AOT, which had not been observed in any other condition; while Chvostek reports having obtained a COT —a condition unheard of in man. Erb failed to obtain these phenomena in the facial, but Chvostek and Weiss claim that they were as well able to obtain these phenomena with the facial as with any nerve of the extremities. J. Hoffman found an increased excitability upon mechanical and electrical stimulation of the sensory as well as of the motor nerves. Erb found the electrical excitability greatest at a time when the attacks were most frequent, and it was he who first ventured the suggestion that the increased electrical excitability might be used as a diagnostic test during the latent period of the disease.

Increased mechanical excitability is another well-marked symptom; a simple tap with a percussion hammer upon a nerve trunk being sufficient to produce contractions of the muscles supplied by the nerve. Pressure with a lead-pencil upon the focal point of the pes anserinus is followed by contractions similar to those which a strong faradic current applied to this point would have produced. Increased reflex excitability of the nerve must be taken as an explanation of this phenomenon. At all events this should be the first employed diagnostic test during the latent period of the disease, as it certainly is better to try this test than to attempt to excite an attack by pressure upon a large nerve trunk or a large artery.

Pathological Anatomy.—In spite of the post-mortem examinations made by Langhans, Weiss, and others, there is little or nothing known of the pathology of tetany. Langhans claimed to have found a periarteritis and periphlebitis of the blood-vessels of the white commissure, and of the anterior horns in the cervical portion of the spinal cord. Weiss found nothing of the sort in his case. He has built up an ingenious theory of the disease, according to which he believes that the attacks of tetany are due to an irritable condition of the gray matter of the medulla and spinal cord, and that this irritable condition is due to sympathetic disturbances, causing irregularities in the vascular innervation of the blood-vessels of the spinal cord: but this is mere theory. H. Schlesinger is of the opinion that tetany is a disease of the entire nervous system; that some of the symptoms are due to involvement of the peripheral nerves, and that the spasms and Trousseau's symptom are due to an increased excitability (of vaso-motor origin?) of the central nervous system, brain, medulla oblongata, and spinal cord. A satisfactory explanation of the disease or of the attacks cannot be had.*

Differential Diagnosis.—There can be no difficulty as to this. There is the mere possibility of confounding an attack of tetany with genuine tetanus. It is necessary to remember the distinctly centripetal character of the attack of tetany, the fact that the disease never begins with trismus, and, above all, the shortness of the attacks, and the existence of a latent period—all of which differs widely from what is observed in real tetanus. During the latent period Trousseau's symptom, and the increased electrical and mechanical excitability, help to establish the diagnosis.

Prognosis is favorable except in those few cases in which the spasms affecting the respiratory muscles may lead to serious lung trouble.

Treatment.—In the way of treatment, it is necessary above all things to remove the active or predisposing cause, to change the patient's abode, to procure absolute rest for him, and, if there is suspicion of intestinal irritation, to look to this, to purge the bowels, and to remove entozoa that may happen to be present.

During the attack, the physician will have to resort to the hypodermic use of morphine, possibly of hyoscyamine. Applications of ice to the back of the neck helped to inhibit an attack in one of Weiss' cases. As soon as the attack is over, it will be well to administer chloral hydrate in daily dose of ʒ i.–ʒ ij.; or the combined bromides in doses of ʒ iss.–ʒ iiss. pro die. During the intervals careful electrical treatment (stabile currents ascending from peripheral nerve trunks), as well as methodical lukewarm baths, deserves a trial; but it is gratifying to know that the majority of cases will get well without any treatment at all. The use of thyroid gland and of thyreoiodine has been favored by some. There can be no objection to a careful use of these preparations in suitable cases. By way of warning, we would suggest to the physician not to employ either counter-irritation or the faradic current. *B. Sachs.*

* Gowers, relying on cases in which a wasting of the muscles has followed upon tetany, believes that the trouble starts in the motor cells of the spinal cord.

TETRA-ALLYL-AMMONIUM ALUM and **TETRA-ETHYL-AMMONIUM-HYDROXIDE** are soluble crystalline salts used in dose of 0.06–0.12 gm. (gr. i.–ij.) as uric-acid solvents. *W. A. Bastedo.*

TETRA-IODO-DI-CHLOR-SALICYLIC ACID, $(C_6S_2\text{-}HCl.OH.COOH)_2$, is a reddish-yellow antiseptic dusting powder obtained by heating salicylic acid with sulphur chloride. It is soluble in alkaline solutions. *W. A. Bastedo.*

TETRA-IODO-PHENOLPHTHALEIN. See *Nosophen.*

TETRONAL, POISONING BY. See *Synthetic Products, Toxicology of.*

TEXAS.—The great extent of this State, its situation on the continent in relation to the surrounding land and water, and the diversity of its surface in mountain, plain, hill, and desert naturally produce a great variety of climatic conditions. The area of the State embraces 237,504 square miles, extending over eleven degrees of latitude and thirteen of longitude. It stretches "from a parallel very nearly coincident with the extreme southern portion of Florida to one touching the southern boundary of Virginia; while east and west it is bounded by the meridians coincident with Sedalia, Mo., and Leadville, Col." [Morse K. Taylor in the previous edition of the Handbook.] In the southern portion, on the gulf coast, we have the zone of tropical cyclones, as witness that of September 7th, 1900, at Galveston, which destroyed over six thousand lives and a considerable portion of the city; while on the northern border the arctic blizzards are experienced.

The eastern and southern portions of the State are at nearly sea-level, and, as one goes northwest, the elevation increases until an altitude of seven thousand feet is reached in the Chinanti Mountains. The intermediate country consists of "high, wide rolling prairies and river bottoms." The vegetation also varies greatly, according to the altitude and topography of the surface. The eastern border, for example, is heavily timbered, while in the west the land is barren of trees, and only the cacti and the stunted mesquite are found. In the extreme south we have a subtropical flora, and in the central portion are fertile agricultural lands where various cereals, fruits, and flowers of temperate latitudes are cultivated. The climate of such an extensive area, so diversified and so situated, cannot well be considered as a whole, except in the most general manner, and it is only by taking various portions of the State, each representing peculiar climatic characteristics, that one can obtain an adequate and intelligent idea of the climate, or rather climates, of the whole State. Taylor's division (*loc. cit.*) appears to be a serviceable one for this purpose. He divides the State into five districts: Eastern Texas, the gulf district, southwestern Texas, northwestern, and central Texas.

Only those districts which offer some claim as health resorts need occupy our attention to any great extent. The eastern district is comparatively level, has no elevations much above five hundred feet, and is heavily timbered throughout. Its climate is a moist, warm one, with a mean relative humidity of seventy-four per cent., and an annual rainfall of about forty-nine inches, with exacerbations in the form of heavy rains and floods. The annual mean temperature is about 66° F. Yellow-fever epidemics occur in this section. It is not a wholesome climate.

The gulf district has a coast line of about three hundred and seventy-five miles, and its surface is comparatively level. Its climate is of a subtropical nature—hot, moist, and windy. For a large portion of the year the winds are from the sea. The annual mean temperature is 73.9° F.; the rainfall, 41 inches; and the relative humidity, 78.6 per cent. Away from the river bottoms it is said to be generally healthy, although malaria is prevalent. During the summer the gulf coast is said to offer a soft, equable temperature and excellent surf bathing, the heat being tempered by a pleasant sea breeze. The beach at Galveston is a fine one, and is a very popular resort; the accommodations are reported to be good.

Southwestern Texas is higher than either of the two previous districts, much of the northern portion being at an elevation of two thousand feet. This district is well drained, and is beyond the yellow-fever line. The climate is moderately dry, particularly so on the Rio Grande line. The annual mean temperature is 68.1° F.; the relative humidity, 67.3 per cent.; and the rainfall, 26.6 inches. "The possibility of outdoor employment," says Taylor, "during the whole year makes this portion better suited for those in delicate health who wish to remain a length of time, and, as they say, 'rough it,' than any other portion of the State. Life on the ranches, though lonely for many, is novel and interesting, and often beneficial." One should, however, bear in mind the wise advice of Hinsdale, that no invalid should go into the country districts unless he is able to endure positive hardships and to subsist on the coarsest food.

While, in general, the summers in Texas are hot (and the invalid from the North is advised not to go there at this season), yet in the southwestern portion "the heat is so tempered by the winds that its intensity is greatly modified . . . and the nights are always cool and dry. From May to October there is rarely any dew, so that persons may sleep in the draughts, on their porches, verandas, housetops, or under the trees with perfect freedom from liability to take cold" [Taylor]. The same authority also avers "that the summer nights of southwestern Texas are more delightful than those of any interior region south of the great lakes." The two health resorts of Boerne and San Antonio are situated in this district, and the reader is referred to Vol. II. and to the first part of the present volume for a consideration of their climate and merits.

Central Texas, which contains the capital, Austin, in the southern portion, ranges from six hundred to two thousand feet above sea-level, and embraces the best agricultural land in the State. It is well settled, and contains several cities. The whole district has an annual mean temperature of 65.4° F., and an annual rainfall varying from 23 to 41 inches, and a relative humidity of from 59 to 67 per cent. The most desirable portions of central Texas for a winter residence are those centering about Dennison on the northern border, Corsicana about 120 miles directly south, and Austin 150 miles south of the latter town. "The general aspect of the country is pleasing," says Taylor; "it is productive and of easy cultivation, and for one seeking a home in a mild and healthful climate it offers advantages scarcely surpassed in the United States." The average maximum temperature at Austin is 99° F., and the average minimum 19°. The annual rainfall is about 33 to 35 inches. The "northers" are experienced throughout this district, especially in the northwestern portions.

The northwestern portion of the State is dry, more or less barren, and sparsely settled, and its climate is characterized by great dryness, small annual rainfall, low humidity, and almost continual sunshine. In the extreme northwestern portion of this district, not far from the boundary line between New and old Mexico, is the health resort of El Paso, a city of 15,000 inhabitants, with an elevation of 3,764 feet. The surrounding country is arid and barren, except as irrigation has been instituted; the city itself, however, is quite attractive. There are several hotels, one or more good boarding-houses, a modern hospital, and a sanatorium. There are various churches, good public schools, and a military fort—Fort Bliss—near by. A large majority of the exports from Mexico enter the United States by way of El Paso. From the middle of September to the middle of May the climate is suitable for tuberculous invalids; after that time it is too hot for

comfort, at least in the middle of the day. As Hinsdale* remarks, El Paso is a good place in which to begin the process of acclimatization to regions of greater rarefactions of air. The soil is dry and porous, except near the river (Rio Grande), where it is adobe. Water can be obtained from artesian wells. The peculiar climatic features which render this a desirable resort are the extreme dryness and purity of the air, the almost constant sunshine, and the mild winter temperature. The moderate elevation, moreover, adds a freshness and tonicity to the air. There is no malaria or fog, and in the winter the winds are not high, though there are occasional dust storms. The rainfall is very low, averaging from 9 to 13 inches during the year, falling principally in the summer, and some years there is hardly any rain at all. The mean relative humidity is 37 per cent. for the year, and for the season from September to May 49 per cent., according to Hinsdale. The average monthly mean temperature is: For January, 43.8° F.; February, 47.9°; March, 55.5°; April, 64.5°; July, 81.2°; and for the year, 63.3°. There are evidently not many resources for the diversion of the visitor. El Paso is reached by the Atchison, Topeka and Santa Fé Railroad.

In conclusion, a few words as to the "northers." They are cold, dry winds sweeping down, as their name indicates, from the north or northwest, occurring during the winter at intervals of about seven days, and lasting twenty-four to forty-eight hours. They are most prevalent and severe in the northern portion of the State. They come suddenly, and produce a sudden marked lowering of the temperature, not infrequently reducing it from summer heat to ten or fifteen degrees below the freezing point in a few hours. Their effect has been thus described: "Northers are intensely dry, and soon drink up all the moisture on the surface of the earth and of the objects upon it capable of yielding their humidity. Great thirst of man and animals is experienced, with many an itching of the skin, a highly electrical condition of the skin of horses and cats, a wilting and withering of vegetation, even when the temperature would not account for it." Taylor (*loc. cit.*) considers their influence invaluable as a sanitary flushing of the country, and that the air following in their track constitutes one of the chief curative agencies in this climate, acting as a vigorous tonic. *Edward O. Otis.*

TEXAS FEVER. See *Arachnida.*

TEXAS SOUR SPRINGS (known also as Caldwell Springs).—Caldwell County, Texas.

Post-Office.— Luling. Hotel.

Access.—Via Galveston, Harrisburg and San Antonio Railroad to Luling; thence six miles north to the springs. The location may also be reached by way of the Burdett Mineral Wells (*q. v.*), which are not far distant.

This is quite a new resort, although the existence of the springs has been known since the early settlement of the country. Tradition has it that the aborigines employed the waters for medicinal purposes, and that Colonel Davy Crockett bathed his wounds in their cool and limpid flow after his famous single-handed fight with the Mexican lions in this vicinity. The springs are located in a rolling country, at an elevation of seven thousand feet above the sea. The air here is dry and balmy, the winters being mild and the summers breezy and pleasant. It is stated that malaria never develops in the neighborhood. The springs are five in number, and afford about sixty gallons of water per hour. They differ but little in their chemical constitution. The following analysis was made by Prof. H. H. Dinwiddie, of the Texas Agricultural and Mechanical College: One United States gallon contains (solids): Aluminum and potassium sulphate, gr. 100.08; ferrous sulphate, gr. 7.58; magnesium sulphate, gr. 16.17; sodium chloride, gr. 42.74; calcium sulphate, gr. 125.01; magnesium chloride, gr. 132.84; lithium chloride, a trace; free sulphuric acid, gr. 7.26; soluble silicates, gr. 12.18; organic matter and loss, gr. 5.12. Total, 448.98 grains.

This analysis shows a rich and potent mineral water. It is a well-marked example of the acid-saline-chalybeate class, and exerts a marked influence when taken internally. It possesses cathartic, alterative, diuretic, and tonic properties. Locally it is astringent, and is beneficial as a lotion in conjunctivitis, a gargle in pharyngitis, a douche in leucorrhœa, etc. The water is used commercially, and an extract prepared from the dried residue is also found in the markets under the name of the "Texas Sour Mass." It is said to possess all the virtues of the water. *James K. Crook.*

THALAMUS OPTICUS. See *Brain.*

THALLINE.—The name *thalline* was given by Skraup, of Vienna, to a body prepared by him synthetically in 1884, of which body the *sulphate* and *tartrate* salts have been used in medicine. Chemically, thalline is *tetrahydroparaquinanisol*, $C_9H_6H_4N(OCH_3)$. Thalline sulphate, the more commonly used salt, is in the form of a cream-colored powder, of a pleasant odor, resembling a perfume of some flower, and of a taste which, though at the outset biting and bitterish, leaves an aromatic flavor upon the palate. The salt dissolves freely enough in water, sparingly only in alcohol, and is insoluble in ether.

Thalline is a fairly efficient antipyretic medicine, operating after the general manner of antipyrin and kairin, and holding rank about midway between those two agents. With efficient dosage, a fall of from 2° to 4° F. can be procured within an hour or so after administration; but very soon after the extreme of reduction the temperature begins to rise again, and quite rapidly, commonly regaining its original elevation in from two to four hours. This after-rise is quite frequently accompanied by a chill, lasting from a few minutes to an hour. Other symptoms commonly observed are a slight diminution in pulse rate and respiration rate, and a very considerable diaphoresis. Vomiting occasionally occurs, but collapse has not been reported, though the subjects may show some depression of strength and present a more or less cyanotic appearance when under the full influence of the drug. Thalline may be detected in the urine within an hour and a half after administration, and its presence may give that secretion a characteristic darkish-green color. Experimentation upon animals has shown that the medicine, in sufficient dosage, is competent to cause arrest of the heart in diastole, to hasten coagulation of the blood, and to exercise a destructive influence on the hæmoglobin of the red blood corpuscles. Some consider that the antipyresis wrought by thalline is due to this action of the drug on hæmoglobin (Brouardel and Loye).

Thalline has been used in medicine as an antipyretic, the dose of the sulphate ranging from 0.25 gm. (gr. iv.), given hourly, up to 1 gm. (gr. xv.), to be repeated in from two to three hours. So large a quantity as 7.33 gm. (gr. cx.) has been given in twenty-four hours without inconvenience (Maragliano). Thalline sulphate may be administered in form of pill, wafer, or in aqueous solution, aromatized to taste. But the thalline salts have practically gone out of use in medicine, having been superseded by more modern antipyretics, which are equally efficient and much more kindly in operation. No preparation of thalline is official in the United States Pharmacopœia. *Edward Curtis.*

THALLIUM.—Thallium is a somewhat rare metal. It was discovered by Crookes in 1861. It has been classed chemically with the metals of the lead group, but its reactions are in many cases different and peculiar to itself. It forms salts which in many respects resemble the corresponding ones formed by potassium and the other alkalies.

Symptoms in Animals.—Its action was investigated by Lamy in 1863, who found that the symptoms in a dog were general weakness, restlessness, tremor, loss of appetite, dyspnœa, salivation, and severe intestinal pains. Convulsions of the posterior limbs occurred, and later these became gradually paralyzed. Paulet, in rabbits, after injection of thallium, found general tremor, loss of co-ordination, slowing of respiration, and death under asphyxia. He found that 1 gm. of the carbonate killed a rabbit in a few hours. Results essentially similar were obtained by Marmé. In small doses, nausea, vomiting, loss of appetite, and salivation were produced with intestinal pain and diarrhœa with bloody dejections; also slowing of both respiration and circulation with dyspnœa. Tremor and inco-ordination, both static and motor, occurred. The autopsies showed swelling and hyperæmia of the mucous membranes of the stomach and intestines with extravasations of blood therein; small hemorrhages and pneumonic infiltration of the lungs; hemorrhages in the epicardium and effusion in the pericardium. The brain and spine showed no constant changes.

The soluble salts are said to be cumulative poisons of slow elimination which may last for three weeks.

Rabuteau, using 5 cgm. of the iodide, found much the same symptoms in dogs (1883). He mentions also albuminuria.

In 1891 Luck used a double salt of thallium and sodium on cats, dogs, and rabbits. The symptoms appeared not immediately, but on the first, the second, or the beginning of the third day. They were weakness, apathy, loss of appetite, vomiting, diarrhœa with blood. Tremor of the extremities and static and motor inco-ordination were present, and twice there were clonic convulsions. The heart action was weak and rapid; the respiration slowed. Clinically there existed the symptoms of a parenchymatous nephritis. Hemorrhages were found in the stomach and intestines.

Richet found in chronic poisoning a generalized muscular atrophy, not simply a wasting of the muscles but their almost total disappearance. This affected especially the masseters, temporals, and muscles of the lumbar spine. He declares that in its great toxicity it resembles lead, while lithium is much less toxic.

Action on Men.—In 1884 Pozzi and Courtade recommended the use of iodide of thallium in doses of 0.010 gm. daily in certain cases of syphilis and obtained favorable results. They found, however, that it produced unpleasant digestive symptoms—pain in the stomach and vomiting; in some cases also they reported that the gums were reddened and there was a blue line at their junction with the teeth. These latter symptoms have not yet been confirmed by other observers. Combemale in 1898 used acetate of thallium for the profuse sweats of pulmonary tuberculosis, and found that even in the last stages of the disease it exerted a strong effect. The ordinary dose was 10 cgm., the maximum 20 cgm. He observed no toxic symptoms during the administration of the drug. Huchard relates two cases in which severe pains occurred in the lower extremities. These patients were in the later stages of phthisis. As the pains disappeared when the administration of the drug was stopped, it was concluded that they were due to the thallium.

Symptoms of poisoning in man are not common. Crookes states that he has swallowed 0.065–0.130 gm. of thallium salt without any effect. Combemale seems to have been the first to notice the peculiar and specific action of the drug in causing alopecia, or falling of the hair. This symptom did not occur while the drug was being taken, but came on later. The loss of hair was said to be total and extraordinarily rapid. This action of thallium was soon confirmed by other observers. Jeanselme reported the case of a woman who, in three days, took nine cachets of acetate of thallium, containing 3 cgm. each. Fifteen days later her hair suddenly began to fall and she lost about one-third of it. Buschke and Bettmann have succeeded in producing alopecia in animals by the administration of thallium acetate.

The writer has lately reported a case of poisoning by sulphate of thallium in a male twenty-seven years old. The symptoms were those of a multiple neuritis coming on with considerable rapidity and continuing for several weeks. There were loss of motion of the lower extremities, diminution of the sensation of a portion of the legs and feet, with pain and extreme tenderness at times in the same regions. The knee-jerks were increased. The patient recovered from these symptoms so as to be fairly well in about six weeks, and in three months was able to resume work. About six weeks or two months after the beginning of the illness his hair fell out completely.

The typical or specific symptom of subacute or chronic thallium poisoning in men is the extraordinary falling out of the hair. This has proved an absolute contraindication to its use for therapeutic purposes in many cases, especially in women. The case last reported illustrates the danger of experimenting with this drug. The amount in this case was half a grain to a grain of the sulphate, which was taken every other day for three or four doses. This was done twice at an interval of about two months. There were no symptoms the first time, but within two or three days after the last dose of the second series numbness was noticed in the toes and finger-tips, and after this the neuritis developed rapidly.

William N. Bullard.

THANATOL. See *Guaiacol-ethyl.*

THEOBROMA. See *Cacao, Oil of.*

THEOBROMINE-LITHIUM SALICYLATE. See *Uropherin.*

THEOCIN, $CH_3(CH_3)_2N_4O_2$, is a name given to the synthetically prepared theophylline, an alkaloid found in very minute quantity in tea leaves. It is prepared from urea by a complicated process in twelve reactions, and is the first alkaloid to be manufactured synthetically from such a simple substance. Chemically it is di-methyl-xanthin, a member of the purin group, and is isomeric with theobromine. It occurs in colorless needles and is soluble in one hundred and eighty parts of cold water, more soluble in hot water, soluble with difficulty in alcohol, and insoluble in ether. Its ammonium and potassium compounds dissolve readily in water, the sodium salt but slightly.

Minkowski finds that the diuretic action of theocin is greater and more rapid than that of theobromine, and that while it has little if any effect on the circulation, it increases the excretion of both solid and liquid. Given on an empty stomach, however, it produced nausea and vomiting unless in very dilute solution. Ach considers it nearly twice as powerful as diuretin. Meinertz, in Grawitz's clinic, studied the action in twenty-three cases and found it a very valuable diuretic in cardiac and renal affections; in four other cases in which the urinary condition was normal, there was no diuretic effect at all. The dose is 0.3–0.5 gm. (gr. v.–viij.).

W. A. Bastedo.

THERMAL ACID SPRINGS.—Inya County, California.

These remarkable springs are found in the Caso Range, twelve miles east of Little Owens Lake, and sixteen miles southeast of Olamoha. The country for miles around the springs is rich in pure crystallized sulphur, having, no doubt, been ejected by the sulphurous steam in the form of sulphurous anhydride (SO_2). On being exposed to the air the sulphur was deposited pure and water liberated. This seems to be a rational explanation of the formation of these large sulphur banks. The water now flows in rather limited quantities through the small crevices and fissures, and is accompanied by sulphurous steam and vapors. The following analysis of the waters has been made by a chemist whose name has been lost: One United States gallon contains: Sodium sulphate, gr. 145.75; potassium sulphate, gr. 880.33; magnesium sulphate, gr. 891.91; calcium sulphate, gr. 69.96; aluminum sulphate (?), gr. 7,407.41; ferric sulphate (?), gr. 1,934.56; sulphuric acid (?), gr. 4,670.72; nitric acid, chlorine, ammonia,

* "System of Physiological Therapeutics," vol. iv., Book ii., "Climatology."

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.

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

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.

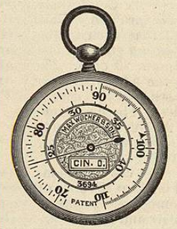

Fig. 4701.—Immisch's Avitreous Thermometer. (Exact size.)

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.

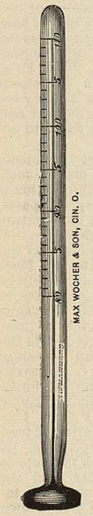

Fig. 4702.—The Surface Thermometer of Seguin.

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.