mouth by extensive removal of the indurated tissue about it. The entire upper lip and a part of the cheek were adherent to the alveolar processes. The middle of the hard palate was covered with irregular cicatrices, which extended to the soft palate and were joined with similar cicatrices in this. The diseased tissues, although so hard to the touch, gave little resistance to the knife and the hemorrhage was slight. In the second case the disease appeared as an enlargement and induration of the nose, which after five years became double in size. The tissue removed was similar in character to that removed in the first case, and was so hard that fair microscopic sections could be made of it in the fresh state.

At the time of the publication of Wolkowitsch the disease had become much better known. Quite a number of cases had been published, and on account of the extent of the lesions in the pharynx, which had been largely neglected by the first authors, the name pharyngoscleroma had been proposed as a substitute for rhinoscleroma. It had been further found that the disease often extended into the lower part of the larynx, and especially on the lower surface of the vocal cords and sometimes into the trachea. The laryngeal and tracheal lesions have been specially studied by O. Chiari and Bendler. In 1873 Gerhardt described under the name of "chorditis vocalis inferior hypertrophica" a form of disease of the larynx which he characterized as a chronic inflammatory hypertrophy of the vocal cords leading to stenosis. From a review of the literature he concluded that the condition had been known before, but not recognized as an independent disease.

Langhofer in 1880 studied the condition histologically, and found the lesions characteristic of rhinoscleroma. He held the two conditions to be the same, and that scleroma could appear in the larynx and trachea independently of any affection of the nose. This was shortly confirmed by O. Chiari, and in 1885 Chiari and Rhiel collected thirty cases of rhinoscleroma, in nine of which the disease had extended into the larynx. In Bandler's case, which was studied from autopsy, the larynx was stenosed in high degree by a thick, hard mass of tissue extensively ulcerated. The trachea was stenosed; its wall was 0.75 cm. thick. This thickening came chiefly from the mucosa and submucosa, which was converted into a hard mass of tissue, partly covered with thickened epithelium and partly ulcerated. On the inner surface of the trachea there were radiate cicatrices. The infiltration extended down to the bifurcation, and for a distance of from 1 to 1.5 cm. into the primary bronchi. The lesion extended up to the pharynx and nares, but without altering the external appearance of the nose.

Wolkowitsch gave a complete clinical and anatomical description of eleven cases, together with short descriptions of all of the cases which he could collect from the literature. In his first case ulceration was prominent. The disease often begins with the appearance of a nodule or as an induration, either at the sides or in the median line of the nose. In certain cases the induration extends over the whole nose and down to the lip, or the chief extension may be backward, or it may extend in both directions. Ulceration is rarely a prominent feature, but in certain cases large crater-like ulcerations, with elevated indurated edges, are formed; they present some similarity to carcinoma.

In other cases the growth seems gradually to fill up the nose. It grows more rapidly from the interior than from the exterior. The nose becomes enormously enlarged and flattened laterally.

The disease is usually found in the lower classes, and it is difficult to get information as to the manner of onset. Sometimes catarrh was noticed as the first symptom. When ulceration is present, the ulcers discharge a thin fluid which is often offensive. There may be external nodules which represent an extension from the interior and give but little idea of the extent of the process. The upper part of the nose is not affected, so that the sense of smell is not lost as long as the external opening is left. In rare cases the disease begins in the pharynx and larynx, and the disease of the nose is secondary and may not appear. The lachrymal sac has been secondarily affected in a few cases, and the disease has also extended into the Eustachian tube. The deeper parts are rarely affected, but in some instances both thickening and ulceration of the cartilage and of the bones has been found. When the disease appears in the nostrils there is a great tendency for it to extend to the upper lip, especially upon the external surface. The nodules are often covered by a network of veins. The gums are thickened; irregular, hard, dark or bluish-red nodules, which sometimes extend to the mucous membrane of the palate, are formed on them. The teeth lose their direction, become pressed forward or backward, and often thrown out. The disease is almost invariably symmetrical, affecting chiefly the middle line and extending equal distances laterally. The growth extends very slowly but continuously. In one of Mikulicz's patients there was more rapid growth at each pregnancy. Like so many affections of the skin there is a continuous peripheral extension with central cicatrization and contraction. There seems to be but little tendency for the lesions to become the seat of pyogenic infections or other secondary processes.

In one case a carcinoma developed in the lesion after the disease had existed for twenty-five years.

The first histological examination was made by Kaposi, who regarded the process as a sarcoma. He found the papillary body and superficial corium thickly infiltrated by small cells, while the deeper layers showed a thick connective-tissue network with slight cellular infiltration. The next investigation was that of Geber, who disagreed with Kaposi, and considered the disease a chronic inflammatory process and not a tumor. Mikulicz also regarded it as a chronic inflammation. Microscopically, he found areas of round-cell infiltration, and, among these, cells which were much larger and paler, with a pale vesicular nucleus. The growth was sharply separated from the normal tissue. Proceeding from the normal tissue to the growth the first change seen was atrophy of the sebaceous glands and the hair follicles. The infiltration was chiefly in the deeper layers of the corium, the papillary body showing little change other than atrophy. Mikulicz considers that the lesions in the epithelium are due to the deep cellular infiltration; the vessels passing through this are in part compressed, and they serve rather the nutrition of the growth than that of the normal tissues. The sweat glands also become atrophied. The connective tissue at first is unaltered, its fibres being simply pressed apart. In places it loses its fibrillar character and the intercellular substance becomes homogeneous. Nerve bundles may be found running through the infiltration, but they seem to be especially resistant. The muscles are destroyed much earlier than the nerves. They are atrophied, often show the degenerative proliferation of nuclei, and in places where the infiltration is more rapid they become hyaline. Fat cells are often present to a considerable extent. Mikulicz thinks that the large cells arise from the connective tissue.

Cornil and Alvares in 1883 called attention to the appearance of hyaline masses in the large cells first described by Mikulicz. They found that the bacteria were in relation to the hyaline masses, which, as they supposed, in part represent the bacterial capsules, and in part are due to a hyaline degeneration of the cells brought about by the bacteria. Wolkowitsch believed that the large cells represented a special form of degeneration of the granulation cells. The hyalin has the general characteristics of hyalin as described by von Recklinghausen. The cells occasionally break down and leave the hyalin free. The peculiar refraction of the fresh tissue and its peculiar induration are due to the hyalin.

The rhinoscleroma bacillus was first described by Fritsch in 1882 in all of the twelve cases which he investigated. The bacilli have been found constantly by every investigator. They are present in large numbers, and are chiefly in the large cells, though they may be found between them; they vary somewhat in size; they are short,

often appearing in double form, and they present some resemblance to the pneumococci, but they are usually much larger. The capsule formation is a permanent characteristic and may be demonstrated even in the tissues. The best way of showing them is to harden the tissue in one-per-cent. osmic acid and then to stain it with some aniline color. The capsules by this means become very prominent, and have a grayish-brown color.

From the appearance of the organism and from its cultural characteristics it was considered by many to be identical with the bacillus pneumoniæ of Friedländer, and a great deal of the bacteriological literature has been on this subject, but the general opinion now is that it is distinctly different. The organism in culture has the following characteristics: It forms a mucoid cap-like colony on gelatin plates; no gas in sugar-agar; no acid in milk-sugar bouillon. The best description of the differential diagnosis between the scleroma bacillus and Friedländer's bacillus is that of Paltauf, who investigated fifteen cases. The principal points of difference between the two are these: first, the superficial whitish extension of the scleroma bacillus on gelatin is drier and more consistent than the corresponding growth of Friedländer's bacillus; second, there is an entire absence of gas formation in sugar-agar; and, third, the organism develops very imperfectly on acid media.

The geographical distribution of the disease is narrow. The first cases were seen in Austria, and the disease has always been more frequent there than elsewhere. The disease is also not uncommon in Russia, where Wolkowitsch studied his cases, but Central America and chiefly the republic of San Salvador seem to be the principal seat of the disease after Austria. Cases have also been observed in France, Germany, Belgium, and Cairo. Only five cases have been reported in the United States, and only one of these was a native American.

The disease belongs to the general class of granulation tumors. The large cells are of the epithelioid character, and resemble the epithelioid cells formed in tuberculosis, and the masses of them may suggest some similarity to tuberculous granulation tissue. They do not undergo caseation, nor is there any necrosis in mass. They are particularly prone to hyaline degeneration, which appears to be due to the action of the bacilli, which they often contain in large numbers. With their complete hyaline degeneration they disappear, and their place is taken by dense masses of connective tissue, to the contraction of which the cicatrization is due. The formation of these masses of large cells appears to be the primary and essential process; the other lesions are those common to all similar processes. It is probable that we must regard the disease as due to the bacillus which is always associated with it. The disease is a peculiar one, and the bacillus is in relation with the cell formation, which constitutes its histological specificity. It is an organism which is easily cultivated, but no characteristic lesions can be produced by inoculation of animals. It is pathogenic only in large doses. In spite of its similarity to Friedländer's bacillus and to the group of the bacillus mucosus capsulatus, both in morphology and in some cultural characteristics, it should be considered to be an independent organism. None of these organisms lead to a proliferation of tissue, and their general action is to produce exudations. The narrow geographical distribution of the disease also points to a distinct etiology. In view of the wide distribution of the bacillus mucosus capsulatus, it is unlikely that a variety of this would have so restricted a field. *W. T. Councilman.*

RHINOSCOPY. See *Nasal Cavities, Diseases of: General Diagnosis.*

RHODANIDES. See *Sulphocyanides.*

RHUBARB.—*Chinese Rhubarb; Rheum*, U. S. P.; *Rhei Radix*, B. P.; *Radix Rhei*, P. G.; *Rhubarbe de Chine, Rhubarbe de Muscovie, Rhubarbe de Perse*, Codex Med., etc.

The dried rhizome and larger roots of *Rheum officinale* Baill., *Rheum palmatum* L., and probably of other species of *Rheum* (fam. *Polygonaceæ*), deprived of the outer corky layers.

The general features of the rhubarb plant are well illustrated by the common garden pie-plants, *R. rhaponticum*, etc. There are twenty or more species, all from Southern and Central Asia, the drug being collected in Northwestern China, Thibet, and the adjacent regions. Both of the above-named species have been introduced to cultivation in Europe, and have produced a drug identical in its essential features with Chinese rhubarb. The second named has not been cultivated upon a commercial scale, but *R. officinale* is quite extensively so cultivated in England. The product is smaller, retains more of its bark, is more spongy, and less esteemed than the Chinese product.

The underground portion consists of a short, thick, erect rhizome, which gives off several thick roots. These are dug in the autumn and the rhizomes and roots preserved separately, the former constituting the most and the more highly esteemed portions of the drug. They are two or three times as large as the roots. The outer corky bark layer is removed and the pieces are dried, mostly by being suspended upon strings passed through perforations made for the purpose.

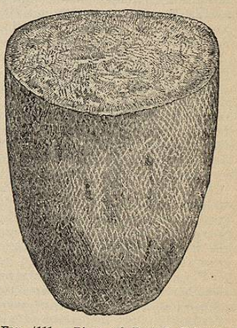

FIG. 4111.—Piece of Round Chinese Rhubarb, showing the white lozenge-shaped reticulation on its surface and the irregular medullary rays on the section. (Baillon.)

DESCRIPTION.—Rhubarb occurs mostly either in unevenly barrel-shaped pieces—from two to five inches in length and one-third to two-thirds as thick, the ends truncated, the surface showing the angular markings left by peeling, though these are more or less rounded off—or in longitudinal halves or slices of such barrel-shaped pieces. Usually the pieces are perforated by a rather large hole. The surface is of a bright light yellow and covered with a fine powder, which should consist of the rhubarb substance, but is sometimes powdered curcuma. That which has been kiln-dried or "high dried" possesses a surface roughened with broad ridges, separated by broad grooves, the latter frequently discolored to appear smudgy or blackish. The surface is less powdery. Underneath this superficial powder the surface of rhubarb is found reticulated, the oblong or lozenge-shaped ends of the reddish-brown or deep yellow-brown medullary rays being separated by intersecting bands of a grayish-white parenchymatic tissue. The fracture is irregular but not at all fibrous, and of a grayish-red color. Upon transverse section the larger (rhizome) pieces show, near the periphery, a nearly continuous circle of pretty stellate fibro-vascular bundles, these being wanting in the root pieces. Upon this transverse view the direction of the medullary rays is seen to be very irregular, less so toward the periphery. Rhubarb possesses a peculiar fine aroma, which, however, becomes coarse, heavy, and a little empyreumatic in the high-dried form. When chewed it produces a very gritty effect between the teeth, is mucilaginous, colors the saliva yellow, and imparts a bitter, astringent, and somewhat aromatic taste.

Powdered rhubarb is frequently adulterated, more especially with turmeric or curcuma. This may be recognized under the microscope by its large, solitary, oval

starch grains, and by the fact that the particles quickly impart a deep yellow color to a colorless volatile oil close to their margins, when placed in contact with it.

Constituents.—From a therapeutic point of view most of the constituents which have been isolated from rhubarb are unimportant. An active substance which has been extracted (usually to the extent of from three to five per cent.) is "cathartic acid," common to a number of important purgative drugs. In doses of from three to five grains it produces the general purgative effects of rhubarb. It is, however, not a simple substance. The resinous constituents remaining after the extraction of the crystalline bodies named below appear also to be quite active. This resinous body has been separated into portions respectively called phæoretin, aporetin, and erythroretin. No one, however, has seriously proposed the substitution of the use of any one constituent of rhubarb for the entire substance or its preparations.

The three constituents which have attracted the most attention from a chemical standpoint, though the second only appears to have any activity, are chrysophanic acid (not an acid however), emodin, and rhein. They are successively, in the order named, oxidation products from some original body which has not been determined, thus: Chrysophanic acid, $C_{15}H_8O_3.(OH)_2$; emodin, $C_{15}H_7O_5.(OH)_3$; rhein, $C_{13}H_6O_2.(OH)_4$. Rheotannic acid is a glucoside yielding rheumic acid. There exist also an unstudied bitter principle, an odorous oil, also a derivative product, about two-thirds of one per cent. of fat, starch, and calcium oxalate, the last reaching to a fourth, or possibly more, of the weight of the drug.

History and Varieties.—Rhubarb has been used in China from the remotest ages (2700 B.C., Flückiger), and possible references to it are found in the earliest European books on medicine. As early as the seventh century of our era, there can be no doubt of its occurrence in Europe, and by the tenth or eleventh it was well known and highly valued.

For about a hundred years previous to 1860 the Russian Government monopolized the rhubarb trade between Siberia and the Chinese provinces, and established an exceedingly strict inspection of all the roots exported that way, condemning and destroying all but those which were absolutely perfect. In this way an exceptionally fine quality was obtained, and exported, after its long hard journey, from Moscow. Curiously, in England and this country the old and entirely inappropriate name "Turkey rhubarb" was given to this variety. Since 1860 this inspection has been discontinued, and this grade of rhubarb has entirely disappeared from English and American commerce.

The great bulk of the present commercial product is known as Canton rhubarb, though this name also has ceased to be descriptive. Shensi rhubarb is preferred to Canton, and a specially fine variety is that known as Tze-chuen. The round pieces are in general preferred to the flat and the natural to the high-dried. For household use rhubarb is frequently cut into pretty little forms, fingers, crescents, stars, etc.

Fig. 4112.—European Rhubarb. (Flückiger.)

Action and Use.—When chewed rhubarb stimulates the saliva. In small doses, in the stomach, it seems to act as a digestive stimulant; in larger ones it appears to be a simple purgative, hastening along the contents of the bowels by increased peristalsis, carrying the liquid contents of the small intestine rapidly down, to soften and force along the more solid mass in the colon and rectum. Intestinal secretion is supposed to be less stimulated by it than by salines or the cathartic resins. Its coloring matters are absorbed, and may tinge the milk and urine.

Rhubarb is mild and fairly certain in its action; it produces comparatively little pain, no depression in moderate doses, and its action is not prolonged. The tannin in it is credited with producing some constipation after its use, but the simple emptying of the bowels without irritation of the mucous membrane would be enough to explain this result. Rhubarb is given in almost all conditions in which simply emptying the bowels is desired.

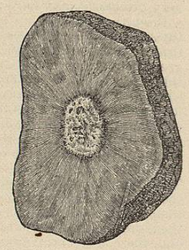

Fig. 4113.—European Rhubarb; surface of a transverse section. (Flückiger.)

Administration. — Rhubarb is offered by the Pharmacopœia in a great variety of forms; it is also found in a good many of the popular proprietary laxative mixtures. It makes a fine, deep yellow powder which is sometimes given, but not often, on account of its very nauseous taste. Two or three decigrams (gr. iij. to v.), once or twice a day, would be a very mild tonic-laxative dose; a single dose of 1 gm. (gr. xv.) is mildly, while one of 2 gm. (gr. xxx.) would be severely, cathartic. Rhubarb in substance is frequently taken by chewing and swallowing a piece of the root as large as a pea or a bean, once a day or so, preferably after eating; the taste, when the drug is used in this way, being less nauseous than that of the powder. The tonic, almost carminative, action of rhubarb upon digestion, has led to its being widely used in this way. The following are the preparations of the United States Pharmacopœia:

Extract, of about 300 per cent. strength; fluid extract; tincture, containing 10 per cent. each of rhubarb and glycerin and 2 per cent. of cardamom; aromatic tincture, twice as much rhubarb, 10 per cent. glycerin, 4 per cent. each of cassia-cinnamon and cloves, and 2 per cent. of nutmeg; sweet tincture, 10 per cent. each of rhubarb and glycerin, 4 per cent. each of liquorice and anise, and 1 per cent. of cardamom; compound powder, 25 per cent. of rhubarb, 65 per cent. of magnesia, and 10 per cent. of ginger; pills, each containing 0.2 gm. of powdered rhubarb and 0.06 gm. of soap; compound pills, each containing 0.13 gm. powdered rhubarb, 0.1 gm. purified aloes, 0.06 gm. powdered myrrh, and 0.005 c.c. oil of peppermint. From the fluid extract is prepared the syrup, of 10 per cent. strength, with 1 per cent. potassium carbonate, 5 per cent. each of glycerin and water, and a little spirit of cinnamon; also the mixture of rhubarb and soda, containing 3.5 per cent. each of sodium bicarbonate and spirit of peppermint, 1.5 per cent. fluid extract of rhubarb, 35 per cent. glycerin, and a little fluid extract of ipecac. The aromatic syrup is made of 15 per cent. of the aromatic tincture, with 85 per cent. of syrup.

Allied Plants.—The genus contains about twenty species, most of whose roots have qualities similar to the above. Several of these, *R. rhaponticum*, and others, are cultivated in Austria and elsewhere in Europe for this purpose, and the European product is trimmed and prepared so as closely to imitate the Chinese. It can generally be told by its duller color, more spongy texture, absence of gritty crystals when chewed, and the more regular arrangement of its medullary rays; the stellate spots are absent. It is very inferior to genuine rhubarb.

Henry H. Rusby.

RICE. See *Starch*.

RICE BODIES.—(Synonyms: *Corpuscula Oryzoidea; melon-seed bodies.*) In chronic tuberculous affections of the tendon sheaths, bursæ, and synovial membranes,

there are frequently formed small hyaline bodies resembling grains of rice or boiled sago. On section they are either homogeneous or granular, or concentrically laminated. In the central portion there is usually a small cleft. Many of these bodies possess a definite capsule, which is narrow, and is made up of concentric layers containing a varying number of nuclei. In the main mass nuclei are either not present at all or are found in very small numbers. Others consist of a hyaline fibrous tissue which in certain parts may show few nuclei. Some are made up wholly of fibrin, while in others the fibrin consists of bands scattered throughout the connective tissue. Giant cells are often present. As shown by the staining reactions these bodies for the greater part represent organized masses of fibrin which have undergone a hyaline change. All stages of the process may be seen. Some of the bodies stain throughout as fibrin with the Weigert fibrin stain; in other cases the hyaline substance stains red with Van Gieson's method. Double staining shows in others the presence of fibrin threads in the midst of the hyaline fibrous tissue. Van Gieson's method causes some of the bodies to take a yellow or brownish stain, the material of which these are composed not giving a fibrin reaction. A deep diffuse blue staining with hæmatoxylin shows the presence of lime salts in others. There has been much dispute over the origin of the fibrin in these bodies, some writers holding that it is the result of a "fibrinoid degeneration" of granulation tissue. The actual facts, however, tend to support the view that the majority of these bodies are formed from masses of exudative fibrin, which becoming organized undergoes a hyaline change.

As shown by the staining the genesis and nature of these bodies must vary. They may consist of fibrinous masses loosened from a fibrinous exudate covering the inner surface of the tendon sheath or bursa; or of partly organized masses of fibrin which have become loosened. The most common mode of formation is from loosened masses of tuberculous or syphilitic granulation tissue. The inner surface of the tendon sheath or bursa in such cases presents a polypoid or villous appearance due to organizing masses of fibrin. The connective tissue grows into the fibrin, organizing it, and after organization becomes changed into a hyaline substance possessing no nuclei. At the end of the villi there are thus formed more or less firmly attached hyaline bodies, which when loosened from their attachments become rice bodies. Around the detached body fresh deposits of fibrin take place, through the organization of which the body acquires a concentric laminated appearance. The hyaline change may begin at the periphery or centre of the body, or in any portion of its substance. It is also probable that portions of necrotic tissue loosened from the inner surface of a tuberculous hygroma may give rise to rice bodies.

By the majority of writers the presence of rice bodies in the joints, in the sheaths of tendons, or in the bursæ, is regarded as positive evidence of the tuberculous nature of the affection. In the great majority of cases the process is undoubtedly tuberculous; tubercle bacilli may be found in numbers upon the surface of the rice bodies, and occasionally within their substance. The formation of these bodies is, however, characteristic of a fibrinous exudate within the structures named, whether due to tuberculosis, syphilis, or other infection. The number of the bodies bears a certain relation to the chronicity of the process.

In many cases great numbers of the bodies may be present within the distended sheath or hygroma. In some cases they may be distinctly felt, and give a marked crepitation when moved upon each other. On cutting into the sac the little hyaline bodies may roll out in great numbers.

Aldred Scott Warthin.

RICHFIELD SPRINGS.—Otsego County, New York.

Post-Office.—Richfield Springs. Hotel and cottages.

Access.—From New York viâ New York Central and Hudson River Railroad; also viâ Delaware, Lackawanna, and Western Railroad. From Philadelphia viâ Delaware, Lackawanna, and Western Railroad. From Washington and Philadelphia viâ Pennsylvania Railroad.

This charming summer resort is picturesquely located on Lake Canandarago, at an altitude of 1,750 feet above the sea-level. Richfield may be classed among the most attractive of our summer resorts. In writing of his visit here Charles Dudley Warner well and truly said, "The charm of Richfield is in the character of its landscapes." It is scenery "that one grows to love, and that responds to one's every mood in variety and beauty. In a whole summer the pedestrian will not exhaust the inspiring views, and the drives over the hills, round the lakes, by woods and farms, increase in interest as one knows them better. The artist is here year after year, one season being too short to satisfy the demands which the charms of the region make upon his love of the beautiful." The art of man has added much to the natural attractiveness of the location. The greatest attraction of Richfield, however, is found in the fine White Sulphur Springs. There are sixteen springs at this resort, and some of them have become widely celebrated. The bathhouse in connection with the springs is one of the most complete in the world, and provides for the therapeutic use of water combined with massage and electricity in a thoroughly scientific manner. It contains sixty-seven rooms for sulphur baths, Turkish and Russian baths, a large swimming pool, a pulverization room, inhalation rooms for the treatment of bronchitis and catarrh, electrical rooms, douche rooms, and a sun bath. The bathhouse is situated on the grounds directly in front of the Hotel Earlington. The following analysis of the principal spring, known as the White Sulphur Spring, was made by Professor Chandler, of New York:

One United States gallon contains (solids): Sodium hydrosulphate, gr. 1.72; calcium hydrosulphate, gr. 0.09; potassium sulphate, gr. 1.67; calcium sulphate, gr. 112.34; strontium sulphate, gr. 0.01; magnesium sulphate, gr. 5.15; sodium hyposulphite, gr. 0.38; magnesium bicarbonate, gr. 31.74; sodium chloride, gr. 0.52; lithium chloride, gr. 0.02; silica, gr. 0.64; and traces of alumina, barium sulphate, iron bicarbonate, and calcium phosphate. Total, 154.28 grains.

Sulphureted hydrogen gas is present to the extent of 14.20 cubic inches in each gallon. This spring, it will be observed, is very heavily charged with sulphureted hydrogen gas. Other important springs at Richfield are the Iron and Magnesia Springs, besides additional sulphur springs. The drinking-waters are obtained from springs west of the village, and are pure and abundant. A course of baths at Richfield has been found of value in cases of insomnia from overwork, in nervousness, in stomach disorders resulting from abused digestion, in chronic malarial infections, in gout and rheumatism, and in some of the disorders of the liver and kidneys. The visitor will find in the Hotels Earlington, St. James, and smaller places accommodations to please any taste or exchequer.

James K. Crook.

RICKETS.—(Synonyms: Rhachitis or Rachitis; Fr., *Nouure, Rachitisme;* Ger., *Rhachitis, Englische Krankheit.*)

Definition.—A general disease of infancy and early childhood, chiefly characterized by alterations in the bony skeleton and by impaired nutrition. In severe cases there may also be changes in the viscera.

History.—The disease was known to the writers of antiquity, but was often confused with other maladies causing deformities of the skeleton, especially with tuberculous spondylitis. We owe the first accurate description of the condition to the English physician Glisson, who published a work upon the subject in 1650. The disease seems to have been especially prevalent in England at that time and later, and has always been the subject of study by English physicians; hence its name of the Englische Krankheit.

During the eighteenth century the French physicians made many contributions to our knowledge of the rachi-

tic process, while more recently the Germans have been most active. Among the names which will always be connected with the history of the study of this important disease of infancy may be mentioned Trousseau, Guérin, Elsasser, Virchow, Kölliker, Rokitansky, and Kassowitz.

Etiology.—The nature of the agent which underlies the pathological changes which we find in rachitic children is still unknown. It has been assumed to be caused by an insufficient amount of calcium salts in the blood, and color has been given to this theory by the oft-quoted experiments of Sutton and others, in which rachitic changes were thought to be produced in animals by nourishing them on food practically free from lime salts. It has been recently shown, however, that the changes which were produced in animals by this means are rather those of osteomalacia than a true form of rickets. The similar belief that an imperfect absorption of the lime salts from the intestine was responsible for the rachitic condition has been shown to be untenable, for the urine of rachitic children contains an amount of calcium quite sufficient to supply the needs of the skeleton; and if larger amounts of calcium salts are administered to either rachitic or healthy children the excess is rapidly excreted in the urine.

The chemical theory that the lime salts either could not be deposited because of the diminished alkalinity of the blood or that they were dissolved out by the action of an acid circulating in the fluids of the body, has been shown to be without foundation. The blood of rachitic children contains neither an excess of acid nor an excess of alkali.

The view brought forward by Kassowitz that the bone changes are purely inflammatory in nature is not in entire accord with the anatomical findings. The most recent suggestions are that the disease is an infection or that it is an auto-intoxication. Neither view has been supported by sufficient experimental evidence to warrant its acceptance, however attractive the assumption may be. Although, therefore, we do not know the actual cause of the disease, there are many predisposing conditions which are known. Among these are chiefly imperfect food and unsuitable hygienic surroundings.

The disease is most frequently seen among the children of the poor, especially those who have been reared upon an artificial diet containing large quantities of carbohydrate and small amounts of fat. It is rare in children who have been breast-fed, the exceptions being principally the children of the laboring classes, where the mother begins to work soon after the delivery of the child, or in children who have been nursed for a long period until the milk becomes insufficient for the needs of the infant.

Children fed upon sweetened condensed milk are frequently rachitic, while those obtaining the unsweetened form are not likely to suffer. Boiling the milk is also thought to set up obscure changes in the composition of that fluid which affect the nutrition and may cause rickets and especially scurvy. The exact form in which the hygienic factors exert their influence is not so clear as it is with food. Some observers, notably Mey, are inclined to consider lack of light and fresh air as very potent forces in the production of the rachitic process; others, for example Lange, regard the hygienic factor as comparatively unimportant and, though acknowledging that the disease is more prevalent in cities where the hygienic surroundings are bad, they lay the most stress upon the food factor. It is certain, however, that rickets is very infrequent in the country, in high altitudes, and in the tropics. It is also true that the children born in these conditions are much more likely to be breast-fed than those in the tenement districts of large cities. The influence of race in the susceptibility to rickets is seen in the negro and in the Italians. The children of both of these races, when confined to the tenement districts in cities, offer our most marked examples of advanced and severe rickets. Congenital influences play some part in the causation of rachitis, though at present the trend of opinion is against a true congenital form of the disease. Cases so described are regarded as distinct from rickets, though showing bone lesions closely resembling those seen in rachitic children. Parental syphilis is a strong predisposing factor in the production of rickets, though it does not seem to be the cause of the disease, as Parrot attempted to show. Tuberculosis and alcoholism in the parents also predispose to rickets, chiefly by reducing the child's power of resistance. Both sexes are equally subject to the disease, though in hospital statistics a larger number of males will be noted. This apparent anomaly is due to the fact that a larger number of male children are received for hospital treatment than female, and large statistics, including private cases, will show about equal numbers affected. The clinical development of the disease is most noticeable in the second year of life, though a large proportion of children show signs of the disease during the first year. After the third year the disease is infrequent. Late cases have been described in children even up to the twelfth year, but such observations are extremely rare. The disease is one which concerns the period of the most active growth and formation of the bones, progressively diminishing as the skeleton assumes its definitive condition.

Pathology.—The constant and characteristic lesions of rickets are to be found in the bones; the visceral changes are comparatively slight and secondary. A rachitic bone, when examined in a fresh condition, is softer than normal, and the actively growing portions—that is, those parts near the epiphyseal junction in the long bones and the ossification centres of the cranial bones—are larger and much more vascular than in normal bones from a child of the same age. The periosteum is thickened and strips with some difficulty from the surface, leaving irregular areas of soft, newly formed bony tissue adherent to the inner layers of the periosteum. The bone from which the periosteum has been removed is soft and very vascular, and has a spongy appearance. The same changes may be noted if one of the long bones is split open and the internal layer of the periosteum is examined. The calcification zone at the epiphyseal junction, which in normal bone is well defined and narrow, is broad and not sharply defined in rachitic bone, and may be quite unrecognizable. In the later stages of the disease, when the acute process has ceased, the rachitic bone is usually harder than normal bone, especially where an active production of new bony tissue has taken place. This newformed bone may resemble ivory in its density and texture. Frequently, however, when the restoration of the bone has been incomplete, it is soft and porous, and contains a considerable quantity of fat scattered through the substance. Such bones are very light and fragile, and green-stick fractures are frequent. The microscopical changes correspond to the gross lesions. The centres of the flat bones of the skull are vascular and the bony layers are replaced by osteoid tissue. This may be very abundant in amount, in which case the bone is so soft that it can be easily indented by the finger, and gives a soft crepitus when palpated, a condition known as craniotabes; or the osteoid tissue may be located in small areas, a few millimetres in diameter, and give the bone an appearance of a coarse sponge. The osteoid tissue may not ossify, and the aperture thus left in the bone may be closed simply by the pericranium. Such marked changes in the regular course of ossification of the cranial bones are as a rule rare, and confined chiefly to the posterior portion of the cranium.

The more frequent course is for the osteoid tissue to be gradually replaced by bone, either by direct ossification or by the replacement of the abnormal tissue by normal bone. When the osteoid tissue ossifies directly the structure produced is as a rule more dense than normal and resembles ivory. In the long bones the most marked lesions are at the epiphyseal junction. It should be remembered, in order to understand the pathology of the subject, that the bones grow in length at this point, while they increase in diameter by the production of new bone from the inner layers of the periosteum. At the same time the medullary cavity is enlarged by absorption of the inner layers of bone. In rickets the pathological

changes consist in the distortion of these normal conditions. The inner layers of the periosteum produce an excessive amount of very vascular osteoid tissue, which undergoes either ossification or absorption. The ossification which takes place is of a very imperfect sort, so that the new bone is soft, spongy, and very much more vascular than normal. In the medullary cavity the process of absorption is very irregular and often excessive in amount. The cavity may extend into the epiphysis, or it may be filled with osteoid tissue, which replaces the normal bone marrow and thus may contribute to the anæmia from which rachitic children suffer by directly diminishing the production of the blood cells. The course of the bone growth, which takes place at the epiphyseal junction, is also disturbed by a combination of the same processes which contribute to the irregular bone production by the periosteum. The cartilaginous area of the epiphyseal portion of the bone is broken up and penetrated by a vascular osteoid tissue, which may be prematurely ossified or may form marrow cavities. The cartilage cells also proliferate and become dislocated from their normal positions. Absorption of these masses may occur or they may become ossified. The normal calcification zone becomes irregular and is broken up by the advance of the osteoid tissue into the epiphysis. After a variable period of from three to eighteen months the active process ceases and the formation of bone begins in a normal manner. The swelling of the epiphyses diminishes, the extreme vascularity is reduced, and the areas of osteoid tissue become calcified. The structural reparation is never quite complete, though a large amount of the distortion of the bone may disappear.

The effect of these changes in the structure of the bones is first to delay their growth, and second to cause deformities. The results of the first condition may be seen in the small bodies and shortened limbs of children that have suffered from rachitis of a severe type. The softness of the bones permits their easy distortion under pressure, as is so well seen in the chest, while the deformity which results from growth alone is best noted in the square form of the cranium or in the curvatures of the upper extremities.

The lesions of the viscera are not an essential portion of the rachitic condition, but they are quite frequently met with in severe cases. The lungs frequently show acute or chronic bronchitis or a bronchopneumonia. When the deformity of the chest wall is considerable, the lungs may be the seat of a marked emphysema in the areas upon which there is no pressure, while those portions which are compressed by the incurving of the thorax may be in a condition of atelectasis. The spleen is frequently increased in size owing to an interstitial splenitis of a chronic form; the liver occasionally shows similar changes. The lymph nodes are often swollen and hyperplastic. Hydrocephalus is no more frequent in rachitic children than in others, the enlargement of the head being due to the increase in thickness of the cranial bones. The muscles of the body are flabby and atrophied.

Symptoms.—The symptoms of the disease vary with the stage of the malady. The earliest symptoms are restlessness during the night, sweating of the head, craniotabes, and the beading of the ribs. The beading of the ribs is an especially early and valuable symptom, and consists of a row of nodules formed at the costo-chondral junction. The beading is often more marked internally, especially in cases with extreme incurving of the chest wall. The craniotabes is often an early symptom, and may best be demonstrated by gently palpating the posterior surface of the head with the tips of the fingers. Small areas, softer than the remainder of the skull, will be felt, and the tissue may crackle under the pressure. In rachitic children the skull appears relatively large and the frontal prominences are well marked; alterations which, when associated with the prominent posterior part of the head, give to the latter the characteristic square appearance, the *tête carrée* of the French. The anterior fontanel is larger than normal, and its closure may be delayed even to the third or fourth year. The two lateral openings are often late in closing, as are also the sutures. The superior and inferior maxillæ are slightly distorted in severe cases, chiefly by muscular action. The teeth are delayed, not appearing until the end of the first year, or even later, and there are often irregularities in the time and order of appearance and arrangement of the different groups of teeth. Some observers consider the teeth of rachitic children to be especially prone to decay. The thorax, as has been mentioned above, is frequently deformed. In mild cases the only change noted is the swelling of the costo-chondral junction, forming the so-called rachitic rosary. The flexibility of the bones of the chest permits the pressure of the atmosphere to exert a considerable influence in the production of deformities, so that a distinct depression frequently exists along the line of the ends of the ribs, or there may be a transverse groove parallel to the line of the insertion of the diaphragm. The deformities known as funnel breast and pigeon breast are largely dependent upon an antecedent rachitic process. Any obstruction to the free admission of air to the chest, such as is associated with chronic bronchitis, enlarged tonsils, or adenoid growths of the pharynx, is likely to exaggerate any chest deformity. The lessened capacity of the thorax causes the liver and spleen to be much more prominent than their increase in bulk from hyperplasia would warrant. The abdomen is usually distended, the enlargement being chiefly due to the distention of the intestines with gas, aided by the weak condition of the muscles of the gut wall and of the abdomen.

In rachitic children the spinal column is much more flexible than normal, owing to the imperfect ossification of the vertebræ and the relaxation of the spinal ligaments. When such children assume an erect position a marked kyphosis can usually be noted, which disappears when the child assumes a recumbent posture. The curve of the rachitic kyphosis is rounded in form, and involves the bodies of a number of vertebræ, in contrast with the sharp projection of the kyphotic curve in spinal tuberculosis. There is usually a compensatory lordosis in the lumbar region and rarely a left-sided scoliosis.

The clavicle and the scapula may be curved slightly. The pelvis is often the site of serious deformities. It is flattened laterally and the promontory approaches the arch of the pubis, which is also narrowed. The approximation of the promontory to the pubis is in part due to the rotation of the sacrum on a horizontal axis, in part to the inward displacement of the ischia. These pelvic deformities are often permanent, and render the bearing of children difficult or impossible. The extremities very early show the characteristic enlargement of the epiphyses, especially of the lower end of the radius, ulna, and tibia. Such epiphyseal swellings may also appear at the upper and lower ends of the humerus and femur, but are much less marked.

If the disease is of a severe type the diaphyses of the bones may become curved. The convexity of the femur is forward and outward; that of the tibia and fibula is often lateral, but may also be forward; that of the radius and ulna is toward the extensor surface, while the humerus is bent forward. The irregular growth of the epiphyseal ends of the bones, combined with the curvature, gives rise to deformities which are especially serious in the lower extremities. The axis of rotation of the knee-joint may remain horizontal, or, as is seen in advanced cases, the axis may be rotated either inward or outward, so that a simple osteotomy of one bone will not suffice to correct the deformity, but both the femur and the tibia will have to be severed and the axis of the joint restored to its normal rotation plane.

The cause of these deformities is not, as is usually assumed, the result of allowing the child to walk before the bones are sufficiently hard, but is due to the rachitic curvature of the shafts of the bones and to the uneven enlargement of the condyles of the femur. A moderate amount of deformity may be increased, however, by allowing the child to walk while the rachitic bone is still

soft. The other symptoms of the disease not connected with the skeleton are chiefly those relating to the digestive, respiratory, and nervous systems. The frequency of respiration of rachitic children is increased in those cases in which there exists a considerable diminution of the respiratory capacity, owing to the deformity of the chest wall and the pressure of the gas-distended intestines against the diaphragm. Bronchitis and atelectasis very frequently complicate the respiratory and circulatory changes produced by the narrowing of the thorax.

Laryngismus stridulus is a not uncommon complication of rickets, and is responsible for a considerable proportion of the fatal terminations of the affection. General convulsions are a frequent complication of the disease, and tetany is also occasionally seen.

A chronic gastro-intestinal catarrh is usually present in rachitic children, and is easily increased in severity by slight indiscretions in diet. The stools are either constipated or thin and fluid. They are as a rule paler than normal and may be very foul-smelling. They contain an excess of calcium salts derived in part from the food and partly from the softening bone. The blood shows an anæmia of the chlorotic type with a moderate reduction of the red cells and a considerably lessened hæmoglobin content. A moderate leucocytosis may also exist, which is in all probability not characteristic of the disease, but is dependent upon the respiratory and intestinal complications. The urine shows no striking alterations. Occasionally there may be a trace of albumin present and a diminution in the excretion of the phosphates and the chlorides. There is no alteration in the amount of lime salts excreted in the urine.

Fever is not a regular accompaniment of the disease. When present it is due to one of the complications. The skin of the rachitic child is pale. Eczema is not infrequent, and occasionally multiple skin abscesses are seen. Severe sweating is the rule in all cases of rickets. The subcutaneous fat is well preserved, though the patients are soft and flabby.

Course and Prognosis.—Cases considered to be congenital rickets have been described by competent observers, but as a rule the symptoms of the disease begin in the latter half of the first year of life; and in a majority of the cases the disease runs its course inside of eighteen months or two years. Very chronic cases, lasting for years, are exceedingly infrequent. The condition which has been classed by some clinicians as acute rickets is probably a form of scurvy. The prognosis of an uncomplicated case of rickets is good so far as life is concerned. The disease is self-limited and often disappears without treatment when the child is old enough to begin a mixed diet. The prognosis of the bone deformities is not so good, and many of the severe cases are permanently deformed, though surgical interference will often allow the complete correction of the deformities of the lower limbs. Death results in all cases from some intercurrent disease and not from the bone lesions alone. Marasmus and laryngismus stridulus are responsible for a considerable proportion of the fatal cases, while the others are carried off either by bronchopneumonia, or by tuberculosis, or by some intestinal condition. Whooping-cough is an especially dangerous complication in rachitic children with marked deformity of the chest.

Diagnosis.—A well-developed case of rickets is easy of recognition, especially at a time when the bone lesions are most prominent; but in children in the early stages of the disease the diagnosis is more difficult, and must be made from the general symptoms. The most important of these are the restlessness at night, the sweating of the head, the general tenderness of the body, and the malnutrition. The craniotabes and the persistent and wide-open fontanel are valuable symptoms, as is also the late eruption of the teeth. The bone lesions of syphilis are in the nature of thickenings under the periosteum rather than of an increase in the size of the bone, and the necroses seen in syphilis are not present in rickets. The other evidences of congenital lues will aid in the differential diagnosis. Confusion between the kyphosis due to tuberculous spondylitis and that due to rachitic softening of the vertebræ and intervertebral cartilages will be avoided if it be remembered that the curve in tuberculous disease is sharp and affects the bodies of only one or two bones, while that due to rachitic disease is more gradual and less limited. The rachitic bones are not very tender to pressure, and the kyphosis can be overcome by placing the patient on a flat mattress. Pott's disease is rarely seen in children under two years of age, a time when rickets is most likely to be well developed.

Rickets is differentiated from scurvy by the absence of the ecchymoses and the changes in the gums.

Prophylaxis.—The prevention of the disease depends naturally upon the avoidance of the conditions determined as the immediate factors in the causation of the malady. This is perfectly possible among people of good circumstances, but becomes a matter of great difficulty when we must cope with the conditions of tenement life among the very poor.

Every care must be taken with the children of parents who have previously borne rachitic children, as the predisposition increases with each child. The mother should be allowed to nurse the child if it is possible for her to avoid hard, manual labor during the course of lactation. But if she is not able to do this, the better plan will be to feed the child on Pasteurized cow's milk. A convenient form of apparatus for this purpose, and one requiring a minimum of intelligence on the part of the user, is that devised by Dr. R. G. Freeman. During the hot season of the year the child should be sent to one of the seaside hospitals or to the country for a time; or if this is impossible, it should be given every opportunity to obtain fresh air that is possible.

Treatment.—The care of rachitic children should be begun as early as the diagnosis can be made, in order to prevent severe bone lesions and also to obtain the maximum result from the treatment, as the best results are secured in cases in which the disease has been recognized in the first stages. The diet should be altered from that under which the child has developed the disease to one which is more nearly normal. If the child is breast-fed the quality of the mother's milk should be determined, and if necessary it may be supplemented by cow's milk in the proper modification. If the mother cannot nurse the child, it must be fed upon properly prepared cow's milk. The diet should be rich in fats and proteids, and contain but a small amount of carbohydrates. This will eliminate all of the proprietary infant foods. Cod-liver oil should be administered in small doses as soon as the stomach will tolerate it. Arsenic and iron are useful to combat the anæmia. The excessive sweating may be relieved by cool sponging, and by atropine in doses of about gr. $\frac{1}{200}$ per day. Opinions vary as to the value of the phosphorus treatment of rickets. Originally recommended by Trousseau, it has been rendered popular through the efforts of Kassowitz, who regards it as a specific. It may be administered in the form of a solution in oil, made by diluting the official oil of phosphorus with olive oil, in doses of gr. $\frac{1}{100}$ three times a day after meals. The use of extracts of the thyroid, thymus, and adrenal glands has not given satisfactory results.

The hygienic treatment of the child is nearly as important as the correction of the food. The child should spend a large portion of the day in the open air and in the sun if possible. Such open-air treatment is best carried out in the country; but if this is impossible, the child should be taken on excursions on the water or to the country, and during the rest of the time be kept in the parks and open squares of the city. The roof of one of the tenement houses is better than the street for such a child, and if the weather is not too hot such a place is often the best possible. The child will be strengthened, and is much less likely to catch cold, if it is sponged off with cold water every day. The addition of some sea salt to the bath is of use if the child is strong enough to stand the stimulus, while massage or even gentle rubbing of the body and limbs before or after the bath is of the greatest value in keeping up the general nutrition.

The correction of the deformities of the extremities is a matter of surgical interference; but much can be done to prevent the curvature from becoming severe by not allowing the child to assume a posture which will increase the deformity, and also by keeping up the muscular tone. The kyphosis may be relieved by allowing the child to sleep on a flat, hard mattress without a pillow. If the deformity of the occiput is marked, the pressure may be prevented by the use of a firm horse-hair pillow with a concavity to receive the flattened portion. If the kyphosis is extreme in a child which is old enough to be about, and in which the bones of the legs are firm enough to permit walking, it may be advisable to fit the thorax with a jacket or a steel brace, which should be worn only when the child is in an erect posture. The use of braces in order to prevent or to cure deformities of the lower extremities is of but very slight benefit. It is better to wait in these cases until firm ossification of the bones has taken place and then to correct the deformity by a proper osteotomy. *Francis Carter Wood.*

RIGOR MORTIS. See *Cadaver, Legal Status of.*

RIO DE JANEIRO, BRAZIL.—Rio de Janeiro, the largest city in South America, with a population of about 779,000, is situated upon the western side of one of the most magnificent harbors in the world. It is in no sense a health resort,—indeed, quite the contrary,—but it is mentioned as an illustration of a tropical or equatorial climate, and also to convey some knowledge of its climate to those who for any reason, either temporarily or permanently, are obliged to reside there.

The city itself occupies flat land with hills in the outskirts, and beyond rise precipitously mountains of from fifteen hundred to three thousand feet high. Foreigners are advised to make some of the high-lying suburbs or towns in the vicinity their place of residence, at least during the warmer months, in order to escape the continuous heat and great atmospheric humidity which combine to make the climate of the city itself so debilitating.

The population of the city is a heterogeneous one, composed of Portuguese, Italians, Germans, French, English, and negroes. There are parks, a national library, museum, colleges, various schools, hospitals, and an observatory. An immense amount of coffee—said to be more than one-half of the world's product—is exported from here.

The water supply is good but somewhat inadequate, and the drainage is said to be satisfactory. Modern sanitary conditions exist. In the outskirts, among the hills and mountains, the scenery is most beautiful and the vegetation luxuriant.

The climate can be summarized as a moist, warm, tropical one; warmest in what is our winter and spring, and coldest in our summer and autumn, but at all times warm or hot. The rainfall is high, the largest amount occurring in our autumn and winter. The air is often sultry and very debilitating. There is generally a daily sea breeze from the south and southeast—part of the trade winds come from the southeast;—it begins about 1 P.M. and lasts until about four or five o'clock. The nights are usually calm. The climatic chart has been arranged from the very elaborate series of observations published by L. Cruls, director of the Observatory at Rio de Janeiro, and the reader who desires to make a more exhaustive study of this climate is referred to this work.

The temperature arrives at its maximum at the beginning of February, and at its minimum the beginning of July. The mean annual variation does not exceed 10.8° F., and the mean diurnal variation does not reach 5.4° F.

The humidity is really greater than would appear from the average relative humidity as shown in the table, on account of the high temperature, for a humidity of over seventy per cent. at a temperature of over 70° F. is very moist. The excessive moisture is one of the striking characteristics of this climate, and renders the heat so unbearable. The daily occurrence of the sea breeze, however, mitigates this condition. There is a large amount of cloudiness and there are but few clear days. The average yearly rainfall is 42.5 inches, and there are one hundred and twenty-seven days of rain. March and December are the rainiest months and July is the driest month. The most prevalent wind is from the south and southeast—the sea breeze,—and next in frequency is that from the northwest—the land breeze.

Yellow fever is generally prevalent during the warm months, and there are severe epidemics at intervals. In the lowlands intermittent fever prevails. The negro population suffers from smallpox. There is, at St. Sebastian, a large hospital which was founded in 1888, and which is devoted to the treatment of epidemic diseases. One would naturally infer that the mortality in such a climate and with so many epidemic diseases would be high, but from the official statistics the average mortality from 1897 to 1901 is found to be 19.4 per 1,000. Tuberculosis causes much the largest number of deaths of any one disease, and bronchitis and bronchopneumonia come next in frequency, while infantile diseases rank third. It would appear, then, that any one individual resident of Rio de Janeiro had many more chances of dying of tuberculosis than from yellow fever, and that this dread disease (tuberculosis) may be quite as prevalent in warm countries as in cold. *Edward O. Otis.*

RITTER'S DISEASE. See *Dermatitis Exfoliativa Neonatorum*, and *Pemphigus.*

RIVIERA, THE.—As the various especial resorts upon this coast have been, and will be, quite thoroughly discussed, only a very brief and general reference will be

Climate of Rio de Janeiro. Latitude, 22° 54′ 23″ S.; Longitude, 43° 8′ 34″ W. From Observations made at the Observatory of Rio de Janeiro, Period of Observation, Nine to Forty Years.*

	Jan.	Feb.	March.	May.	July.	August.	Sept.	Nov.	Year.
Temperature (degrees Fahrenheit)—									
Average or normal	79.45°	79.6°	78.6°	72.4°	69.1°	70.1°	70.8°	74.4°	74.2°
Mean maximum	94.4	94.7	91.6	84.6	78.2	83.9	86.1	93.3	88.7
Mean minimum	66.7	68	66.3	59.7	57.4	57.8	58.1	61.3	55.8
Highest or maximum, 102° Dec. 8th, 1889.									
Lowest or minimum, 50.3° Sept. 1st, 1882.									
Humidity—									
Average relative	78%	80%	79%	79%	78%	77%	80%	77%	78%
Precipitation—									
Average in inches	4.6	4.3	5.3	3.5	1.4	1.7	2.2	4.2	42.5
Wind—									
Prevailing direction	S. S. E.	S. S. E.	S. S. E.	N. W.	N. W.	N. W.	S. S. E.	S. S. E.	S. S. E.
Weather—									
Average number clear days	11.2	9	12.8	10.9	16.8	12.5	5.7	9.1	131
Cloudiness+	61	62	59	60	50	77	71	64	64
Average number days of rain	12.6	12	11.5	10.6	5.9	6.5	11.1	11.8	127
Average number days of storm	6.3	5.3	3.8	9.6	.4	.6	1.4	2.7	30

* "Le Climat de Rio de Janeiro," par L. Cruls, Director of the Observatory of Rio de Janeiro, from observations taken during the period of 1851 to 1890, Rio de Janeiro, 1892.

+100 is taken to represent a completely covered sky, and 0 a completely clear sky.