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.

made here to this region as a whole, and the reader is referred for more detail to the articles upon *Alassio, Bordighera, Cannes, Hyères, Nervi, Nice, Mentone, Monte Carlo,* and *San Remo.*

The Riviera is a strip of coast extending 323 miles along the shore of the Mediterranean at the foot of the maritime Alps and their offshoots. The portion from Hyères to Genoa, 203 miles, is called the Western Riviera; and that extending from Genoa to Leghorn, 112 miles, the Eastern Riviera. It is the former portion that is the more frequented, and is what is generally meant when one speaks of the Riviera. The topography of this region is that of "a long shelf, or rather a series of shelves, on the south side of a very high mountain wall, which wall, up to the level of these shelves, is submerged in the waters of the sea" (Richards).

The general climatic features of all this region are the same, varying at one resort or another in certain minor aspects according to the local peculiarities of situation, principally with regard to shelter from the winds. These climatic features—and here the colder months of the year are only considered—are comparative warmth, moderate dryness, a large amount of sunshine, and great heat of the sun's rays; the small number of rainy days, and relative immunity from cold winds. No station is entirely exempt from these cold winds, but some are more exposed than others, as has been shown in treating of the various resorts. Moreover, the seasons differ from one year to another. The latitude of the Riviera has not so much to do in the production of its mild winter climate, but this is rather due to the protection afforded by the maritime Alps from the cold northerly winds, and also partly to the southern exposure and partly to the warm water of the Mediterranean Sea.

The mean temperature for the three cold months (December to February) according to Weber ("A System of Physiological Therapeutics," vol. iii., Book I., "Health Resorts," F. Parkes Weber, 1901), is from 47° F. to 49.8° F.; for the six cold months (November to April), about 51° F.

According to the same authority the mean relative humidity is from sixty-five to seventy per cent., and the annual rainfall from twenty-eight to thirty-one inches, the greater part falling during October and November.

The principal winds are the northwest—the "mistral," a cold dry wind prevailing in March; the northeast, or "bise," a cold wind; and the southeast, or "sirocco" a "warm, wet, enervating wind."

Quoting Weber again, "during the six winter months one hundred days or more may be expected to be fine enough for most invalids to be in the open air for several hours."

Besides the danger from the high winds, especially the dreaded "mistral," there is also to be mentioned the great difference between the sun and the shade temperatures, and the rapid fall of the temperature after sunset, with the increased humidity at that time. The dust is also an objectionable feature of this region. The Riviera season extends from about the end of October to the end of April. Abundant and good accommodations, all more or less expensive, are to be found in all the Riviera resorts.

As to the natural attractions of the Riviera, they are too well known to require any extended description. "Nothing," says Lindsay, "can exceed the loveliness of this strip of flowery coast land, with its jutting crags and circling bays, bounded on one side by spurs of the Alps, and on the other by the Mediterranean, now glittering in brilliant azure, again rippled into sapphire by the breeze." In comparing this region with the littoral of Southern California, the latter is undoubtedly superior in climate, but in beauty of scenery supplemented by art, the former is by far the more attractive.

The Riviera is visited in the winter by great numbers from Northern Europe, who desire to escape the cold and more or less cheerless winters of their own region. This climate affords a blessed relief for those who desire to spend the winter in a warm, sunny climate amidst most attractive surroundings. The aged, the feeble, the convalescents; those with diminished powers of resistance, and those suffering from various chronic affections with deficient powers of reaction, all find more or less comfort, relief, and healing here. The diseased conditions for which this climate is recommended are chronic bronchitis and emphysema, bronchial asthma, certain varieties of pulmonary tuberculosis, scrofula, chronic pneumonia, and anæmia.*

The Riviera is now easily and comfortably reached by steamers sailing from New York or Boston direct to Genoa, and from Genoa the railroad runs along the shore of the Mediterranean parallel with the celebrated Corniche road for a good part of the way. Express trains also run from Paris direct to the Riviera. *Edward O. Otis.*

ROANOKE RED SULPHUR SPRINGS.—Roanoke County, Virginia.

POST-OFFICE.—Roanoke Red Sulphur Springs. Hotel and cottages.

ACCESS.—Viâ Norfolk and Western Railroad to Salem, thence nine miles north to springs.

This resort is located under the shadow of the outlying ranges of the Alleghanies, twelve miles from Roanoke City. The manifold attractions of the Virginia mountain region find here a faithful exemplification. The high and dry location, the pure, fresh air, and the unsurpassable mountain scenery unite to form a most delightful summer health resort. In the hotel will be found all the comforts and attractions which go to render a stay at a watering place enjoyable. The Roanoke Red Sulphur waters have been examined by Prof. M. B. Hardin with results as follows: One United States gallon contains (solids): Calcium carbonate, gr. 6.54; magnesium carbonate, gr. 5.83; lithium carbonate, gr. 0.02; manganese carbonate, gr. 0.02; iron carbonate, gr. 0.06; sodium chloride, gr. 0.24; ammonium chloride, gr. 0.02; calcium chloride, gr. 0.03; strontium sulphate, gr. 1.71; calcium sulphate, gr. 2.19; sodium sulphate, gr. 3.04; potassium sulphate, gr. 0.33; sodium hyposulphite, gr. 0.03; ammonium nitrate, gr. 0.05; silica, gr. 0.83; organic matter, gr. 0.76; bicarbonates, gr. 5.96; and traces of copper carbonate, lead sulphite, barium sulphate, alumina, and arsenic. Total, 27.66 grains. The gases present in one gallon of the water are: Carbonic acid, 12.4 cubic inches; sulphureted hydrogen, 2.44 cubic inches.

These waters are useful in those classes of cases which require a fairly concentrated sulphur water. They possess alterative, diuretic, and tonic properties. It will be observed that they contain an unusually large proportion of strontium, an element whose therapeutic properties are not as yet fully understood.

The following analysis of the chalybeate spring at this resort was made by Dr. H. Froehling: One United States gallon contains (solids): Calcium carbonate, gr. 0.45; magnesium carbonate, gr. 0.95; iron carbonate, gr. 2.09; manganese carbonate, gr. 0.09; sodium carbonate, gr. 0.44; bicarbonates, gr. 2; and very small quantities of sodium chloride, potassium sulphate, sodium sulphate, aluminum sulphate, aluminum phosphate, silica, ammonium carbonate, and organic matter. Total, 7.20 grains. Free carbonic-acid gas, 12.30 cubic inches. This water is very useful in anæmia and debilitated states of the system. The Roanoke Sulphur Springs are much resorted to in the treatment of chronic bronchial, pulmonary, and throat affections. The waters of the spring, combined with the wholesome atmospheric conditions of the neighborhood, are believed to be almost a specific for hay fever. *James K. Crook.*

ROCHESTER, NEW YORK.—Rochester, N. Y., a city of 162,608 inhabitants, is situated on both sides of the Genesee River, seven miles from Lake Ontario. It lies in the so-called "Lake Region" of the United States, which region has the climatic peculiarity of great winter cloudiness in comparison with that of the Oregon winter, and

* Vide: "A Joint Inquiry as to what kind of Patients should be Sent to the French Riviera," by Stanley M. Rendall, M.D., of Mentone, and Thomas Linn, M.D., of Nice.—The Climatologist, November 15th, 1891.

of the St. Lawrence Valley district. As will be seen by the climatic chart, the number of clear and fair days are least in winter, and the relative humidity is highest. The rainfall is least in autumn.

"During the six months, April to September inclusive, the relative humidity of the atmosphere is markedly lower at Rochester than at New York, and the cloudiness is nearly the same at the two places; during the midsummer months it is actually less at the former than at the latter. Thus, during the winter season, Rochester is decidedly damper and more cloudy than New York; during the summer season, and especially the midsummer season, New York is markedly damper and a trifle more cloudy than Rochester" (Richards, previous edition of the HANDBOOK).

These springs are located in a glen-like nook formed by the spurs of the North and Mill Mountains, and they break forth from a mass of slate rock at the base of the ridge. This slate contains large quantities of alumina and the salts of iron, and the springs are formed by the percolation of water through this mass. Four different reservoirs, numbered respectively No. 1, No. 2, No. 3, and No. 4, have been formed. The immediate surroundings of this resort are very attractive. The hotel and cottages afford comfortable accommodations. The numerous springs here vary somewhat in their analyses, the proportion of alum ranging from 6.88 gm. per gallon in Spring No. 6, to 81.05 gm. in Spring No. 7. Different chemists have also arrived at different results in analyses of the same spring. The following analysis, by Prof.

CLIMATE OF ROCHESTER, N. Y. LATITUDE, 43° 8′; LONGITUDE, 77° 42′. PERIOD OF OBSERVATION, THIRTEEN YEARS.

	January.	February.	March.	May.	July.	August.	November.	Year.
Temperature (degrees Fahr.)—								
Average or normal	24.4°	25.1°	30.1°	56.8°	70.9°	69.4°	36.2°	46.8°
Average daily range	14.0	15.6	14.5	18.8	17.9	18.0	13.5	
Mean of warmest	30.9	34.1	39.5	65.7	80.0	78.6	45.0	
Mean of coldest	16.9	18.5	24.9	46.9	62.1	60.6	31.5	
Highest or maximum	69.0	68.0	69.0	90.0	96.0	96.0	71.0	
Lowest or minimum	−12.0	−12.0	7.0	23.0	48.0	47.0	1.0	
Humidity—								
Average relative	80.1%	76.9%	75.7%	62.3%	66.7%	67.3%	75.5%	71.4%
Precipitation—								
Average in inches	3.31	2.68	3.41	3.31	3.52	3.05	2.91	36.78
Wind—								
Prevailing direction	W.	W.	W.	W.	W.	S. W.	W.	W.
Average velocity in miles	11.1	11.3	11.6	9.6	7.5	6.9	10.3	9.6
Weather—								
Average number of clear days	1.5	3.3	3.9	9.2	9.2	10.4	2.9	71.5
Average number of fair days	8.2	10.8	11.0	12.5	14.7	13.7	9.3	133.3
Average number of clear and fair days	9.7	14.1	14.0	21.7	23.9	24.1	12.2	204.8

It will further be noted from the chart that the temperature range is great, a characteristic of the climate in the temperate zone; and that the prevailing wind the year through is from the west or southwest. If this chart is compared with that of Portland, Me., given in the present volume, it will be seen that there is a close resemblance in many of the data. The temperatures are very nearly the same. At Rochester the average mean annual temperature is 46.8°, and at Portland, 46.5°; for the winter, in the former place, the average is 25.7°, and in the latter, 25.6° F.; and so of the other seasons. The rainfall for the year in Portland is 39.04 inches, and in Rochester, 36.78 inches. The average relative humidity is 71.4 per cent. at Rochester, and 69.7 per cent. at Portland. We notice, however, that there is more wind at Rochester, and the direction is more constant. When we come to the number of clear and fair days, there is a decided difference. While the number of clear days at Rochester is only 71.5 per annum, it is 107.7 at Portland; and the number of clear and fair days at the latter place exceeds by forty-seven the number at Rochester. More sun and less wind, then, are to the advantage of Portland.

Where an outdoor life under clear skies and in sunshine is desirable for a patient, it is evident that he must seek some other locality than that of this "Lake Region" as represented by Rochester.

Forty-four miles south of Rochester is situated the Jackson Sanatorium, for the treatment of certain chronic cases, such as neurasthenia, etc. It is said to be well equipped with apparatus for the various forms of treatment by hydrotherapy, electricity, etc.

Edward O. Otis.

ROCKBRIDGE ALUM SPRINGS.—Rockbridge County, Virginia.

POST-OFFICE.—Rockbridge Alum Springs. Hotel and cottages.

ACCESS.—Viâ Chesapeake and Ohio Railroad to Goshen, thence by stage to springs.

M. B. Hardin, of Spring No. 2, is fairly representative of the group:

One United States gallon contains: Sodium sulphate, gr. 0.03; calcium sulphate, gr. 3.23; lithium sulphate, gr. 0.02; magnesium sulphate, gr. 5.61; potassium sulphate, gr. 0.41; aluminum sulphate, gr. 42.61; manganesium sulphate, gr. 0.09; iron persulphate, gr. 1.95; nickel sulphate, gr. 0.14; calcium phosphate, gr. 0.17; sodium chloride, gr. 0.11; silica, gr. 3.70; sulphuric acid, gr. 3.83; and traces of cobalt sulphate, zinc sulphate, lead sulphate, ammonium nitrate, calcium fluoride, antimony, copper, arsenic, and organic matter. Total, 62.35 grains. The following gases were also found in one United States gallon: Oxygen, 1.49 cub. in.; nitrogen, 3.98 cub. in.; and carbonic acid, 10.89 cub. in. These have long been regarded as among the best alum waters known. They are clear and odorless, but possess a strongly astringent and styptic taste. Their temperature ranges from 50° to 56° F. They are of undoubted efficacy in cases requiring an astringent chalybeate. They have proved valuable in atonic and catarrhal states of the different mucous membranes—for example, in chronic diarrhœa, in leucorrhœa, in pharyngitis, in rhinitis, etc. They are very useful locally in scrofulous ulcers and in other slow-healing similar conditions. The waters sometimes prove purgative in large doses and are always diuretic in doses of one-quarter to one-half of a small tumblerful taken six, eight, ten, or twelve times a day. The effects of the water often last far beyond the period during which they are taken.

James K. Crook.

ROCK CASTLE SPRINGS.—Pulaski County, Kentucky.

POST-OFFICE.—Rock Castle. Springs Hotel.

These springs are located in the Rock Castle River, and are accessible by the Louisville and Nashville and Queen and Crescent Railroad lines. There is daily connection by stage with morning and afternoon trains at London. The situation is one of great natural charm

and beauty, being in the heart of the Cumberland Mountains, at an elevation of over two thousand feet above the sea-level, and surrounded by a vast natural park of pine trees. The pure air and equable temperature, as well as the isolation from the thoroughfares of travel, combine to render the location one of exceptional freedom from the ills of hot weather. A comfortable hotel, with ample arrangements for the comfort of guests, is at hand. The surrounding forests, hills, and fields offer many attractions for the botanist, the naturalist, and the sportsman. The following analysis was made by Dr. Robert Peter: One United States gallon contains: Iron carbonate, gr. 0.84; calcium carbonate, gr. 2.58; magnesium carbonate, gr. 0.86; calcium sulphate, gr. 0.17; magnesium sulphate, gr. 0.12; sodium sulphate, gr. 3.09; sodium chloride, gr. 0.15; silica, gr. 0.74. Total, 8.55 grains. A considerable quantity of free carbonic acid gas is also present.

The waters of the springs have been in use since 1843. They are said to possess excellent tonic and diuretic properties. It is also maintained that the location is very beneficial for cases of hay asthma, nasal catarrh, laryngitis, etc. *James K. Crook.*

ROCK ENON SPRINGS.—Frederick County, Virginia.

Post-Office.—Rock Enon Springs. Hotel.

Access.—Via Valley Branch of the Baltimore and Ohio Railroad to Winchester, thence by coach over picturesque mountain road sixteen and one-half miles to springs. Time from Washington, six and one-half hours.

This resort is located in the great North Mountains. It is surrounded by the primeval forest, and nestles under the shadow of a majestic peak in a romantic gorge, through which flows Laurel Brook, a beautiful stream which is supplied by the mountain springs, and which winds about the hotel and its attractive lawn. The locality is free from swamp lands and malaria. The hotel has a location of twelve hundred feet above tide water. This is a model caravansary, and the visitor may feel assured that every device for his comfort, health, and amusement has been arranged for by the thoughtful proprietor. The scenery in the neighborhood is exceptionally fine. Close to the hotel are three mineral springs, which have been found to possess well-marked medicinal properties.

The *Chalybeate Spring* was analyzed by Professors Gale and New, of the Smithsonian Institute, Washington, who found it to contain, in one United States gallon, the following solid constituents: Sodium carbonate, gr. 1.21; calcium carbonate, gr. 5.13; calcium sulphate, gr. 3.56; magnesium sulphate, gr. 12.89; magnesium chloride, gr. 1.12; iron oxide, gr. 14.25; manganesium oxide, gr. 1.05; alumina, gr. 0.80; silica, gr. 0.42. Total, 40.43 grains.

The water resembles that of the Pyrmont Spring in Waldeck, Germany. It is a strong chalybeate, and possesses aperient and diuretic properties.

A qualitative analysis of the *Alkaline Spring* by Professor Lupton, late of the University of Virginia, showed the presence of potassium and magnesium carbonate, sodium chloride, calcium sulphate and carbonate, silica, and carbonic, sulphuric, and hydrochloric acids. The water is antacid, diuretic, and aperient, and is used in affections of the kidneys and urinary passages, in dyspepsia, in gout, and in catarrhal affections.

The *Old Capper Spring* once gave its name to the resort, and it is styled Capper's Springs in the older books. It has been in use for more than a century. The water is described as being efficacious in rheumatism and in diseases of the skin, and as a cure for certain of the intestinal worms.

White and blue sulphur springs of excellent quality are also found in the neighborhood. The following data show the mean temperature at Rock Enon for July and August during the past ten years: July, 7 A.M., 66° F.; 12 M., 77°; 3 P.M., 78°; 6 P.M., 75°; and 10 P.M., 66.25°. For August, at the same hours, the record was 64.5°, 74.5°, 76°, 73°, and 66° F. *James K. Crook.*

RODENT ULCER. See *Carcinoma of the Skin.*

ROENTGEN RAYS, USE OF, IN MEDICINE AND SURGERY.—The discovery by Wilhelm Conrad Roentgen, in 1895, of the kind of radiant energy now known as the Roentgen or *x*-rays, was at once recognized as giving a most important addition to the armamentarium of the diagnostician in surgery. With improved apparatus and technique, and with more extended experience, the application of the Roentgen rays has gradually extended until their use is now universally regarded not only as indispensable in surgery, but as most valuable for diagnosis and therapy in many diseases not classed as surgical.

Nature and Action of the Roentgen Rays.—The Roentgen rays are produced by the passage of an electrical current of *small volume* and *high tension* through a specially constructed vacuum tube of high exhaustion. If an electrical current is passed through a glass tube from which the air has been but partly exhausted, an arc of light will be projected from the cathode (negative pole) to the anode (positive pole). If a similar tube of high exhaustion is used, no arc of light will form, but a peculiar fluorescence will appear at the anode. This fluorescence appears to emanate from any body exposed to the cathode of a vacuum tube. In the ordinary Roentgen-ray tube, the anode is a platinum plate placed in a line with the cathode, and the electrical energy passing from the cathode falls upon the anode, and from thence both fluorescent and Roentgen rays are projected. If the cathode is concave and directed toward the side of the tube, fluorescence will appear to emanate from the side of the tube at the point toward which the cathode is directed. Not only does the body fluoresce upon which the cathode rays are directed, but it will glow with heat if the electrical current is strong. In consequence, if the cathode rays are directed toward the side of the vacuum tube, the tube will become heated at the point of impingement, will soon soften and be destroyed by the giving way of the melted glass. For this reason the cathode rays are in practice directed toward a platinum plate which forms the anode, and which is set at an angle of about 45°, so that the Roentgen rays are directed from it outward at about a right angle to the long axis of the tube (Fig. 4114).

The visible fluorescence which appears in the tube must not be mistaken for the Roentgen rays.

The Roentgen rays are themselves *invisible*, and are appreciable to the senses only by their effect upon cer-

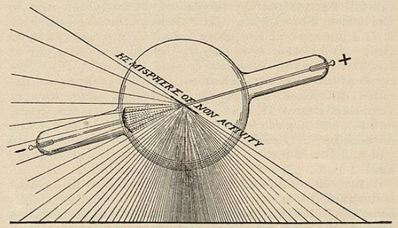

Fig. 4114.—Diagram of Roentgen-Ray Tube with Lines of Roentgen Radiation. The lines diverging from the anode show by their relative proximity to each other those parts of the hemisphere in front of the anode which are more or less acted on by the Roentgen rays.

tain substances. This effect is manifested in three ways: (*a*) by the fluorescence of certain chemical substances when the rays fall on them; (*b*) by the reduction, when exposed to the rays, of certain silver salts ordinarily used for photography; and (*c*) by changes produced in living tissues when the rays act upon them for a sufficient length of time.

The first of these effects, *i.e.*, the fluorescence of cer-

tain chemical substances, is the means used for producing visual effects directly from the vacuum tube. When the Roentgen rays fall upon certain substances, notably calcium tungstate, the double cyanide of platinum and ba-

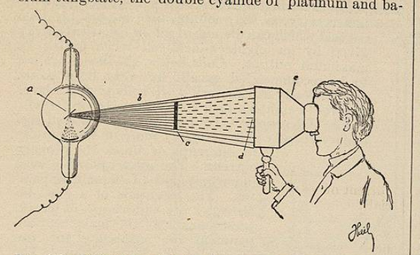

Fig. 4115.—Diagram showing the Fluoroscopic Method of Obtaining Visual Images by Roentgen Radiation. *a*, Anode; *b*, Roentgen rays passing to light-excluding chamber with fluorescent screen *d*, on which appears the fluorescing image formed by rays passing by or through the object *c*.

rium, platinum and magnesium, platinum and potassium, zinc oxide, etc., these substances glow with visible fluorescent light, the fluorescence in a degree depending upon the number and strength of the impinging rays.

This property of producing visible fluorescence is utilized to give visual effects from the rays. A chemical substance which will fluoresce, usually the double cyanide of potassium and barium, is spread and fixed on some plane surface which is opaque to light. Upon excluding light and allowing the Roentgen rays to pass through the support and fall upon the coated surface, this is seen to glow to a degree depending upon the amount of radiant energy which falls upon it. The amount of energy affecting the fluorescent surface depends upon the energy given out by the tube, the distance of the tube from the plate (the effect varying inversely as the square of the distance), and the extent to which the passage of the Roentgen rays to the fluorescent surface is obstructed by objects placed between the sensitive surface and the tube (Fig. 4115).

The visible images produced by the Roentgen rays are in every sense shadow pictures. The objects outlined by the rays are not themselves seen, but only their shadows cast upon a fluorescent screen or impressed on a photographic plate. It is of the greatest importance in interpreting these shadow images to recognize the fact that they are shadows and not real images of the objects observed.

Roentgen rays are always projected in straight lines from the fluorescing anode, and unlike light rays they are incapable of refraction, dispersion, or regular reflection. Consequently the shadow images formed are similar to shadow images made by ordinary light when projected from a point, and therefore depend for shape and size not only upon the shape and size of the object projecting the shadow, but upon the position in which the object is placed, its relative distance from the source of the rays, and the plane upon which the shadow is cast. These facts are of the utmost importance in judging the radiographic image, and a competent observer in reaching a conclusion always considers all these factors and their relation to each other. Correct estimation of the relative value of these factors is of especial importance in ascertaining the size and position of foreign bodies lodged in the tissues, and is to be particularly considered in medico-legal cases where deformity may be inferred from malposition of tube or plate, or from erroneous reading of the shadow picture.

In addition to their non-deviation from the direct lines in which they are projected, Roentgen rays differ from light in that they are capable of passing through or penetrating all substances. This transparency (to use the term) to Roentgen radiation is not, however, the same with all substances, but appears to be in large measure in inverse ratio to the density of the substances. The property of obstructing the passage of the rays differs markedly with different tissues, both normal and abnormal, of the human body; and as the rays which pass through the least resistant tissues are thus able to exert their greatest effect upon the fluorescent screen or photographic plate, the shadow image gives the outlines of certain tissues, and by difference in density it may furnish evidence of normal and abnormal conditions. Thus, for instance, not only are the outlines of a long bone clearly marked out by the rays, but the medullary cavity is shown as well; and, while in radiographs of the normal lung the denser bronchi only are shown, in pulmonary tuberculosis the tuberculous thickenings from their greater resistance to the rays appear as clearly defined shadows.

As to the real nature of the Roentgen rays many hypotheses have been advanced, some physicists holding that they are longitudinal vibrations of the luminiferous ether, others that they are minute particles of matter driven out from the cathode, and others that they differ from ordinary light rays only in the number of vibrations. While consideration of these hypotheses is of interest to the physicist, to the physician and surgeon the practical facts are: (*a*) that *Roentgen radiation is a form of energy projected in straight lines from its source;* (*b*) *that the ease of its passage through the human body depends upon the structure and density of the tissues;* (*c*) *that it is capable of producing molecular and chemical changes in certain substances used for making its action visible, such as the fluorescent screen and photographic plate;* and (*d*) *that it can produce tissue changes by affecting the metabolic action of living cells.*

Practically, the selection of apparatus which will best produce these visual, chemical, and physiological effects is a matter of much importance, and as there are many variations in type of apparatus for producing Roentgen radiation, a careful study of the apparatus and the principles upon which they are constructed is necessary before they can be properly understood and judicious selection made.

Roentgen-Ray Apparatus.—There are two types of apparatus commonly employed for producing the electrical current of small volume and high tension necessary to excite the vacuum tube to Roentgen radiation—the static machine and the induction coil.

The Static Machine.—The static machine is the only apparatus in which an electrical current of required strength and tension is directly produced. In this apparatus the electrical current is produced by the machine and carried direct to the tube, the electrical energy given out being derived from the mechanical energy used in driving the machine. Two forms of static machine are most used—the Wimshurst and the Holtz. Of these the Holtz form is most used in America, while the Wimshurst is almost exclusively used in England. The use of static machines for Roentgen-ray work is much more common in the United States than in any other country. In this country much attention has been paid to this form of apparatus, and a type of apparatus considerably modified from the original Holtz has been developed, which is, with certain limitations, quite satisfactory. The machines now most used (Fig. 4116) have from eight to sixteen circular glass plates mounted on an axle. These plates rotate in one direction, and between them are fixed inductor plates of glass.

The special *advantages* of the static machine are that it is easy to operate, that with ordinary care it is not liable to get out of order, and that it is capable of producing a steady and fairly powerful output, which is not injurious to vacuum tubes. For good work it is necessary to have a static machine of large size, twelve to sixteen plates, thirty-two inches in diameter, or even larger, and it should be driven not by hand but by power, a one-half horse-power motor with speed regulation being required to give good results. The *disadvantages* of the machine