line, about 2 mm. wide at the junction of the gum with the teeth, occurs in a large proportion of cases of chronic lead poisoning. It is often hard to distinguish from the discoloration due to an accumulation of tartar on the teeth of people who give their teeth no care. Nor must the absence of the blue gum line be considered conclusive evidence against lead poisoning.

The symptoms above enumerated being present, it is essential that the patient be removed from the danger of further poisoning. This can sometimes be done, in a smelting or manufacturing plant, without throwing the man out of work, by giving him some different employment, out of reach of lead dust or smoke, and if possible out of doors. Moderate purgation and warm baths; if possible sunshine and good food; a little later, when the stomach is in better shape, bitter tonics with iron; and then the exhibition of iodide of potassium for a time, may bring the patient out of his cachectic condition without his developing the more violent symptoms presently to be described. The only safe course for a person who has shown well-marked symptoms of lead poisoning is to abandon the occupation which has induced the malady, but it is often impossible to bring this about.

2. *Lead Colic.*—Quite frequently persons who are attacked with lead colic have previously observed none of the symptoms above described, either because of the general stupidity of the individual or because the symptoms were truly absent. The colic comes on suddenly and soon attains great violence. It has usually been preceded by and is accompanied with obstinate constipation. The abdominal walls are rigid and sunken, there is no tenderness on pressure, and the pain is referred to the region of the umbilicus. The pain is usually continuous, with violent exacerbations every few minutes, or at longer intervals. The attack, under proper treatment, may last for two or three hours or for as many days. It rarely subsides until there has been a copious evacuation of the bowels and not always then. Retching and vomiting are not infrequent. The pulse is usually slow and hard. There is no rise of temperature.

The treatment consists in the hypodermic use of morphine, large doses, not less than half a grain, being often required, and the evacuation of the bowels. The latter may be a difficult task. It may be accomplished by repeated doses of Epsom salts or it may require the use of croton oil in doses of two or three drops. Enemata are helpful at the last. Mercurial purgatives are to be avoided on account of their possible retention, with subsequent salivation. In one instance after two or three days of colic and constipation, in spite of all cathartics, violent convulsions having supervened, the writer has seen the inhalation of chloroform promptly followed by free catharsis and recovery. A severe attack of colic is not likely to be very soon followed by another. A period of some weeks more commonly intervenes, even though the individual may still be exposed to the same malign influences as before.

3. *Lead Encephalopathy.*—By this vague term, which is practically a confession of ignorance, we refer to those graver disturbances of the nervous system, such as convulsions, mania, and coma, which sometimes follow in the wake of other and often repeated symptoms of lead poisoning and are very likely to end the life of the victim. Although, as just stated, these grave disturbances most frequently follow prolonged lead cachexia, repeated attacks of colic, lead arthralgia, and perhaps even paralysis, yet it is possible for them to be the first, as well as the last symptom of lead poisoning in a given case. This seems to be particularly true in the case of members of the negro race. The writer has repeatedly seen able-bodied negroes, in early or middle manhood, who had been working for months or years at lead furnaces, who were well nourished and had never lain off on account of sickness, suddenly fall in convulsions, which recurred frequently for a few days and were followed by coma and death. Other cases have been reported in which encephalopathy appeared as the first symptom after very brief exposure to the influence of lead. More commonly, however, it is the old lead-worker who has been through the whole list of the symptoms of plumbism, who finally develops lead eclampsia or who falls into a state of mental hebetude and apathy, gradually deepening into coma or breaking into delirium and mania. Not all of these cases prove fatal. Subjects with eclampsia may have but few seizures or may remain subject to them for years. Those with active delirium and mania frequently recover.

The treatment of these patients, during the attack, is the same as of those suffering from similar conditions not dependent on lead poisoning.

4. *Lead Paralysis.*—This subject is fully treated of under the heading *Lead Palsy*, and will therefore not be here considered.

*Lead Arthralgia* has not been treated of under a separate heading because it is never met with alone, but always accompanies some one of the other forms of lead poisoning. It is, however, a very troublesome accompaniment and may require for its relief the use of the salicylates, antipyrin, or similar drugs until the iodides, which are being used for the elimination of the lead, have had their effect.

Chronic nephritis is one of the terminal complications of chronic lead poisoning which should not escape the notice of the practitioner.

*Pathological Anatomy.*—There is very little known of the pathological changes which take place in connection with lead cachexia, colic, or encephalopathy. In death following colic the intestines have been found contracted, the muscular coat hypertrophied, and the mucous membrane more or less atrophied. This would seem only to point to nature's effort for the relief of the habitual constipation due to lead. In spite of many theories on the subject the philosophy of the poisonous action of lead on the body is as yet not understood.

*Prognosis.*—The prognosis as to life is good. As to recovery it is also good, except in a few extreme cases, provided the subject can be induced to withdraw himself entirely from exposure to lead. The vast majority of such persons recover entirely, lead paralysis even disappearing. Even those who do not abandon the occupation in which they have been poisoned, who have suffered from repeated attacks of colic and from paralysis, having recovered from the latter, may return to their former work and keep at it for years before being again prostrated. But sooner or later the cachexia will deepen and the victim, unless carried off by some intercurrent disease, will succumb to his old malady.

*Treatment of Lead Poisoning.*—The treatment has already been considered in the preceding sections, but the reason for recurring to the subject here under an independent head is to insist on the prophylaxis against the disease. In ordinary life all that is necessary is to bear in mind the possibilities of accidental poisoning and to guard against them. In carrying on industries that inevitably expose their employees to lead poisoning, proprietors should adopt all such precautions as will reduce the danger to the minimum, and it is the duty of the state, through its health authorities, to see to it that this is done. Otherwise thousands of ignorant and stupid workmen will suffer in health and become a burden to the state. Much can be done to lessen the amount of dust and smoke in workrooms and to carry it away by means of hoods over the mouths of furnaces or over work-tables, with proper suction or blast attachments. Respirators, sponges tied over the mouths of operatives, and like appliances are impracticable, interfering too much with free respiration. Supplying eating-rooms away from the dust or smoke and absolutely enforcing the rule that no man enters the eating-room without removing his hat if worn at work and outer body garment and thoroughly washing his face and hands, would do much to prevent lead poisoning. Eating in working rooms should be strictly prohibited. The drinking-water supplied to operatives should be strictly pure, and kept in closed receptacles that cannot be opened in the dust- or smoke-laden atmosphere.





Facilities for free bathing should be furnished and men should be urged to avail themselves of the same. Instruction should be given as to the precautions whereby the risk of poisoning is reduced to a minimum.

In addition to these measures a competent medical service should be inaugurated, not only for the treatment of the sick but for the inspection of the employees; and, on the recommendation of the medical man, such employees as show the early symptoms of lead poisoning should be removed from posts of danger, being either assigned to work that is not dangerous, laid off temporarily, or discharged.

As regards the medicinal treatment of lead poisoning the old methods have not been improved upon. Such laxatives as will answer the purpose must be employed; iron, quinine, and strychnine should be given in full tonic doses; and, for the elimination of the lead, iodide of sodium or potassium should be prescribed in fifteen-grain doses three times a day for two or three weeks or more at a time, to be resumed again after an intermission of a couple of weeks. Except in cases of confirmed eclampsia resembling epilepsy, some cases of paralysis, and those in which organic changes in the kidney have supervened, this line of treatment, with absence of further exposure to the poison, will usually result in a cure.

*Edward W. Schauffler.*

**LEBANON SPRINGS.**—Columbia County, New York.

POST-OFFICE.—Lebanon Springs. Hotel.

ACCESS.—From Bennington, Vermont, or from Chatham, New York, viâ Lebanon Springs Railroad. The location is in the extreme northeastern corner of Columbia County, 155 miles north of New York and 25 miles northeast of Chatham. This spring claims our attention as being the only thermal water in the extensive territory embraced by New York and the New England States. The temperature, 75° F., is about the same as the Old Sweet Springs of Virginia. The spring yields about 30,000 gallons hourly. The following analysis was made by Prof. H. Dussance:

LEBANON THERMAL SPRING.

ONE UNITED STATES GALLON CONTAINS:

| Solids. | Grains. |
|---|---|
| Sodium carbonate | 2.41 |
| Calcium carbonate | 4.04 |
| Potassium sulphate | 1.04 |
| Magnesium sulphate | 1.06 |
| Sodium chloride | .96 |
| Sodium sulphide | .02 |
| Iron oxide | .94 |
| Alumina | .45 |
| Silica | 3.25 |
| Organic matter | 10.21 |
| Total | 24.38 |

| Gases. | Cu. in. |
|---|---|
| Carbonic acid | 0.48 |
| Oxygen | 2.00 |
| Nitrogen | 3.52 |

This place has been a well-known resort since pre-Revolutionary days. The salubrity of the climate and the beauty of the scenery tend to make the surroundings very attractive. The water is used principally for bathing. A valuable chalybeate spring is located in the village of the Brickyard Shakers, a short distance from Lebanon Springs.

*James K. Crook.*

**LECITHIN.**—Lecithin is a complex phosphorized fat occurring, apparently, in all forms of protoplasm but most abundantly in the brain, spinal cord, and nerves of the higher animals and in the eggs of all animals. In the nervous tissues it is usually combined with other substances to form protagon and similar compounds. In the egg it seems to be combined with a proteid (vitellin): this combination is easily broken up by boiling with alcohol.[1] It has been found in the mucous membrane of the stomach, in the lungs, kidney, liver, spleen, semen, blood, milk, bile, pus, and serous fluids and exudates; in many cases it is combined more or less firmly with proteids to form lecithalbumins (Liebermann[2]). It is a prominent constituent of the electrical organ of the ray. It has also been obtained from the yeast and other vegetable cells.

Lecithin was first obtained in quantity by Gobley from the yelk of the egg of the fowl. It is usually prepared[3] from the hen's egg as follows. The yelk is shaken with ether until the latter is no longer colored; the insoluble residue is then extracted with alcohol at a temperature of from 50° to 60° C. The ether-alcohol extract is concentrated to a syrup at 60° C.; this is then dissolved in a small amount of absolute alcohol and the solution exposed to a temperature of about −10° C. for twelve to twenty-four hours. The lecithin separates out in the form of small round clumps. It may be purified by dissolving it in chloroform and precipitating with acetone.

Lecithin is a colorless or yellowish-white, waxy, imperfectly crystalline substance which may be kneaded but often crumbles during the process. It is very hygroscopic; upon the addition of water it swells up and forms a kind of emulsion. It is soluble in alcohol, less so in ether; it also dissolves in chloroform, benzol, and oils. On cooling a solution of lecithin in alcohol it separates in crystalline clumps. When a little lecithin under the microscope is treated with water or glycerin it is seen to swell and little curling filamentous processes protrude from the edge of the solid; these are the so-called "myeline forms" and they may simulate nerve fibres or nerve cells. When lecithin is burned it leaves a residue of metaphosphoric acid. Lecithin combines readily with acids; the hydrochloride forms a double compound with platinum and cadmium chlorides. The platinum compound, which has the formula $(C_{44}H_{90}NPO_9Cl)_2 + PtCl_4$, is insoluble in alcohol, easily soluble in water, and contains 10.2 per cent. of platinum. By removing the metal with hydrogen sulphide the lecithin may be obtained in a perfectly pure form; analysis shows it to have the formula $C_{44}H_{90}NPO_9$.

Lecithin is easily decomposed by acids and alkalies; it also undergoes decomposition when allowed to stand in contact with water. When an ethereal solution of lecithin is shaken with dilute sulphuric acid the water is found to contain the base cholin (*q. v.*), while in the ether is found distearyl-glycerin-phosphoric acid. The latter is glycerin-phosphoric acid ($C_3H_5(OH)_2OPO_3H_2$) in which the two hydroxyl hydrogens are replaced by the radicle of stearic acid; hence its formula is $C_3H_5O_2(C_{17}H_{35}CO)_2OPO_3H_2$. When lecithin is boiled with barium hydroxide, cholin, glycerin-phosphoric acid, and barium stearate are formed:

$$\underset{\text{lecithin.}}{C_{44}H_{90}NPO_9} + 3H_2O = \underset{\text{stearic acid}}{2C_{18}H_{36}O_2} + \underset{\text{glycerin-phosphoric acid.}}{C_3H_5PO_6} + \underset{\text{cholin.}}{C_5H_{15}NO_2}$$

The cholin is readily identified by the formation of a characteristic double compound with platinum chloride (see *Cholin*). These decompositions show that lecithin is a compound of cholin with distearyl-glycerin-phosphoric acid. At one time it was thought that lecithin was simply a salt in which cholin plays the part of a base, but Hundeshagen[4] prepared synthetically a cholin salt of distearyl-glycerin-phosphoric acid which was isomeric with lecithin but which did not possess the characteristic properties of lecithin. Hence lecithin is more probably an ether-like combination, the cholin being united to the acid by means of the oxygen of the hydroxyl. So far, efforts to prepare lecithin synthetically have failed.

Instead of stearic acid, palmitic or oleic acid, or both, may occur in the lecithin molecule; hence there are a number of lecithins, and the one considered above is more properly termed distearyl lecithin. In some of the lecithins of plant origin the acid radicle seems to be combined not with cholin, but with a similar base, betain; such lecithins have been found in the beet root and cotton seed. It is possible that in the brain some of the lecithin contains neurin instead of cholin.*

When lecithin undergoes putrefaction glycerin-phosphoric acid and cholin are formed: the latter is readily decomposed into marsh gas and trimethylamine. Under some little understood conditions a small amount of the highly poisonous base neurin is formed from cholin (and so presumably from lecithin) by the action of bacteria.[6] Apparently such a decomposition may also take place in the intestine.[7]

Lecithin is decomposed by the pancreatic juice into cholin, glycerin-phosphoric and stearic (or other fatty) acids.[8] These products are absorbed and the urine of a dog fed upon the yelk of eggs contains an increased amount of phosphoric acid. As the fatty acid is absorbed, lecithin may serve, to a limited extent, as a food.

Nothing definite is known as to the origin of lecithin or as to its use in the plant and animal economy. That it serves a very important purpose, however, is made probable by its very wide, perhaps universal, distribution in living matter. Burow[9] showed that the quantity of lecithin in the milk of an animal varies with the weight of the brain of the young of that animal. Thus, in a series of experiments the following results were obtained. Ratio of weight of brain to body weight: calf, 1:370; dog, 1:30; man, 1:7. Ratio of lecithin to proteid of milk: calf, 1:71; dog, 1:47; man, 1:33.

Attention was called above to the fact that lecithin combines with acids; thus, one molecule of lecithin combines with one molecule of carbon dioxide. The red blood corpuscles contain about 0.75 per cent. of lecithin, so that 100 gm. of red blood corpuscles might hold 22 c.c. of carbon dioxide in loose chemical combination; these facts may be shown to have a bearing upon the manner in which carbon dioxide is held combined in the blood.

Lecithin and its decomposition products have attracted some attention from the standpoint of pathology; thus, Mott and Halliburton think the cholin formed from its decomposition may account for some of the symptoms observed when there is a breaking down of nervous tissue (see *Cholin*), and Nesbitt's work suggests the possibility of poisonous effects resulting from the formation of neurin from lecithin in the intestines.

Lecithin, either in the pure form or in the yelk of eggs, has been used occasionally in therapeutics. Huchard[10] claims to have obtained good results from the administration of lecithin to patients suffering from diabetes, anæmia, tuberculosis and other wasting diseases; he thinks pure lecithin, rather than the yelk of eggs, should be employed, as the latter give rise to an increased production of uric acid.

The presence of lecithin in an organ or liquid may be detected in the following manner. An alcoholic extract is prepared; this is evaporated to almost dryness at a temperature of about 60° C., care being taken to keep the reaction of the solution neutral. The residue is then extracted with a mixture containing equal parts of alcohol and ether; this extract is evaporated to almost dryness and the residue extracted a number of times with ether. The residue, after evaporation of the ether, is fused with sodium hydrate and potassium nitrate and tested for phosphoric acid by one of the usual methods; the presence of phosphoric acid shows that lecithin was present in the original extract, for the salts of neither phosphoric nor glycerin-phosphoric acid are soluble in alcohol and ether. Another method consists in decomposing the lecithin with barium hydroxide and examining the solution for the decomposition products of lecithin, viz., cholin, glycerin-phosphoric and stearic acids. The lecithin may be determined quantitatively by determining the amount of phosphoric acid obtained on its decomposition. If the organ or tissue contains jecorin, however, the figure for lecithin will be too high, for this body (which contains phosphorus in the form of glycerin-phosphoric acid) is also extracted by alcohol and ether (see *Jecorin*).

Burow used the following method for determining the lecithin of milk. To 200 c.c. of a mixture containing equal parts of ether and alcohol and a little acetic acid, 100 c.c. of milk is added one drop at a time. After standing for fourteen hours in a well-stoppered vessel, the liquid is filtered off and evaporated to a syrup at a temperature not exceeding 50° C. The syrup is extracted several times with ether, the ether evaporated, and the phosphorus determined in the residue in the usual way.

*Reid Hunt.*

[1] Hoppe-Seyler: Med. Chem. Untersuch., p. 215.
[2] Liebermann: Archiv f. d. ges. Physiol., 50 and 54, p. 573.
[3] See Diakonow, Hoppe-Seyler's Med. Chem. Untersuch., p. 223.
[4] Hundeshagen: Journ. f. prakt. Chemie, n. F., 28, p. 219, 1883.
[5] Lippman: Ber. d. deutsch. chem. Gesellsch., 20, p. 3206. See also E. C. Shorey: Journ. Amer. Chem. Soc., 20, p. 113.
[6] Schmidt: Archiv d. Pharmacie, 229, p. 485.
[7] Nesbitt: Journ. of Exper. Med., 4, p. 1, 1899.
[8] Bokay: Zeit. f. physiol. Chemie, 1, p. 162.
[9] Burow: Zeit. f. physiol. Chemie, 30, p. 495.
[10] Huchard: Journ. des Praticiens, 1901, p. 439.

**LEECHES.** See *Hirudinea*.

**LEG, APPLIED ANATOMY OF.**—In anatomy the term leg is used to indicate only that part of the pelvic limb between the knee and the ankle, the portion above the knee being known as the thigh.

In man the shape of this region is somewhat characteristic. In most other animals the bellies of the great muscles are above the knee, and the leg is comparatively slender; in man, however, the erect position requires the constant application of muscular force to hold the foot at right angles to the axis of the limb, and this causes very considerable bellies to be formed below the knee. The prominence of the calf is, therefore, not only characteristic of footmen, but, to a certain extent, marks the higher races of mankind generally. Australians and other low savages resemble children and apes in the slender calibre of their legs.

It is not quite correct to compare the leg to an inverted cone, as is often done. In a fully developed man the prominence of the calf is confined mainly to the upper and posterior part of the limb, and represents the two bellies of the gastrocnemius, the inner one being larger and descending somewhat farther than the outer. This prominence is enormously developed in ballet-dancers, who possess here a dense, hard ball of muscles, quite characteristic of the occupation. It may be brought out more fully by rising upon the toes. In women the calf has usually a somewhat different shape, the muscular prominence being masked to a certain extent by fat, and descending somewhat lower than in males. The bones being more slender, the ankle is more finely modelled, and the whole contour of the limb approaches more nearly those lines of grace which please the eye in the "Greek Slave" or in Canova's "Venus." It is this contraction of the leg toward the ankle that makes it necessary to take certain precautions in bandaging, by proceeding from below upward and making the necessary reverses. It is also the reason why the circular operation for amputation is not so easily performed here as above the knee, it being difficult sufficiently to retract the "sleeve." The shape of the ankle is, however, far from being cylindrical, the strong, flat tendo Achillis producing a prominent projection behind, as will be seen on inspecting Figs. 3183 and 3186. Anteriorly, the leg is remarkable for the considerable area throughout which the bone is quite subcutaneous. The inner surface of the tibia, along its whole length from the tuberosity downward to the end of the malleolus, is but slightly covered, and in case of fracture the ends are very apt to extrude, a compound fracture being more frequent here than in any other part of the body. The anterior edge, popularly termed the shin, may be followed down as far as the lower third, where it begins to be rounded and covered with tendons passing over the ankle into the foot. The lack of soft parts here to serve as a cushion under the skin causes it to be liable to certain injuries. A blow from a blunt instrument, which would elsewhere produce a contusion, will here cause an incised wound. Contusions may also produce the same blood tumors that we see occasioned in a similar way upon the skull.

The usual curve of the crest of the tibia may be exaggerated by various causes. One of the earliest signs of rickets is an increase of the bend at the lower part. If children are encouraged to walk too early there is usually an outward bend, causing the child to appear bandy-legged. It is probable, however, that when this is considerable, there is a defect in the nutrition of the bones. Where the potable water shows a marked deficiency of lime salts deformities of this kind are more common. Still, it is not unusual to see the limbs of a bandy-legged child straighten as puberty approaches, and it may be questioned whether a certain degree of this defect is not due to a reversion to the type of tibia found in our "frugivorous ancestors of arboreal habits." Among negro children bandy legs are very common. As this defect occasions an unusual prominence of the shin, and consequent liability to injury, it is probable that there may be some slight ground for the prevalent notion that the shin of the negro is one of his most vulnerable points.

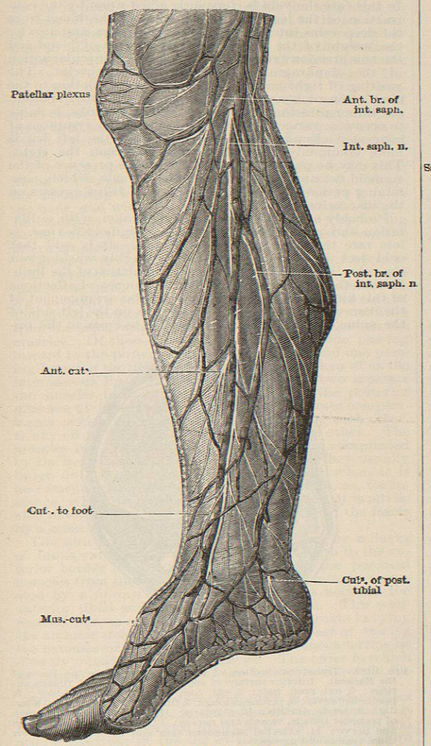


FIG. 3180.—Cutaneous Veins and Nerves of the Right Leg, Internal View.

In certain races, especially those that approximate to the prehistoric type, such as the Esquimaux, the Patagonians, certain Indians, early Europeans, and the mound-builders, a peculiar form of tibia is found which is decidedly simian in character. The bone is markedly flattened from side to side, and presents a sabre-like edge on the crest. This is known as the platycnemic tibia. Wyman found upon examination of a considerable number of skeletons of the mound-builders that about sixty per cent. of their tibiæ were platycnemic. It seems quite probable that in such legs the tibialis anticus muscle is larger and more deeply embedded between the bones than is the case in the usual type, adapting the foot to strong inversion of the sole, as is the case with apes, and thus making climbing easy.

The fibula, although not so superficial as the tibia,

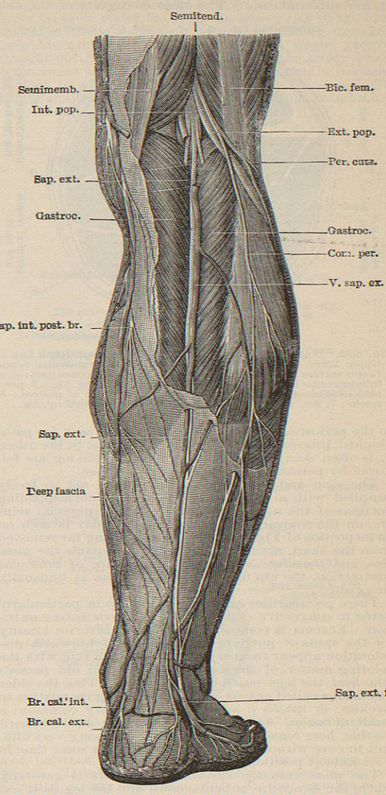


FIG. 3181.—Branches of Right External and Internal Saphenous Veins.