normal. Small infiltrations in the retina may sometimes be seen with the ophthalmoscope as little whitish spots, and occasionally swelling and inflammation of the disc are found. These changes are spoken of as constituting leukæmic retinitis.

The Genito-Urinary System. Leukæmic infiltrations are usually marked in the kidneys, especially in and about the glomeruli. The organs themselves are apt to be enlarged, with smooth surface, and paler than normal. The tubular epithelium shows cloudy swelling or fatty changes. The influence of these changes, as revealed in the urine, is not great, but albuminuria may be present, especially late in the disease. Recently a true acute or subacute parenchymatous nephritis, coming on as a terminal event in some cases, has been described as a leukæmic change.

The urine in leukæmia usually contains an excess in total uric acid. This condition is now thought to be due to excessive nuclear metabolism, leucocytes being especially rich in nuclear compounds; but whether the breaking down of nuclear substance is in the circulating white blood cells or in the hæmatopoietic organs, is not surely known. As before mentioned, hæmaturia may occur as an expression of the hemorrhagic tendency of the disease. In a recent case I observed a positive diazo reaction during the last two months of life. In the male sexual organs the occurrence of priapism, probably due to circulatory obstruction in the corpora cavernosa, is the only symptom of importance. In the female, uterine hemorrhage is frequent.

The Skin. The color is usually paler than in health and often muddy, but in some cases there is no visible anæmia, and the face may even be plethoric. Various eruptions have been described in connection with leukæmia, but probably they are of merely coincident occurrence. In Virchow's original case there was a general pustular eruption, which he held to be purely secondary. Petechial hemorrhages are of a closer relationship. One extremely rare and interesting condition, described as "dermal leukæmia," has a very definite connection with the disease itself. About twelve cases of this kind are on record, the first one having been observed by Biesiadecki. The condition occurs in both varieties of leukæmia. Multiple tumors of small size are present in the skin and form a prominent feature of the clinical picture. These tumors histologically are infiltrations similar to those found in the internal organs.

The Digestive System. Apart from the liver there are no important changes either in structure or in function. Infiltrations occur, especially in the wall of the intestine. Severe ulcerations in the mouth and throat not infrequently lead to a fatal tissue. Ulcers are also found in the intestines.

As in all chronic diseases, digestive disturbance is the rule and loss of appetite, vomiting, constipation, etc., are frequent. Obstruction of the bowels from the pressure of the enlarged spleen has been reported. Some of the vomiting may be due to the same cause. Diarrhœa at times proves intractable and is the cause of fatal exhaustion. Ascites may occur, but is never of serious dimensions.

The Respiratory System. This is not directly involved in the disease. The diminished capacity of the thorax, due to the pressure upward of the increased intra-abdominal contents, is in part responsible for the dyspnœa. Bronchitis, pneumonia, and œdema of the lungs are common causes of death.

The Nervous System. Ollivier and Ranvier have described in detail many disturbances of the nervous system that occur in leukæmia, and as a rule in its terminal stages. Headache, vertigo, and syncopal attacks are the earlier and, as they say, prodromal symptoms. Later, an apathetic condition may develop with increasing somnolence merging at last into coma, more or less prolonged, but always terminating in death. Convulsions have occurred just before death and a condition of maniacal excitement has been described.

Cerebral hemorrhages have been found at autopsy, either large or small and multiple. The cerebral and spinal vessels have been seen enormously distended with the peculiar brick-red or chocolate-colored blood. Such a condition must be associated with increased intracranial pressure and be the probable cause of the later symptoms. Death by apoplexy is of course the result of sudden hemorrhage of large size. Of the earlier attacks of faintness, headache, vertigo, etc., cerebral anæmia is alleged as the cause. Whether this is so or not, there is certainly marked disturbance of the cerebral circulation. I have seen one case in which intense vertigo came on suddenly and persisted for weeks on any attempt to rise, and was followed by total deafness, but which eventually ended in recovery. The most plausible explanation of the symptoms seemed to be a hemorrhage into the semicircular canals and internal ear.

Body temperature. Leukæmia is not a febrile disease, but some fever is usual during its later stages. The more rapid cases are accompanied by fever from the onset, most frequently of a remittent or intermittent type, with the maximum elevation in the afternoon. The attacks of perisplenitis usually cause elevation of temperature, and the intercurrent infections of course present their usual symptoms.

General Metabolism. Emaciation is a constant feature of the disease, sharply distinguishing it from primary pernicious anæmia. The appearance of the patients toward the close is cachectic. Experiments relating to metabolism have been made by several observers on leukæmic patients, but the disease is of such duration and variations in its progress are so common that most contradictory results have been obtained.

Lymphatic Leukæmia.

(Synonym: Lymphæmia.)

Occurrence.—This type of leukæmia, in either its acute or its chronic form, is said to be much less frequently met with than the myelogenous, though my experience has not borne out this statement.

Predisposing Conditions.—Practically nothing is known of the effect of antecedent conditions upon the development of the disease except that in rare cases a transition from Hodgkin's disease has been observed. These will be discussed later in considering the theories as to the real nature of the leukæmic processes. Patients with chronic glandular enlargemepts remaining after an adenitis, as in the cervical glands from inflammatory processes in the throat, have later suffered from this malady; but the frequency of such glandular enlargements is such that coincidence is very possible and no relationship need be postulated, though it is not to be excluded.

Onset, Course, and Termination.—From the clinical standpoint there are two distinct forms of the disease, the acute and the chronic, which some physicians consider, in many respects rightly, as sharply differentiated from one another. In their essential lesions, however, so far as we know them, such a line cannot be definitely drawn, and cases are seen which form a connecting link between the two.

Acute lymphatic leukæmia or acute leukæmia, as it is often called, begins for the most part suddenly, with pronounced symptoms, fever, hemorrhages from the nose, gums, or the mucous surfaces generally, purpuric spots in the skin, a rapidly progressive anæmia and slight or moderate enlargement of the lymphatic glands, spleen, and liver. In some cases, after a short period of less severe manifestations, the patients become rapidly worse. The whole course of the disease may cover only a few days, but usually it occupies five or six weeks and may be more protracted. It is in these longer cases that the separation from the chronic form is difficult. The result is invariably fatal.

Chronic lymphatic leukæmia, in its typical manifestation, is a slowly progressive affection, beginning with purely local manifestations and only in its later stages adding general symptoms to the picture of gradually increasing glandular enlargements. The duration varies

from months to several years. I have in mind at present one patient who lived for four years after the first swellings were noted. No cases have ever terminated in recovery.

General Clinical Description.—As has been said, *acute leukæmia* is a rapid, in many cases fulminating disease, with the picture of an acute purpuric affection and giving the impression of an intense infectious process. Its symptoms, quite unlike those of the chronic leukæmias, may precede the visible glandular or splenic tumors and the blood changes. The disease is always accompanied by fever, moderate as a rule, but sometimes considerable. The hemorrhages from any or all of the mucous membranes and under the skin are its most constant and characteristic feature. Coincident with these a profound anæmia develops, but whether this is secondary to the loss of blood, or is due to a toxæmia which is the common cause of both manifestations, is uncertain. The patient becomes rapidly exhausted and passes into a typhoid state, in which he dies; or delirium, stupor, or convulsions may occur. Severe and progressive ulcerations in the mouth and in other portions of the gastro-intestinal tract are common and rather characteristic occurrences. Marked gastro-intestinal disturbance, vomiting, diarrhœa, etc., are frequent, as in other acute diseases. An acute nephritis may also be present.

The glandular enlargements are at the most of moderate dimensions, and the spleen and liver never attain the size usual in myelogenous leukæmia. Tenderness of the bones is sometimes complained of. A very few cases have been reported in which neither the lymphatic glands, including the lymph nodes in the intestinal wall, nor the spleen were enlarged, but at autopsy marked lymphoid changes were found in the bone marrow.

In the very rapid cases in which death occurs within a few days of the onset, the diagnosis often is not made until the autopsy.

Chronic lymphatic leukæmia, or lymphæmia, is a disease which, apart from its characteristic blood changes, allies itself clinically more with Hodgkin's disease or other forms of lymphatic glandular tumors than with the types of leukæmia previously considered. That some intimate relationship with Hodgkin's disease exists is evident from the recorded cases of transition from the latter complaint. Some writers also speak of an "aleukæmic stage," meaning by this expression that the local symptoms may precede the development of the lymphatic character of the blood. In all cases, certainly the first manifestations are the enlargements of some or many groups of lymphatic glands. Those most often affected are the cervical, then the inguinal, retroperitoneal and mesenteric, axillary, etc. Some groups may escape considerable enlargement throughout the whole course, but in most cases all the lymph nodes of the body are at length affected. The tumors increase progressively in size, are painless, as a rule soft, though sometimes firm, and do not tend to break down or suppurate. The spleen and liver are moderately enlarged.

With these local symptoms we note an anæmia, usually moderate, such as is present in the myelogenous form, and emaciation, loss of strength, and other signs of general failure in health. Late in the disease a tendency to hemorrhages may appear. As a rule the patients die from intercurrent disease—local suppurations or ulcerations, which they resist badly, pneumonia, etc. Tuberculosis has occurred in several reported cases.

The duration may be several years, but as a rule it is from nine months to two years. Cases lasting from four to nine months are uncommon, but are occasionally noted; they form a connecting link between the acute and the chronic type. They are intermediate between the two forms in their symptoms also.

Unusual forms beside those already mentioned are the very rare cases without glandular enlargements, but with the blood state and other symptoms, in which, post mortem, lymphoid proliferation is found in the bone marrow.

"Dermal leukæmia," as already described, has been more commonly found in connection with lymphatic than with myelogenous leukæmia.

Whether cases of true mixed leukæmia, presenting the lesions and blood picture of both types, really occur is now called in question. In all probability the majority of such descriptions heretofore have been due to a confusion between myelocytes and lymphocytes, due to the insufficiency of the staining methods used for their differentiation. On the other hand, competent observers have reported cases which seem to admit of no other interpretation. At the best, such a combination must be of exceedingly rare occurrence

Special Pathological Anatomy and Physiology.—The Blood. The gross appearance of the blood as obtained by puncture and collected from the vessels at autopsy is the same as already described under myelogenous leukæmia. Its quantitative changes are also very similar and it is influenced in like manner by treatment and by intercurrent disease The leucocytosis does not reach such extreme figures as in the myelogenous form, 450,000 per cubic millimetre being the highest count I have found in ten cases examined. From 100,000 to 300,000 per cubic millimetre in the chronic and below 100,000 in the acute cases are the usual figures. The oligocythæmia is apt to be more pronounced, however, and in the acute form rapidly reaches an extreme degree. I have seen one such case with only 800,000 red cells per cubic millimetre.

The characteristic change produced in the blood by lymphatic leukæmia is the tremendous increase in the absolute number of circulating lymphocytes. While in healthy blood these constitute less than thirty per cent. of the whole number of white cells, in this condition they form over ninety per cent. of a total leucocyte count, which is many times the normal. In many, at least, if not in all cases, there is an absolute decrease in the number of polymorphonuclear cells; eosinophiles are seldom seen and myelocytes appear only in rare cases. Hence we have a blood in which the white cells are almost wholly of lymphatic origin. Here we do not have to deal, as in the myelogenous blood, with the presence of vast numbers of cells which are foreign to the circulation in health, but with an abnormal increase in one of the normal types and an accompanying diminution in the others. From a theoretical standpoint this decrease in the leucocyte forms supposed to be derived from myeloid tissue, is of great interest.

The lymphocytes of normal blood can be differentiated into two classes, called large and small lymphocytes, distinguished from one another not alone by their size but also by their staining affinities, the small being about five times more numerous. In lymphatic leukæmia the increase may be confined wholly to one or the other of these forms, or it may affect both of them. In the chronic type the small lymphocyte as a rule predominates, though not invariably, as has been claimed.

Acute leukæmia, however, as first pointed out by Fraenkel, is characterized by the great preponderance of the large lymphocytes, and this most interesting fact has been made the basis of an attempt to claim a different pathological foundation for the two forms of the disease. I have, however, seen chronic lymphæmia with the same blood picture.

The lymphocytes in leukæmic blood, especially those of the large type, frequently stain with difficulty and show marked degenerative changes—evidence of the presence of dead cells within the circulation.

Nucleated red cells are present in much smaller numbers than in the myelogenous form, not more than would be found in a chronic anæmia of the same severity. In acute leukæmia a few megaloblasts may be found and occasionally a myelocyte. When the anæmia is severe, poikilocytosis and polychromatophilic changes in the red cells are present.

The Bone Marrow. The marrow lesions of lymphatic leukæmia, though in gross extent so much inferior to the glandular changes, are certainly of equal importance. The typical appearance is a bright red or grayish-red marrow, which may encroach somewhat on the fatty

marrow, but does not show the rarefaction of surrounding bone and increase in the marrow cavity noted in the "pyoid" change of myelogenous leukæmia. To the eye there may be no alteration visible. Microscopically, however, the lymphadenoid transformation, as Neumann has named it, is evident at once. Lymphocytes are in great abundance, but myelocytes, eosinophiles, etc., are less conspicuous than normal. This change is undoubtedly due to the overgrowth of lymph nodes normally present in the marrow, as has been conclusively demonstrated by Cornil and Neumann. The mechanical interference with the circulation, shown by the compression and dilatation of vessels, is present here, as are also the infiltrations into the vessel walls described by Benda. These may be agencies favoring the escape of the lymphocytes into the circulation. The compression of the myeloid tissue by the hypertrophied lymphoid marrow offers a plausible explanation of the diminished number of polymorphonuclear leucocytes and eosinophiles in the circulation and, to my mind, constitutes one of the strongest arguments for their myelogenous origin. Tenderness of the bones occurs less frequently than in myelogenous leukæmia.

The Spleen. Enlargement of the spleen is much less pronounced in this form of leukæmia, but is fairly constant, and its general character during life is the same as that of the splenic tumor of myelogenous leukæmia. It never encroaches on the right side of the abdomen and seldom reaches below the umbilicus. In acute cases the enlargement may be only slight.

The nature of the changes found after death, however, differs markedly. Instead of an infiltration with myelocytes, etc., there is a great increase in the lymphocytes throughout, and large collections of them are present. There is not so much connective-tissue increase. Infarcts, when present, are of smaller size. Hemorrhages and pigment accumulations are present.

The Lymphatic Glands. These, except in the rare cases mentioned, in which the changes are in the marrow alone, are enlarged, and as a rule very markedly so. When the disease is of long duration the neck becomes of tremendous size from the growth of the cervical chain. Often the increase is much more pronounced on one side. The glandular tumors are of varying consistence, but usually soft. They do not tend to spread out into the surrounding tissue nor to merge together. Besides the superficial and deep lymph nodes, the tonsils, thymus glands, Peyer's patches, and the solitary follicles of the intestine may be affected. It is also a question whether the lymphoid infiltrations in the various organs are in reality such, or whether they do not perhaps represent a proliferative action on the part of minute resident lymphatic collections.

During life the glandular tumors cause inconvenience but not actual pain. Rarely, the enlarged bronchial or mediastinal glands may, like other tumors within the chest, cause pressure upon important structures, particularly a bronchus, with serious results.

On section the color of the glands is pinkish to red and fresh hemorrhages may be present. Microscopically there is great increase in the collections of large lymphocytes, which show karyokinesis; the small lymphocytes are also much increased and are closely packed together; there may be infiltrations of the blood-vessels. The collections of polymorphonuclear leucocytes and myelocytes which are present in the glandular enlargements of myelogenous leukæmia are not found, though polymorphonuclear cells, eosinophiles, mast cells, and macrophages are scattered here and there. Fibroblasts and proliferating endothelial cells are present, and also red cells collected in small extravasations. Degenerations in the cells are not infrequent.

Other Organs and Tissues. The lesions in the non-hæmatopoietic tissues correspond with those of myelogenous leukæmia, except that the cells composing the infiltrations are lymphocytes and not leucocytes of myelogenous origin. These infiltrations are most frequent in the liver, here situated in the periportal spaces, and are in part the cause of the increased size of the organ. They also occur in the kidneys, stomach, lungs, serous membranes, retina, and skin.

The disorders of function in like manner do not need a separate description, the essential features having been considered in the general clinical description. The great tendency to hemorrhages in acute leukæmia is the point of most importance.

Causation.—Of the actual cause of leukæmia we are still wholly ignorant. The several hypotheses concerning it are based only upon other theories as to the nature of the disease processes, and will be discussed in that connection. All attempts to cause the disease in animals by inoculations of the blood or of emulsions of the hæmatopoietic organs have failed.

Several observers have described bacterial forms as present in the blood during life in isolated cases, but without further proof of any causative relationship.

In 1899 Löwit reported the constant presence of sporozoa in the blood-making organs and in some of the circulating leucocytes of a number of cases of leukæmia. He distinguished two forms: one associated with myelogenous leukæmia, the other, found in lymphatic cases, acute and chronic, in Hodgkin's disease and in the so-called pseudo-leukæmic infantile anæmia of von Jaksch. He classes them with the malarial organisms and claims that they are the specific causes of the leukæmias, each of the form with which it is associated. His methods of demonstrating the organisms, however, are very complicated and were not disclosed at first, and the experiments which he reports as successful in inoculations of leukæmia are not at all convincing. His results so far have lacked confirmation by other observers. They are of interest especially in connection with the present investigations of numerous workers into the parasitic and perhaps causative nature of the cell inclusions found in malignant growths.

Nature of the Leukæmic Processes.—Since the early days of active controversy between Bennett and Virchow the real nature of the disease or diseases which we know as leukæmia has been one of the great debating grounds of modern medicine. Many theories have been advocated which could not bear a close analysis and were soon abandoned. Among them were Bennett's, that it is a suppuration of the blood; Löwit's, that it is due to a prolongation of the lives of the leucocytes and a retardation in their evolution; and the view that the affection is a cancer of the blood itself. The opinions which deserve consideration to-day can be grouped under two general hypotheses: the first, originally advanced by Virchow, that the disease is allied to the malignant tumors; the second, that the process is an infectious one and the blood condition a specific leucocytosis. According to the neoplasmic theory the local infiltrations are to be regarded as metastases, while, if the infectious theory be correct, they may be either mechanical depositions or areas of local leucocytosis due to a concentration of the chemotactic influence at particular points. In its fulminating course acute leukæmia has no analogue among the malignant tumors; but, on the other hand, the close resemblance between chronic lymphæmia and Hodgkin's disease, as well as lymphosarcoma, is much more easily interpreted by the first theory. Neither one is competent to explain all recorded facts, nor need we suppose that new facts will not arise which will alter our conceptions, not only of the leukæmic processes, but also of the great unsolved mystery of the tumors. Experiments on the effect of long-continued leucocytosis upon the hæmatopoietic organs, which are just beginning to be carried on, should also throw new light upon this vexed question.

Among the attempts to explain the apparently close connection between leukæmia and pseudo-leukæmia (Hodgkin's disease), Neumann's theory is of especial suggestiveness. He holds in general to the neoplasmic nature of the process, but teaches that "if the pathological stimulus to proliferation falls first or alone upon the spleen or lymphatic glands, whose elastic capsules expand with their growth, then only pseudo-leukæmia re-

sults; if in like manner the bone marrow is affected and brought to a condition of hyperplasia, then leukæmia will exist." The few observations of lymphatic leukæmia without enlargement of the lymphatic glands or spleen, especially those recently reported by Pappenheim, lend considerable support to this conception.

Diagnosis.—In the vast majority of cases the diagnosis, not only of leukæmia, but of the exact form present, is one of the easiest problems which the practitioner encounters, if only he has acquired the simple technique needed for the examination of stained blood films. The character of the blood has already been discussed and will not be reviewed here. Upon it depends the diagnosis. Leukæmia must never be confounded with leucocytosis, in which the increase is of the polymorphonuclear leucocytes, while in leukæmia of either type the mononuclear cells are in the majority.

An acquaintance with the clinical features of the disease will lead to a suspicion of its existence in most cases. Extreme enlargement of the spleen with enlargement of the liver is so much more common in myelogenous leukæmia than in any other condition, that no other diagnosis should be considered until a blood examination has been made. The importance of routine blood examinations in all cases of doubtful nature has been well demonstrated. Were this practice always followed the diagnosis of chronic malaria would be less frequent.

In acute leukæmia the diagnosis will be, as a rule, between that disease and an acute purpuric affection, and can be definitely settled only by finding the large lymphocytes in very great excess. Where considerable enlargement of the lymph nodes, spleen, and liver exists, there is little danger of confusion.

Chronic lymphæmia presents so exactly the external features of Hodgkin's disease that only a blood examination can give the clew to the real process. In Hodgkin's disease and in sarcoma of the lymphatic glands there may be a leucocytosis affecting both polymorphonuclear cells and lymphocytes, or a lymphocytosis of slight degree, and here a careful analysis of stained specimens is necessary. A hasty examination of the fresh blood might lead to the diagnosis of leukæmia, which should not be made except on the evidence of a predominance of lymphocytes of the extreme grade described. Infants at birth have the lymphatic blood picture, without increase in the total leucocytes, and throughout childhood slight causes will produce a leucocytosis of quite marked lymphatic type. This fact should be borne in mind when cases in early life come under consideration. A lymphocytosis equalling that of lymphatic leukæmia has been very rarely observed in acute infectious diseases, especially whooping-cough, in children, but the condition has disappeared immediately with the subsidence of the sickness.

The ill-defined pseudoleukæmic anæmia of infants offers some possibilities for confusion with myelogenous leukæmia, myelocytes being found in the circulation, but it does not present the complete polymorphous blood picture which has been described.

Rare cases of metastatic malignant growths in the bone marrow and multiple myeloma also may cause the appearance of numerous myelocytes in the blood; but no cases are as yet on record in which all forms of mononuclear granulated cells were increased.

Finally, in cases of leukæmia under treatment or during an attack of intercurrent disease, the diagnosis may be difficult or perhaps impossible. Here the standard of comparison should be, not the blood in health, but the blood picture of a non-leukæmic subject suffering from the disease present.

Prognosis.—As has been said, the ultimate recovery of patients suffering from this disease is not to be expected. The most that can be hoped is that the process will remain stationary for a considerable period, or will advance but slowly. The outlook in myelogenous leukæmia is, as a rule, more favorable to a prolonged course than it is in the lymphatic variety, though in the latter treatment seems more apt to be beneficial. Acute leukæmia may be expected to kill within three months from the onset of severe symptoms.

As regards the deductions which can be drawn from the symptoms as to the probable duration and the present condition of the patient, only a few general statements are possible. The best guides are the extent of emaciation and failure of strength and the condition of the digestive and circulatory organs. The total number of leucocytes is of only slight significance, but a steady increase points to advance of the disease. The actual size of the spleen, or of the lymph glands in lymphatic leukæmia, is of equally small importance, but progressive enlargement has the same significance as a constant increase in the number of leucocytes. The converse is not necessarily true, and patients have died under treatment with far lower leucocyte counts than in an earlier stage of their sickness. Diminution in the size of the spleen, in the absence of hemorrhages, diarrhœa, and other causes for decrease in the total blood volume, is usually favorable. Rapid or progressive fall in the number of red cells is a serious sign. Cases with fever are apt to run a more rapid course than afebrile ones. Symptoms of grave import are the larger hemorrhages, dropsy, and pronounced nervous disturbances. Ulcerations which advance in spite of treatment, or the development of bronchitis, pneumonia, or severe diarrhœa in the later stages, may lead quickly to a fatal issue.

Treatment.—In the absence of any knowledge of the true cause of the disease or a thorough understanding of the processes at work, our treatment of the condition itself must be wholly empirical. The only drugs which have seemed to exert any influence in checking the progress of the malady are arsenic and quinine. Löwit, on the ground of his supposed finding of the real cause in an organism allied to the malarial organism, advocates the use of quinine. Arsenic in certain cases causes a marked fall in the number of leucocytes in the circulation, in some even below the normal, but this has never been followed by recovery, though in all probability life has been prolonged. Sooner or later there is usually a relapse with increasing leucocytosis, but patients have died without the white cells rising again above the normal number. When this drug is given it should be pushed to the extreme limit of tolerance and continued indefinitely. This of course subjects the patient to the danger of arsenical poisoning.

Removal of the spleen has been attempted as a curative measure, but with a fatal result in most cases. General opinion holds the operation unjustifiable, and when it is proposed for tumor of the spleen a blood examination should always be made.

Feeding with splenic tissue and other animal extracts has no empirical or rational basis and can be expected to produce no results except digestive disturbance. Dr. William Ewart has recently advised inhalations of carbonic acid gas and reports rapid improvement under the treatment.

Measures of real importance for the patient's comfort, and probably not without influence on the prolongation of his life, are attention to general hygiene and the treatment of symptoms as they arise.

Patients suffering from leukæmia as from other chronic diseases should so regulate their lives as to obtain the maximum of enjoyment and usefulness with the minimum of fatigue. Many of them can for a considerable time continue some occupation with advantage. Sunshine and fresh air are beneficial. The food should be the most nourishing that can be digested. Late in the disease the patients are confined to bed and the digestive disturbance makes careful regulation of the amount and character of the food necessary. Laxatives should be given with special care, for uncontrollable diarrhœa may be the result of their injudicious use, and this same caution should be exercised in the administration of any drugs of doubtful utility. Most of all should an atmosphere of hopefulness be preserved, one of the most important adjuncts to the treatment of any incurable disease.

Several symptoms require special treatment. For the anæmia, beside the usual iron preparations, bone marrow (well tolerated when frozen as a kind of ice-cream) may be administered, and oxygen inhalations are useful. Of the effect of the newly exploited cacodylic acid on the anæmia of this disease I have no knowledge. The attacks of perisplenitis call for rest in bed and are best relieved by the local application of cold, preferably the ice-water coil. Painting with iodine, mercurial inunctions, and the faradic current have also been made use of to reduce the size of the spleen.

Other disturbances should be treated as they arise, it being always borne in mind that we cannot look for a cure of the disease, and therefore that we must make the patient's comfort, for the remaining short term of his life, our first consideration. *Theodore C. Janeway.*

LEVANT FEVER. See *Malta Fever.*

LEVICO.—Two mineral springs and a village bear this name, in Tyrol, Austria, just north of the boundary line of Italy. The town has about 6,000 inhabitants and is situated at an elevation of 1,700 feet above sea-level, on a large mound of shale at the southern slope of Monte Fronte and Monte Canzana. It is surrounded by the beautiful mountain scenery of the southern Tyrolese Alps, in the picturesque valley of Valsugana, a little more than an hour's ride by rail from Trent. A short distance up the valley, at the end of a rather steep ascent, are two beautiful lakes, Caldonazzo and Levico, the source of a small rivulet, the Brenta, which flows down the valley, and, after attaining considerable size, crosses the Venetian plain, to empty into the Bay of Venice.

The mineral springs issue from two grottoes in the side of Monte Fronte at an elevation of fully 3,000 feet above the sea. They are known as the Vetriolo and the Ocra (or Ocker), and, in reference to the comparative strength of their waters, as the weaker and the stronger. The most remarkable feature of the waters is that they contain considerable quantities of iron, arsenic, and manganese, in addition to many other mineral salts. Some analyses show also free acids. One thousand parts have been found to contain:

	Vetriolo.	Ocra.
Cupric sulphate	0.0470	
Ferric sulphate	4.3210	
Ferrous sulphate	.0290	0.4008
Manganese sulphate	Trace.	
Aluminum sulphate	.8428	
Magnesium sulphate	.1504	.2630
Calcium sulphate	1.0520	.1320
Sodium sulphate	.0120	
Arsenious acid	.0008	.0099

There are also small quantities of the oxides of iron, aluminum and manganese, and some free carbonic acid gas.

The water has been found beneficial in all conditions for which iron and arsenic are indicated, hence in the different forms of anæmia, chlorosis, neuralgia, and other nervous affections, especially hysteria, neurasthenia, and chorea, in skin diseases, in uterine and ovarian affections, and in gastro-intestinal disorders.

At the springs, only the weaker water is administered internally, the stronger being used for bathing. Both are generally diluted with pure spring water in proportions prescribed by the attending physicians. Both waters are bottled, however, and are on sale in all parts of the world. The patient is directed to begin with one tablespoonful of the weaker water, well diluted, or a third as much of the stronger, morning and evening. The dose is increased every third or fourth day until three tablespoonfuls are taken after each meal.

In the bathing institutions at Levico there are, in addition to the ordinary baths, all facilities for special hydrotherapy, massage, and all forms of electrical treatment. *James M. French.*

LEVULOSE. See *Sugar.*

LEYSIN, SWITZERLAND.—This mountain village is a high-altitude resort, 4,150 feet above the sea-level, situated in Western Switzerland at the junction of the Ormont and Rhone valleys, a few miles from the eastern end of Lake Geneva. It is easily reached from Paris by rail to Lausanne and Aigle, and thence by diligence and an electric road.

Pulmonary tuberculosis is the principal disease treated at this resort, although the climate is recommended for bronchial asthma, chronic bronchitis, anæmia, convalescence from pneumonia and pleurisy, neurasthenia, tuberculous conditions in children, and obstinate dyspepsia. The climate is favorable for a continuous residence the year through. The peculiarities of a high-altitude climate, such as have been described under Davos and elsewhere in the HANDBOOK, are exhibited at Leysin: a comparatively dry, pure atmosphere, a large amount of winter sunshine, freedom from mists and high winds, and intense solar radiation, characteristic of the attenuated air of altitudes. The meteorological data are similar to those given under Davos. The average winter temperature, however, is somewhat higher than that at Davos, ranging from a minimum of 21.7° F. to a maximum of 35.6° F. at 7 A.M., and from a minimum of 25.8° F. to a maximum of 39.1° F. at 10 A.M. The lowest temperature observed was —2° F. The sun temperature in winter is between 86° F. and 122° F., while the ordinary temperature is between 32° and 50° F. The mean relative humidity for the five winter months, November to March inclusive, for the three winters 1887–90, was 61.9 per cent. There are on an average from five to five and a quarter hours of sunshine a day, though the possible daily insolation is, of course, greater. The total number of hours of sunshine for the five winter months from 1887–90, was as follows: 1887–88, 482.70 hours; 1888–89, 601.05 hours; 1889–90, 737.6 hours, or a little over four hours a day.

In the four years 1887–90 the percentage of calm days (absence of wind) was 81. Wind, therefore, is the exception. The prevailing direction of the wind is from the southwest and southeast. Fog or mist is rare.

Leysin, then, well fulfils the conditions of a high-altitude health resort, which are: (*a*) purity of the atmosphere; (*b*) dryness; (*c*) absence of wind; (*d*) intense insolation; (*e*) low temperature; (*f*) diminished barometric pressure.

Above the village of Leysin, which is itself situated on a plateau, is the plateau of Feydey, 610 feet higher, and here is situated a sanatorium with a large annex. To the north, northeast, and northwest rise chains of mountains which afford protection from the winds blowing from these directions. The sanatorium is situated on the border of great forests of fir trees which clothe the mountain sides. In front of the sanatorium is a great terrace looking toward the south, and affording a wide and extended view. This sanatorium, which with its annex, has one hundred and forty chambers, is equipped with all the appliances for modern sanatorium treatment, and is under skilful medical direction. The tuberculous who are most likely to improve in this, as in all high-altitude health resorts, are those whose general condition is good, and in whom the involvement of the lungs is not too extended or active, as indicated by continuous pyrexia. The best time of the year in which to begin a residence in Leysin is in August or September.

As has been mentioned above, the "cure" can be continued the year through, though for those who spend the winter in the south Leysin affords a favorable summer climate. There are many attractive mountain excursions about Leysin, and in the winter there are skating and tobogganing. There are Catholic and Protestant churches, shops, and attractive chalets which can be hired for the season. The postal and telegraphic facilities are good.

To one desiring to take the high-altitude cure in a well-conducted sanatorium and at the same time gain a knowledge of French and French people, Leysin can be recommended. *Edward O. Otis.*

FIG. 3193.—Sanatorium of Leysin (4,800 feet above sea-level).

LIBERTY, SULLIVAN COUNTY, NEW YORK.—Sullivan County occupies a position near the summit of the eastern water-shed of the Delaware River, south of the Catskill Mountains at a point where the boundaries of New York, New Jersey, and Pennsylvania meet. The country is beautiful, hilly, but not wild; it is devoted to dairy farms and supports a prosperous community. There are no large bodies of water near, no swamps or stagnant water-courses, and rapid drainage gives to the air a dryness not found in the lake region or at the seaboard. The soil in the lower levels is a loam with a moderate amount of clay, but on the hillsides it is more porous. The range of temperature is great; there are usually four months of sleighing, the snow which falls in November remaining dry and hard through March. The mean annual temperature is 44° F., and the mean annual rainfall about fifty inches.

The death rate for Sullivan County and for Delaware County adjoining is the lowest in the State, being about one-third that of New York City. The native population is of hardy Dutch stock with very little foreign blood.

The neighboring towns of Liberty Falls, Fallsburg, Woodburne, Youngsville, Parksville, Neversink, Monticello, and Hurleyville, although not quite so high as Liberty (elevation 1,600–2,200 feet), share in great measure its natural advantages and are attractive for summer residence.

As a winter resort Liberty is attractive. There are about one hundred hotels and private houses that afford accommodations during the summer. Access is by the New York, Ontario, and Western Railway in about four hours from New York.

Liberty was selected by the late Dr. Alfred L. Loomis as the site of the sanatorium which now bears his name. This institution was opened in 1896 and has been liberally equipped for the treatment of tuberculous patients. There are two departments: one for patients paying from fifteen to thirty dollars weekly, and a charitable annex for patients paying five dollars weekly. Special arrangements can be made for private cottages and suites. There are at present nineteen buildings with a total capacity of 125. Only those patients are desired who are in the early stages of consumption, and to whom a residence of a number of months in the sanatorium promises a complete cure or such an improved condition that they can return to their homes and be able to carry on their work. Both men and women are admitted. Patients are required to remain at least eight hours a day out of doors unless excused on account of sickness or during rainy weather. Climate is not wholly relied upon in the treatment of patients, for use is made of appropriate medical treatment as well. There is, in connection with the sanatorium, a training school for nurses which educates them in ministering to the special needs of tuberculous patients.

Liberty has acquired a wide reputation for the treatment of pulmonary tuberculosis on account of the success of this sanatorium, but during the past year local sentiment has been aroused against the consequent influx of visitors having this disease. The village authorities have passed a regulation prohibiting the maintenance of any institution or house for the reception of patients having tuberculosis within the limits of the village. The Loomis Sanitarium, at a distance of two miles from the station, does not fall under this restriction. *Guy Hinsdale.*